JYU DISSERTATIONS 394

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To all Skilled Kids – participants, families and children
Who dedicated time and effort,
Which enabled scientific knowledge to be heard.

Kaikille Taitavat tenavat osallistujille, perheille sekä lapsille,
jotka omistivat aikaa tutkimukseen osallistumiselle.
Teidän ansiostanne tutkittu tieto saa jalansijaa ja pääsee kuulluksi.

ABSTRACT

Niemistö, Donna
Skilled Kids around Finland: The Motor Competence and Perceived Motor Competence of Children in Childcare and Associated Socioecological Factors
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The main objective of this study was to examine motor competence (MC) and perceived motor competence (PMC) in Finnish children attending childcare through the following research questions: 1) What is the level of MC and PMC in children living in different regions of Finland? and 2) Which socioecological factors are associated with their MC and PMC? The sample consisted of 945 children (mean 5.42 yrs., boys n = 473, girls n = 472) and their families, recruited via cluster-randomised childcare centres (n = 37) considering the geographical locations and residential densities of the childcare centres. MC was assessed with the Test of Gross Motor Development, third version (TGMD-3; Ulrich 2019) and Körperkoordinationstest für Kinder (KTK; Kiphard & Schilling 2007). PMC was assessed with the Pictorial Scale of Perceived Movement Skill Competence (PMSC; Barnett, Ridgers, Zask, & Salmon 2015) for young children. Information on socioecological factors and the child's temperament were collected via parental questionnaires. Additionally, weight and height were directly measured, and children's body mass index standard deviation score (BMI SDS) was calculated. Appropriate statistical analyses were performed, including linear regression models. As a result, MC seemed to increase but PMC to decrease as a function of age. Gender differences were found with the TGMD-3 and PMSC but not with KTK. Based on living environment, some differences were found as children from the countryside, spending most of the time outdoors, outperformed children from other regions in the TGMD-3. Children living in the metropolitan area participated the most in organised sport. Regarding socioecological factors, MC was positively associated with age, participation in organised sport and temperament traits such as activity and attention span persistence. Regarding PMC, younger age and higher levels of BMI SDS, participation in organised sport and the TGMD-3 gross motor index were associated with higher PMSC. In conclusion, the individual-level correlates appear to be the most important for MC and PMC, including age and gender. Therefore, age-appropriate tasks should be available for children. Gender differences and other related factors seem to vary to some extent in different MC assessment tools. Thus, the choice of test battery is crucial. As participation in organised sport was associated with better scoring on MC and PMC, it seems that in early childhood, motor development benefits from sport-related hobbies. Yet, as children from the countryside had the best MC, one should not forget the importance of outdoor play, everyday life choices and a supporting environment that helps to promote more daily physical activity in early childhood.

Keywords: motor skills, TGMD-3, KTK, perception of motor competence, PMSC, preschoolers, socioecological model

TIIVISTELMÄ (ABSTRACT IN FINNISH)

Niemistö, Donna
Taitavia tenavia ympäri Suomen: Päiväkotilasten motoriset taidot ja koettu motorinen pätevyys sekä niihin yhteydessä olevia sosioekologisia tekijöitä
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Tutkimuksen tarkoituksena oli tuottaa tietoa suomalaisten päiväkotilasten motorisista taidoista sekä koetusta motorisesta pätevyydestä. Tutkimuskysymykset olivat 1) Minkälaiset ovat päiväkotilasten motoriset taidot ja koettu motorinen pätevyys eri puolella Suomea? ja 2) Mitkä sosioekologiset tekijät ovat yhteydessä motorisiin taitoihin ja koettuun motoriseen pätevyyteen? Tutkimukseen osallistui yhteensä 945 lasta (ka 5,42 vuotta, poikia 473, tyttöjä 472) perheineen. Tutkimukseen valittiin satunnaistetulla ryväsotannalla 37 päiväkotia eri puolilta Suomea. Satunnaistamisessa huomioitiin päiväkodin maantieteellinen sijainti sekä alueen asukastiheys. Motoriset taidot mitattiin Test of Gross Motor Development (TGMD-3; Ulrich 2019) ja Körperkoordinationstest für Kinder (KTK; Kiphard & Schilling 2007) mittareilla. Koettu motorinen pätevyys mitattiin the Pictorial Scale of Perceived Movement Skill Competence (PMSC; Barnett, Ridgers, Zask, & Salmon 2015) for young children –testiosiolla. Sosioekologisia tekijöitä sekä lapsen temperamenttia selvitettiin vanhemmilta kyselylomakkeiden avulla. Lapsen paino ja pituus mitattiin huomioiden ikävakioitu kehon painoindeksi. Aineiston käsittely perustui lineaariseen regressiomalliin. Tutkimuksen päätulokseksi saatiin, että lasten motoriset taidot kehittyvät iän myötä, mutta koetussa motorisessa pätevyydessä iän vaikutus oli päinvastainen eli laskeva. Motorisissa taidoissa (TGMD-3) ja koetussa motorisessa pätevyydessä (PMSC) havaittiin eroja sukupuolten välillä. Asukastiheyden perusteella maaseudun lapset olivat parempia motorisissa taidoissaan (TGMD-3) ja he viettivät eniten aikaa ulkona päiväkotipäivän jälkeen. Pääkaupunkiseudun ja Etelä-Suomen lapset osallistuivat eniten ohjattuihin liikuntaharrastuksiin. Vahvin yhteys motorisiin taitoihin oli lapsen vanhemmalla iällä ja liikuntaharrastamisella, sekä yksilöllisillä temperamentin piirteillä, kuten aktiivisella reagointitavalla ja kyvyllä ylläpitää tarkkaavaisuutta. Vahvin yhteys puolestaan koettuun motoriseen pätevyyteen oli lapsen nuoremmalla iällä, korkeammalla kehon painoindeksillä, osallistumisella liikuntaharrastuksiin sekä korkeammalla motorisen taidon tasolla. Yhteenvetona voidaan todeta, että yksilölliset tekijät, kuten esimerkiksi lapsen ikä ja sukupuoli, selittävät eniten motorisia taitoja sekä koettua motorista pätevyyttä. Lisäksi motoriikan eri mittareiden havaittiin tuottavan osittain erilaisia tuloksia, joten motoriikan mittaamisessa testimenetelmän valinta on tärkeää. Ohjattuihin liikuntaharrastuksiin osallistuminen oli yhteydessä parempiin motorisiin taitoihin. Siitä huolimatta maaseudun lapsilla oli parhaimmat motoriset taidot, joten on tärkeää huomioida myös vapaan leikin ja ulkona vietetyn ajan merkitys motoristen taitojen kehityksessä ja monipuolisessa tukemisessa.

Asiasanat: motoriset taidot, TGMD-3, KTK, koettu motorinen pätevyys, PMSC, päiväkotilapset, sosioekologinen malli

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On a sunny springlike day
Jyväskylä 12.05.2021
Donna Niemistö

LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following original publications, which will be referred to by the following Roman numbers:

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II. Niemistö, D., Finni, T., Haapala, E.A., Cantell, M., Korhonen, E., & Sääkslahti, A. 2019. Environmental correlates of motor competence in children – The Skilled Kids study. International Journal of Environmental Research and Public Health, 16 (11): 1989. doi: 10.3390/ijerph16111989

III. Niemistö, D., Barnett, L.M., Cantell, M., Finni, T., Korhonen, E., & Sääkslahti, A. 2019. Socioecological correlates of perceived motor competence in 5- to 7-year-old Finnish children. Scandinavian Journal of Medicine & Science in Sports, 29 (5): 753-765. doi: 10.1111/sms.13389

IV. Niemistö, D., Barnett, L.M., Cantell, M., Finni, T., Korhonen, E., & Sääkslahti, A. 2020. What factors relate to three profiles of perception of motor competence in young children? Submitted.

FIGURES

TABLES

ABBREVIATIONS

AM.	Ante meridiem: Before noon
AMC	Actual motor competence
APM	APM Inventory
BS	Ball skills
BMI SDS	Body mass index standard deviation scores
CCTI	Colorado childhood temperament inventory – questionnaire
CI	Confidence interval
CM	Centimetres
DCD	Developmental coordination disorder
HRF	Health-related fitness
ICC	Intraclass correlation coefficient
IPAQ	International physical activity questionnaire
KG	Kilogram
KTK	The Körperkoordinationstest für kinder
LM skills	Locomotor skills
N	Number
M-ABC	Movement assessment battery for children
MC	Motor competence
MMT	Maastrichtse motoriek test
MOT 4-6	Motoriktest für vier-bis sechsjährige kinder
MVPA	Moderate-to-vigorous physical activity
PDMS	Peabody developmental motor scales
OC skills	Object control skills
OE	Overestimation/overestimation group
p, p-value	Significance probability
PA	Physical activity
PM	Post meridiem: After noon
PMC	Perceived motor competence
PMSC	Pictorial scale of perceived movement skill competence for young children
PSPP	Physical self-perception profile
RE	Realistic/realistic estimation profile
SB	Sedentary behaviour
SDQ-1	Self-description questionnaire
SD	Standard deviation
TGMD-3	Test of gross motor development – third edition
UE	Underestimation/underestimation profile
US	United States of America, American
YRS.	Years
Q.	Question

CONTENTS

1 INTRODUCTION

The lifestyle in current societies is becoming increasingly more sedentary with less physical activity (PA). According to the conceptual model by Stodden et al. (2008), from now on called a *conceptual framework*, one reason for failing to cease this increase of physical inactivity in all age groups is that we do not understand the importance of the underlying mechanism of motor competence (MC) in PA. Therefore, according to the framework, to prevent physical inactivity, one must recognise the importance of MC in the initiation, maintenance or decline of PA behaviour and how this role may vary across the lifespan.

Especially early childhood is an important phase for motor development as children are gaining and practising the fundamental movement skills that are the foundation for all motor skills. In fact, Clark and Metcalfe (2002) stated regarding childhood, 'the overall goal of this period is to build a sufficiently diverse motor repertoire that will allow for later learning of adaptive, skilled actions that can be flexibly tailored to different and specific movement contexts' (p. 176). Consequently, if a child does not have opportunities to gain motor experiences throughout early childhood, (s)he is at risk of having delayed motor development, which most probably influences his/her PA and possibilities to join in play with other children. In fact, middle childhood – from six to nine years – is proposed to be a critical time where the positive or negative trajectories of PA, health-related fitness (HRF) and weight status, all related to MC, begin to diverge (Robinson et al. 2015; Stodden et al. 2008). Therefore, interventions in early childhood, before middle childhood, are highly warranted.

MC also has other benefits for children's health in addition to preventing a decline in PA. It predicts future PA behaviour and positive body composition effects (Jaakkola, Hillman, Kalaja, & Liukkonen 2015; Robinson et al. 2015; Slotte, Sääkslahti, Metsämuuronen, & Rintala 2015; Stodden et al. 2008) and is connected to cognitive functions, academic achievement (Haapala 2015; Jaakkola et al. 2015; Rasberry et al. 2011) and better health and weight status (Robinson et al. 2015). MC seems to be highly intertwined with a child's personality, thus, PA, supported by good MC, is often considered the best remedy for cognitive but also social and emotional wellbeing (Reunamo et al. 2014) since it permits children to join in play with other children in age-appropriate games, such as tag, ball games and hide and seek, which are essential experiences in the creation of the perception of motor competence (PMC) in early childhood.

PMC reflects a child's expectations and conviction of being competent in motor tasks (Estevan & Barnett 2018). PMC evolves over time (Harter 1999). Due to cognitive immaturity, young children tend to overestimate their mastery of motor tasks (Robinson 2011), which can lead to engagement and persistence in PA behaviour despite unsuccessful outcomes (Harter 1982). This tendency to have high hopes is important to push the developmental boundaries of children. However, Stodden et al. (2008) stated that an underlying mechanism in these frameworks, not adequately addressed, is the notion of actual MC. More specifically, if a child does not have MC, perceptions of competence will drop as the child gets older, and the cognitive maturation level allows him/her to evaluate his/her actual MC more precisely (Goodway & Rudisill 1997). Consequently, as a fuction of age, PA may also drop.

Based on this conceptual framework by Stodden et al. (2008), in this thesis, both MC and PMC are studied. However, the younger the child, the more dependent his/her (motor) development and daily activities are on his/her family environment. In this equation, to provide opportunities to enhance MC and PMC in young children's lives, there is a need to understand the factors that may enhance or decrease MC, PMC and, subsequently, PA. According to the socioecological model (Bronfenbrenner 1974, 1994), a child's behaviour stems from reciprocal interactions between micro-, meso-, exo-, macro- and crono-systems and, thus, on individual, family, environmental and community levels. According to Sallis, Prochaska and Taylor (2000), to be able to make substantial behavioural changes, interventions must target changes at each level of this model. In essence, Bronfenbrenner's (1974, 1994) model and Sallis et al.'s (2000) statement are reinforced in the Finnish recommendations for PA for young children (Varhaisvuosien fyysisen aktiivisuuden suositukset [Recommendations for physical activity in early childhood] 2016): to promote children's PA, the engagement of the whole community is required. Therefore, in this thesis, the focus is not on narrow aspects of MC and PMC but on their broader understanding in a socioecological framework.

One of the strenghts of the current thesis is that, unlike several previous sport pedagogy theses (e.g. Iivonen 2008; Laukkanen 2016; Pönkkö 1999; Soini 2015), it is not restricted into a study sample within one region only but intends to represent the entire country. During recent decades, several doctoral theses in Finland, with a close relationship with the Sport Sciences at the University of Jyväskylä, have focused on either childcare-aged children or on MC, PA and PMC and related factors. It is worth mentioning a few of these doctoral theses that are most closely related to the current thesis and/or age group addressed herein. Numminen (1991) examined the role of imagery in MC development in children aged three to seven years old. Most recently, a PhD thesis related to early childhood, MC and objectively measured PA was defended at the University of Turku by Matarma (2020). Before that, three theses at our faculty have focused on interventions of MC or PA in children under eight years old; specifically, Sääkslahti (2005) investigated the effects of PA intervention on PA and MC and the relationships between PA and coronary heart disease risk factors, Iivonen (2008) studied the associations between an Early Steps physical education curriculum and MC development, and Laukkanen (2016) examined PA and MC in a family-based cluster-randomised controlled PA trial. Two recent PhD dissertations address motor skill difficulties in primary school children (Asunta 2018) and childcare children's PA (Soini 2015). As mentioned, the themes presented in this dissertation have in one way or another already appeared in the 1990s University of Jyväskylä PhD research. In addition to the research of Numminen, three other dissertations from that era can be mentioned. Sirèn-Tiusanen (1996) investigated the stress load of children attending childcare centres and how it affected children's sleep and movement activities. Self-perceptions were studied in early adolescence by Lintunen (1995) and Sarlin (1995). Finally, the perceptions of childcare-aged children were studied at the end of the 1990s by Pönkkö (1999).

In contrast to these abovementioned dissertations, the current thesis has a larger, national study sample, which gives robustness and generasalibility to the results. However, from a global perspective, countries have widely different living environments, which is likely to cause differences in MC via diversity in sociocultural and geographical aspects (Hulteen, Morgan, Barnett, Stodden, & Lubans 2018). Consequently, in Finland, there are several unique aspects influencing PA and motor development throughout the society and the environment.

At the society level in Finland there is the national curriculum of early education (Varhaiskasvatussuunnitelman perusteet [National Core Curriculum of Early Childhood Education and Care] 2018), which covers the whole nation and supports equal educational actions and recommendations for PA (Varhaisvuosien fyysisen aktiivisuuden suositukset [Recommendations for physical activity in early childhood] 2016) for all children in early education (children less than seven years old). Moreover, the educational level attained by parents is quite high, and a certain level of socioeconomic status (SES) and health care is provided by the state for all. Consequently, SES and parental educational level may interfere less with MC and PMC in the population of Finnish children. Concerning the Finnish environment, it permits children to move around quite freely, safely and independently (Kyttä 1997) due to the right of common access ('jokamiehen oikeus'). Globally, there exists more variance in terms of possibilities to let children move freely in the environment (Burdette & Whitaker 2005; Drenowatz, Hinterkörner, & Greier 2020). Additionally, the Finnish attitude towards different weather conditions is 'säällä kuin säällä', which translates to 'no matter what the weather'. In contrast, some countries have shown that weather and climate are directly associated with PA levels (Atkin, Sharp, Harrison, Brage, & Van Sluijs 2016; Carson & Spence 2010; Fisher, Smith, van Jaarsveld, Sawyer, & Wardle 2015), and, consequently, the MC development of the children. In summary, all of these aforementioned reasons may affect the motor development and PA of Finnish children.

Globally, research on young children has increased in recent decades as the importance of the prevention of low PA and MC has been understood more widely. Several examples of global networking can be given. Recently, CIAPSE (Congrès Internationale sur l'Activité Physique et le Sport chez l'Enfant [International Congress on Children's Physical Activity and Sport]) was created to focus on research on children younger than 12 years of age. Moreover, to promote the interaction of researchers and academics with an interest in issues relating to early childhood education, children's early years, PA and health, physical education and physical development, AIESEP (Association Internationale des Écoles Supérieures d'Éducation Physique [International Association for Physical Education in Higher Education]) created a special interest group (SIG) for early childhood education. The same tendency of growing international interest can be seen in the study of MC and PMC. In 2015, the International Motor Development Research Consortium (I-MDRC) was created to facilitate international collaboration and to frame the collective research agenda within the field in the 20th century, underscoring motor development's identity as a unique discipline. PMC research plays a large role in this consortium. I personally believe that the Stodden's conceptual framework played an important role in the activation of this consortium and also in drawing attention to the prevention of low PA, MC and PMC starting in the early years.

The current thesis aims, on one hand, to consolidate the previous knowledge on MC and PMC based on a theoretical framework of a conceptual and socioecological model. On the other hand, the current thesis utilises a variety of socioecological factors in relationship to MC and PMC to bring new knowledge and a broader perspective to MC and PMC research in childcare-centre-aged children. Finally, due to the large study sample, a nationwide comparison can enhance our understanding about the environmental factors associated positively or negatively with young children's MC and PMC. The results and perspectives of the thesis are discussed in relation to the research literature conducted in the field and possibilities of implementing the research findings on a practical level.

2 LITERATURE REVIEW

During infancy, MC plays a crucial role in understanding the developmental phases of the child (Eaton, McKeen, & Campbell 2001) as new motor behaviours emerge from a mix of interacting factors (Adolph & Franchak 2017). Some of these motor behaviours are less recognised as being directly linked to motor behaviour (e.g. facial expressions and speech), while others are known to be important milestones for a child's overall development (e.g. walking) (Adolph & Franchak 2017). Indeed, these essential motor skills are also described as building blocks for future PA and movement patterns.

In the following sections, the scientific research literature relevant to the current thesis is reviewed from a developmental perspective and according to those socioecological factors that are known to be associated with MC, PA and/or PMC in early childhood. The review provides a theoretical background of this thesis, which will help in understanding why, on one hand, MC and PMC are crucial for the child and, on the other hand, why PA so closely interacts with MC and PMC. Also, by introducing the socioecological model, it will be possible to elaborate on those factors that are useful to consider while examining the MC and PMC of children.

2.1 Theoretical background

In the current chapter, two theoretical background frameworks will be introduced. An understanding of these frameworks will help in comprehending why it is useful to examine MC and PMC in early childhood via a socioecological model.

2.1.1 Developmental mechanisms influencing physical activity trajectories of children

To demonstrate the bidirectional relationship between MC and PA, the conceptual framework of Stodden et al. (2008) was utilised in this thesis. Robinson et al. (2015) reviewed the current evidence on the conceptual hypotheses in the framework by Stodden et al. (2008). The conceptual framework states that there is a bidirectional relationship between PA, MC, PMC, HRF and obesity (Figure 1), a so-called spiral of (dis)engagement in a physically active and healthy lifestyle. For example, if an individual has a good level of MC, (s)he most probably engages in a physically active lifestyle, and the PA positively affects body composition, PMC and HRF. However, if the individual has low MC, (s)he may struggle to engage in physically active games and sport. Subsequently, (s)he may be at risk of obesity, low PMC and poor body composition.

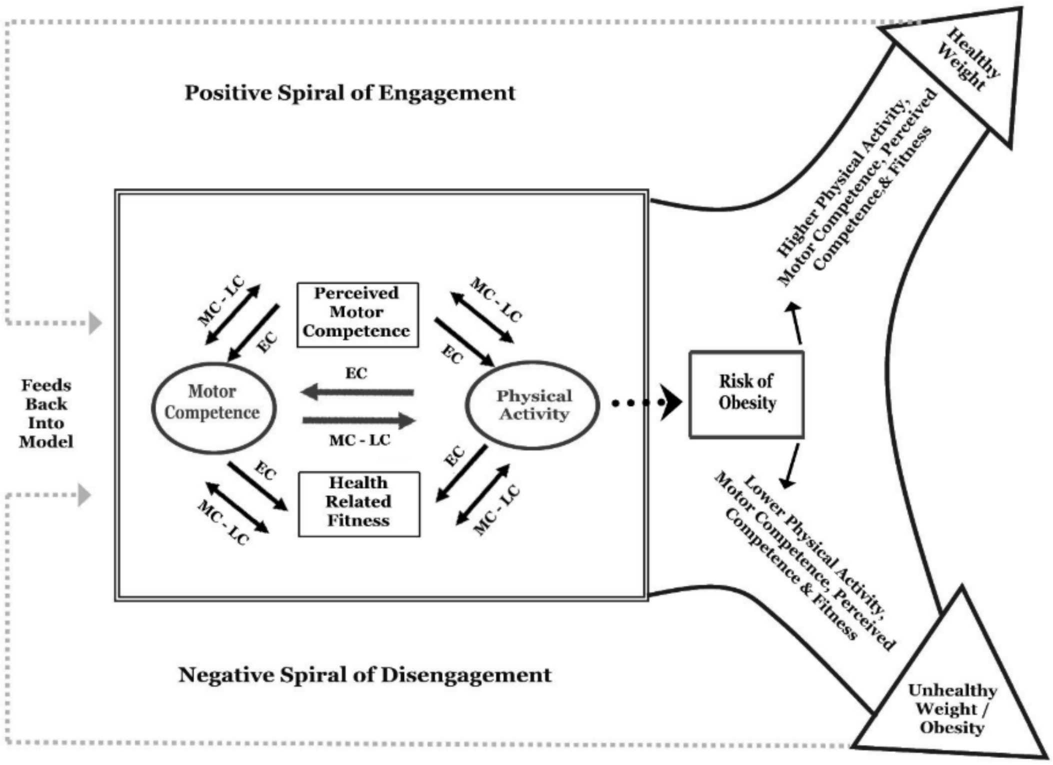


FIGURE 1 Developmental mechanisms influencing physical activity trajectories of children (Stodden et al. 2008, p. 294). EC= early childhood, MC= middle childhood, LC= late childhood. From A Developmental Perspective on the Role of Motor Skill Competence in Physical Activity: An Emergent Relationship by Stodden, D.F., Goodway, J.D., Langendorfer, S.J., Roberton, M.A., Rudisill, M.E., Garcia, C., & Garcia, L.E., Quest, copyright © 2008 National Association for Kinesiology in Higher Education (NAKHE), www.nakhe.org, reprinted by permission of Taylor & Francis Ltd, http://www.tandfonline.com on behalf of National Association for Kinesiology in Higher Education (NAKHE), www.nakhe.org., 60:2, 290-306, DOI: 10.1080/00336297.2008.10483582

More specifically, it can be suggested that there is a strong, reciprocal and developmentally dynamic relationship, yet age-related, between MC and PA. In early childhood, the development of MC is driven by opportunities to engage in PA (Bürgi et al. 2011; Robinson et al. 2015; Stodden et al. 2008). Therefore, it is important to encourage children to be physically active in various types of surroundings (Sallis et al. 2000), such as in terms of outdoor play (Kyttä 1997), independent mobility (Kyttä 1997, 2003) and the provision of multiple affordances in the environment (Kyttä 2002). Previous research has shown that children find outdoor environments stimulating and motivating (Fjørtoft & Gundersen 2007; Kyttä 2003; Ward 2018), which can enhance their willingness to engage in PA play. For example, large yards provide affordances to play and run (Fjørtoft 2001), enhancing the development of locomotor (LM) skills, such as walking, running, climbing, galloping and jumping (Donnelly, Mueller, & Gallahue 2017). Furthermore, large spaces and areas of play are also crucial to practise ball skills (BS) (Iivonen & Sääkslahti 2014). Consequently, these opportunities for PA in multiple surroundings promote neuromotor development, which enhances motor development (Stodden et al. 2008).

Later, in middle and late childhood, the relationship between PA and MC is purported to become more reciprocal. Hence, the level of MC makes it possible for the child to engage in diverse physically active games, plays and sport. That is, if a child has a good motor repertoire, (s)he can engage more in multiple physical activities. On the contrary, if a child has difficulties with these basic movement skills, (s)he will struggle more in participating in age-appropriate sport and games (Bouffard, Watkinson, Thompson, Causgrove & Romanow 1996; Cantell, Smyth, & Ahonen 1994; Clark & Metcalfe 2002; Emck, Bosscher, Beek, & Doreleijers 2009) and in fulfilling the recommendations for moderate-to-vigorous-intensity physical activity (MVPA) (De Meester et al. 2018; Williams et al. 2008) and is at risk of accumulating a higher body mass index (BMI) and body weight (Cairney et al. 2010; Cantell, Crawford, & Doyle-Baker 2008; D'Hondt et al. 2014; D'Hondt et al. 2013; Slotte et al. 2015). Additionally, Rodrigues, Stodden and Lopes (2016) underscored that not all children improve their MC and fitness as a function of age. Therefore, early childhood plays a critical role in developing a positive HRF and MC, which protects from obesity and overweight.

Several authors proclaim that basic movement patterns of MC should be mastered before the age of eight (Adolph & Franchak 2017; Donnelly et al. 2017; Gallahue, Ozmun, & Goodway 2012; Malina, Bouchard, & Bar-Or 2004). Interestingly, a recent systematic review (Lounassalo et al. 2019) found that the decline in PA starts as early as the age of seven. Therefore, it would be interesting to discover if this outcome is related to a lack of age-appropriate motor skills, which, according to Stodden et al. (2008), would reflect a decline in PA. It could also be a behavioural consequence as children are expected in most Western countries to engage in school activities at approximately this age. According to Reilly (2016), systematic reviews and longitudinal studies suggest that MVPA begins to decline, and sedentary behaviour (SB) begins to increase, starting around the age of school entry, resulting in obesity having become a growing problem globally (Ng et al. 2014). Indeed, as summarised in recent systematic reviews, the majority of cross-sectional studies have found a favourable association between PA and MC (Holfelder & Schott 2014; Lubans, Morgan, Cliff, Barnett, & Okely 2010; Xin et al. 2020), and this relationship seems to increase as a function of age (Utesch et al. 2019). Nevertheless, some longitudinal studies struggle to find these relationships between PA and MC (Poitras et al. 2016). Therefore, it remains unclear whether the decline in PA is associated with SB or lower levels of MC; however, it can be assumed that both are critical factors influencing MC and PA in children under eight years of age (Bardid, Rudd, Lenoir, Polman, & Barnett 2015; Brian et al. 2018).

PMC plays a large role in the spiral of (dis)engagement with PA. It is described as an important factor that mediates the role between actual MC and PA. Thus, there is suggested to be an indirect relationship between MC and PA through an individual's perception (Robinson et al. 2015; Stodden et al. 2008). In early childhood, children tend to have inflated perceptions of their actual MC (Harter 1999, 2012). As a result, they often confound the effort towards engaging in PA and improving motor skills with the mastery of skills. This tendency is due to a lack of cognitive capacity to make realistic evaluations of one's actual skills (Harter 1999; Harter & Pike 1984). However, this developmental phase is important for engaging children with PA as it motivates children to persist at skill development despite unsuccessful outcomes. In conclusion, during early childhood, the relationship between PMC and MC is not expected to correlate. Several studies (De Meester et al. 2018; Hall, Eyre, Oxford, & Duncan 2019; Lopes, Barnett, & Rodrigues 2016; Lopes, Saraiva, Goncalves, & Rodrigues 2018; Spessato, Gabbard, Robinson, & Valentini 2013; True, Brian, Goodway, & Stodden 2017) affirm this expectation even though opposite findings also exist. Duncan, Jones, O'Brien, Barnett and Eyre (2018) and Robinson (2011) found a positive correlation, LeGear et al. (2012) found a modest one and, finally, Pesce, Masci, Marchetti, Vannozzi and Schmidt (2018) and Toftegaard-Stoeckel, Groenfeldt and Andersen (2010) found a weak correlation between MC and PMC in children under eight years of age. Additionally, studies by Brian et al. (2018) and Crane, Foley, Naylor and Temple (2017) found a relationship only between perceptions and BS but not with LM skills. Moreover, in some studies, the correlation has varied based on the gender of the child (Crane et al. 2017; Piek, Baynam, & Barrett 2006).

In middle and late childhood, due to the development of cognitive capacity, children tend to be better at the evaluation of skills, and their perceptions more closely approximate their actual MC (Harter 1999, 2012). Therefore, children with lower MC may have lower perceptions (Piek et al. 2006), and they may perceive many tasks as more difficult and challenging. In contrast, children with higher MC may have higher perceptions and, subsequently, perceive tasks as less difficult and engage in more frequent mastery attempts. As a function of age, the relationship between MC and perceptions of MC should approximate as skills improve and inflated early childhood perceptions decrease (Robinson et al. 2015; Stodden et al. 2008). There are several studies affirming this expectation (Babic et al. 2014; Carcamo-Oyarzun, Estevan, & Herrmann 2020; True et al. 2017), at least partly (Crane et al. 2017). Contrary to these hypotheses, a recent systematic review and meta-analysis by De Meester, Barnett, Brian, Bowe, Jiménez-Díaz, Van Duyse, Irwin et al. (2020) – which included 69 papers involving children from three years old to adults up to 24 years old – found that the strength of the actual MC–PMC relationship was not moderated by a person's age.

In essence, in a conceptual framework by Stodden et al. (2008), the relationship between PA and MC is mediated by PMC. PMC's role in the spiral of engagement with PA becomes more evident as a function of age as children become more aware of their actual MC, which affects their willingness to participate in PA. By the time the conceptual framework was launched, there was a lack of evidence based on PMC in the framework. Later on, Robinson et al. (2015) found preliminary evidence for a relationship in which PMC acts as a mediator for PA and MC. Additionally, a studies by De Meester, Maes et al. (2016) and Khodaverdi, Bahram, Khalaji and Kazemnejad (2013) stated that highly positive PMC promotes PA engagement, affirming the hypothesis of the conceptual framework by Stodden et al. (2008).

Later on, differences were found in how PMC and actual MC correlate in different skill categories of MC (Pill & Harvey 2019). As an example, Barnett, Ridgers and Salmon (2015) found that actual and perceived BS were positively associated, while Liong, Ridgers and Barnett (2015) found a significant correlation between boys' perception and actual BS but not with girls. Similarly, there is also a study stating a lack of significant associations between MC and PMC in children (Liong et al. 2015). In conclusion, it is difficult to truly ascertain the strengths of the association between MC and PMC in different phases of a child's development. One main reason for this is a lack of studies using assessment tools that align measures between MC and PMC (Robinson et al. 2015). To gain more understanding about this relationship, aligned measures between MC and PMC should be used (Barnett, Ridgers, & Salmon 2015; Estevan & Barnett 2018) and more longitudinal studies should be launched.

In the past, the conceptual framework was often used in relation to cross-sectional (Barnett, Lubans, Salmon, Timperio, & Ridgers 2018; Barnett & Goodway 2018; Lopes, Barnett, & Rodrigues 2016; Spessato, Gabbard, Robinson, et al. 2013) and longitudinal studies (D'Hondt et al. 2013; Lima, Bugge, Ersboll, Stodden, & Andersen 2019; Lima et al. 2017) as well as different theoretical frameworks (Estevan & Barnett 2018; Hulteen et al. 2018), reviews (Robinson et al. 2015) or meta-analyses (Utesch et al. 2019) as a base element.

2.1.2 Socioecological model

The conceptual framework (Stodden et al. 2008) purports that young children demonstrate various levels of MC primarily because of differences in PA experiences. These differences are the result of many factors, including individual-related aspects, such as self-efficacy, family-related factors, such as parental influences and the SES of the family, and, finally, environmental-related factors, such as culture, the environment and its possibilities, climate, etc.

(Stodden et al. 2008). Moreover, other researchers have provided information on the factors influencing MC in young children (Barnett, Lai, et al. 2016; Iivonen & Sääkslahti 2014; Laukkanen et al. 2019; Lubans et al. 2010). A conceptual framework by Hulteen et al. (2018) underscored the importance of the sociocultural and geographical aspects of MC development as they may have different targets and aims for MC and PA. Additionally, some theoretical models (Gibson & Pick 2000; Newell 1986) support the relationship between MC development and environmental factors, such as home and childcare settings as well as social and cultural interaction. Therefore, in this thesis, a socioecological model is applied to provide a frame for the possible factors influencing MC in children.

According to the socioecological model (Bronfenbrenner 1974, 1994), to be able to understand the development of a child, one must consider the ecological system in which the child is growing (Figure 2). This system is composed of five socially organised subsystems, including micro-, meso-, exo-, macro- and chrono-systems. In other words, a child's behaviour stems from reciprocal interactions between the individual, family, environmental, community and historical levels. These five systems form a set of nested structures, each inside the next. The child's development is strongly and closely related to the environment in which the child is living. In essence, to understand the development of the child, we cannot look only at narrow aspects of development; rather, we need to understand the variety of systems that are interacting with each other, influencing, directly or indirectly, the development of the child (Bronfenbrenner 1974, 1994).

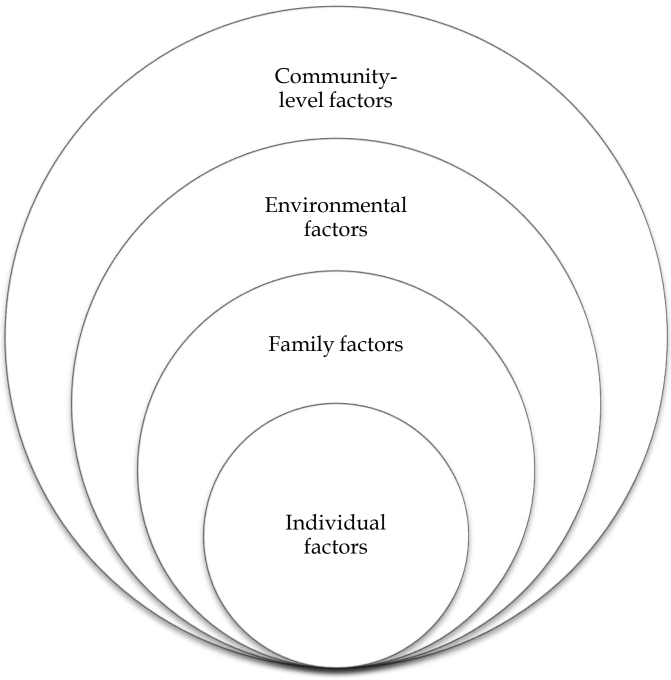


FIGURE 2 Socioecological model, modified from Bronfenbrenner (1974, 1994).

At the core of the socioecological model, there is a child with his/her biological and psychosocial characteristics (in the current thesis, so-called individual, such as biological or behavioural, factors). The innermost level includes the microsystem. At this level, child's development contains the structures, such as the immediate social environment (family-related factors) and physical environment (environmental factors), that are directly and actively in contact with the child, including parents, siblings, peers and early educators, and later on, teachers. These relationships and their influences are described as bidirectional as they go away from the child and towards the child (Bronfenbrenner 1974, 1994, p. 22).

The meso-system includes likewise the physical environment (environmental factor), but it comprises the linkages and processes taking place between two or more settings containing the developing person (e.g. the relations between the home and childcare settings), and therefore, it is not directly associated with the child but it is associated with the child via the environment.

The exo-, macro- and chrono-systems describe the influences of both local and national regulations on the child's development in historical time. These levels of systems are linked in a larger social system in which the child does not function directly but nevertheless feels either a positive or negative force stemming from interaction with his/her own system (Bronfenbrenner 1979, p. 237). These factors are not directly dealt in the current thesis; however, this level was present in the lives of participating children via an indirect link to the Finnish Guidelines of Early Education (Varhaiskasvatussuunnitelman perusteet [National Core Curriculum of Early Childhood Education and Care] 2005) and recommendations regarding PA for Finnish children (Varhaiskasvatuksen liikunnan suositukset [Recommendations for physical activity in early childhood education] 2005) attending childcare centres. These guidelines (Varhaiskasvatussuunnitelman perusteet [National Core Curriculum of Early Childhood Education and Care] 2018) and recommendations (Varhaisvuosien fyysisen aktiivisuuden suositukset [Recommendations for physical activity in early childhood] 2016) had been previously updated. Additionally, during the data collection period, most of the Finnish children attended the childcare centres five days per week as it was normal that both parents of the child worked. Normally, the children attended early education approximately from eight to nine hours daily (from 7.30AM until 4PM). During the data collection period, most of the people in Finland lived in the southern part of the country (21.1%) and cities (70.5%) (Tilastokeskus [Statististics Finland] 2017).

The socioecological model has been used and applied in relation to MC (Barnett, Hinkley, Okely, & Salmon 2013; Robinson et al. 2015; Zeng, Johnson, Boles, & Bellows 2019), PA (Bellows et al. 2013; Soini 2015), PA interventions (Mehtälä, Sääkslahti, Inkinen, & Poskiparta 2014) and SB (Määttä et al. 2016; Määttä et al. 2020) as well as participation in or dropping out of participation in sport (Vella, Cliff, & Okely 2014) in children. PMC and socioecological factors have been less studied to authors' knowledge.

According to Barnett et al. (2013), those correlates that are directly associated with the individual level seem to be the most important ones for MC. However, other factors related to a child's life and surroundings may also enhance or limit the possibilities for PA and MC practice (Gallahue & Donnelly 2003; Malina et al. 2004; Sallis et al. 2000). Therefore, the factors associated with the family level (Cools, De Martelaer, Samaey, & Andries 2011; Laukkanen et al. 2018; Laukkanen, Sääkslahti, & Aunola 2020) as well as the environmental level (Bardid et al. 2015; Brian et al. 2018; Laukkanen et al. 2019) should be recognised as important factors associated with MC (Fjørtoft & Sageie 2000; Hulteen et al. 2018) at least in regard to PA possibilities (Gray et al. 2015; Gubbels, Van Kann, & Jansen 2012; Krahnstoever Davison & Lawson 2006; Kyttä 2002). These factors and their associations with MC are described in more detail in section 2.4.

2.2 Motor competence

In recent decades, several different definitions (Logan, Ross, Chee, Stodden, & Robinson 2018) and measures (Cools, De Martelaer, Samaey, & Andries 2009; Pill & Harvey 2019) have been utilised in assessing MC in early childhood. In this section, first, a short presentation of the definitions of MC will be provided; then, the development of a child's MC is described; and finally, an overview of MC assessment tools follows.

2.2.1 Definitions and terminology

In this thesis, MC was initially defined as gross motor skill competency, encompassing fundamental movement skills and motor coordination but excluding motor fitness. MC can be also conceptualised as a person's ability to execute different motor acts, including coordination of both fine (e.g. manual dexterity) and gross (e.g. static and dynamic balance) motor skills (Henderson, Sugden, & Barnett 2007); nevertheless, as in the current thesis no fine motor skills were evaluated, this description was not appropriate.

MC has been described as being 'essential', 'fundamental', 'foundational' or 'specialised' skills that are based on 'movement' or 'motor' actions with an outcome of 'skill', 'proficiency', 'ability', 'pattern' or 'competence'. According to a systematic review of terminology (Logan et al. 2018), 70% of the studies utilised the 'movement' rather than 'motor' skill terminology in their research. In a systematic review by Scheuer, Herrmann and Bund (2019), 'motor abilities' was used in 35%, 'motor skills' in 20% and 'motor competence' in 25% of the studies. There was also a fourth category for studies using both 'motor abilities' and 'motor skills' (20%). In the current thesis, the selection of terminology is based on the content of the assessment tools used in this research to describe as clearly as possible the content of the findings. Therefore, MC is categorised as LM skills, BS as well as body coordination and balance skills.

The movements can be viewed from a variety of perspectives. First, movement can be described in the context of 'patterns' and 'skills', which is important when discussing motor development (see also section 2.2.2). Patterns refers to the basic movement(s) of the performance of a particular task, emphasising the movement that forms the pattern. Thus, many children can perform the basic movement patterns of jumping even though their levels of proficiency may vary greatly. In contrast to movement patterns, skill emphasises the accuracy, precision and economy of the performance of the child (Malina et al. 2004, p. 196).

Motor activities (or manipulative movement skills) are frequently categorised as fine and gross (Donnelly et al. 2017; Gabbard 2016; Gallahue & Donnelly 2003; Malina et al. 2004). Fine motor activities (or fine motor manipulation) refers to precision, accuracy and dexterity in manipulative tasks, such as tying one's shoelaces, colouring or cutting with scissors, which all require motor control. Gross motor activities refers to movements of the entire body or major segments of the body, such as LM skills (Malina et al. 2004). Gross manipulative skills encompass movements that involve giving force to objects or receiving force from objects, such as throwing, catching and kicking (Gallahue & Donnelly 2003).

The basic patterns of MC (or the fundamental motor/movement skills) are elementary forms of movement which are often described as basic motor skills (Malina et al. 2004) or the 'building blocks' of movement. Basic motor skills are often divided into the following three divergent subscales: LM (or LM movement) skills, referred to here as LM skills; non-locomotor (or stability movement) skills, referred to here as body coordination and balance skills; and manipulative (manipulative movement) skills (Gallahue & Donnelly 2003; Gallahue et al. 2012; Malina et al. 2004), referred to here as BS. In the current thesis, BS is used as it refers to the assessment tool used (TGMD-3) (Ulrich 2019). The aim is to be precise in reporting what is measured.

LM skills are those skills that permit the body to be moved through space in a horizontal or vertical direction from one point to another (e.g. walking, running, jumping, galloping, hopping, sliding, leaping, climbing and skipping) (Gallahue & Donnelly 2003; Gallahue et al. 2012; Malina et al. 2004). LM skills are important for enabling a child's (independent) movement, leading to increased opportunities to engage in social and cognitive interactions (Campos et al. 2000) in the environment (Adolph & Franchak 2017). Body and coordination and balance skills (or stability movement/non-locomotor skills) permit specific parts of the body to be moved while maintaining the balance of the body (dynamic balance), or the body remains in place but moves around its horizontal or vertical axis (static balance) (e.g. stretching, turning, swinging, inverted supports, body rolling, landings/stopping, dodging, balancing, bending and twisting) (Gallahue & Donnelly 2003; Gallahue et al. 2012; Malina et al. 2004). Body coordination and balance skills form the basis of LM skills and BS, and they help the child to maintain balance on variable and unsteady surfaces. Finally, BS (or manipulative [movement] skills) refers to actions where objects are moved by giving force to or receiving force from the objects (e.g. throwing, catching, trapping, striking, kicking, volleying, bouncing, ball rolling and punting) (Gallahue & Donnelly

2003, p. 57). BS are crucial, for example, for hand–foot coordination (Adolph & Franchak 2017) and its development.

After the basic motor skills (or patterns), so-called fundamental movement skills are developed, achieved and refined, there will be a development of more specialised and more complex skills that unify, for example, all of these three basic motor movement skill categories. These specialised skills could be employed in, for example, playing basketball, where one must run and walk (LM skills), throw the ball (BS) and maintain balance in movement (dynamic balance) or remain in place while throwing (static balance) (Malina et al. 2004).

2.2.2 Motor development

Motor development can be defined as 'the process through which a child acquires movement patterns and skills' (Malina et al. 2004, p. 196). There are several different factors influencing motor development (Gabbard 2009), such as neuromuscular maturation with its genetic component (in this thesis, e.g. temperament); the growth of the child (biological factors, e.g. weight, height and BMI SDS in this thesis); the tempo of growth and maturation; the residual effects of prior motor experiences, including prenatal experiences; and the quantity and quality of (new) motor experiences (family and environmental factors) of early childhood. All of these intervening factors related to MC development are strongly influenced by the physical and social aspects, including family and the environment of the child (Gabbard 2009; Malina et al. 2004). Thus, motor development includes the biological maturation of the child's body and musculoskeletal system (Barnett, Lai, et al. 2016; Freitas et al. 2015; Gallahue & Donnelly 2003); however, it also includes the acquisition of motor skills that require PA and repetition of motor tasks to gain proficiency in MC (Gallahue & Donnelly 2003; Malina et al. 2004; Robinson et al. 2015; Stodden et al. 2008).

There are different phases in the motor development of the child which can be categorised as reflexive, rudimentary, fundamental and specialised movement phases (Gallahue & Donnelly 2003). During the first years of a child's life (at the end of two years), there are developmental phases of reflexive and rudimentary phases. Reflexive phase is a continuum of an infant's prenatal life. Moreover, the rudimentary phase is situated in infancy, and these two phases are critical for gaining motor experiences and forming 'building blocks' towards the phase of fundamental movement skills.

The age between the years of two to seven is considered the fundamental movement phase, which is in focus in this thesis. Typically, a child conquers fundamental movement skills within three stages of development before going to school – the initial, elementary and mature stage of the skill (Figure 3). However, these stages are not only associated with age or biological maturation of the child, as there is a need for repetition of the skill and PA to gain a certain level of movement skills.

At the age of two to three years, a child is typically in the initial stage of skill development. During this stage, the child makes purposeful attempts to master motor tasks; nevertheless, the attempts are either grossly exaggerated or inhibited. The pattern of the movement is relatively crude, uncoordinated and rhythmically unbalanced; thus, the skill is not precisely mastered nor yet automatically executed (Gabbard 2016; Gallahue et al. 2012). Additionally, the level of execution may vary greatly between each attempt. The child needs lots of energy and focus to execute the task at this stage. For example, in the initial stage of catching, there is often an avoidance reaction, where the child turns his/her face or hands away from the ball which is coming towards him/her. Instead of the arms moving towards the ball, typically the arms are going away from the oncoming ball. During this initial stage, equipment that facilitates motor task learning is highly recommended. For example, in the case of catching a ball, it is suggested to have large and soft ball, which makes it easier to catch (Gabbard 2016; Gallahue & Donnelly 2003; Gallahue et al. 2012; Malina et al. 2004).

At the age of three to five years, child is typically in the elementary stage of the skill development, which is highly influenced by the maturation of the child. At this stage, the movement patterns are improving, and the child gains more control over his/her movement patterns. Nevertheless, there is still variety between the movement patterns, and the skill is not yet automatic and is lacking the fluidity of the skill. Interestingly, according to Gallahue and Donnelly (2003), many adults are at this stage of motor development as they have mastered the elementary stage due to biological maturation; however, due to a lack of practise, encouragement and instructions, they have failed to achieve the final, mature stage of the development (Gabbard 2016; Gallahue & Donnelly 2003; Gallahue et al. 2012; Malina et al. 2004).

At the age of six to seven years, the child is typically achieving the mature stages of motor development. Finally, the movement pattern is correctly executed, and it becomes a skill as the execution of the task is fluid, well-coordinated and mechanically correct. As the child has achieved mastery of the skill, (s)he can focus on doing the motor task better, throwing further, running faster and jumping higher. Additionally, if a child catches a ball three times, (s)he not only succeeds three times but the performances are similar to each other as the skill has become automatic and requires less focus and energy from the child (Gabbard 2016; Gallahue & Donnelly 2003; Gallahue et al. 2012; Malina et al. 2004).

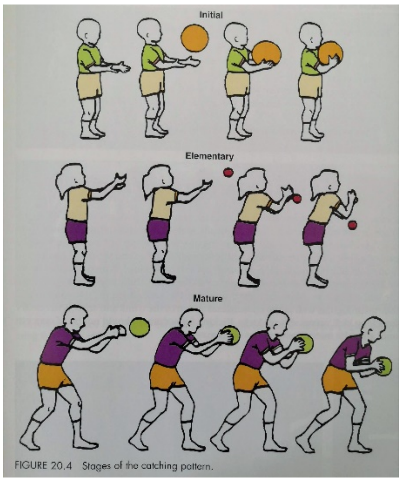


FIGURE 3 Initial, elementary and mature stages of the motor development of the child. ‘Stages of the catching pattern’ (Gallahue & Donnelly 2003, p. 513). © Human Kinetics. Reprinted with permission from D.L. Gallahue and F.C. Donnelly, of Developmental Physical Education for All Children, 4th ed. (Champaign, IL: Human Kinetics, 2003), 513.

It is assumed that children master the fundamental movement skills (walking, running, jumping, throwing etc.) by the time they enter primary school. At this age, many children also start or continue a sport-related hobby. After maturity, they experience a specialised movement phase, which includes the stages of transition, application and lifelong utilisation (Gallahue & Donnelly 2003). During this phase, children are eager to learn and execute motor tasks, and they can also apply previously developed fundamental movement skills in more specialised, sport-related skills. Thus, the acquisition of fundamental movement skills is important from a physical and social perspective. Physically, the acquisition of fundamental movement skills permits children to be physically active throughout their lives, creating good ‘building blocks’ for physically active lifestyles. Socially, the acquisition of fundamental movement skills allows children to engage in age-appropriate games with their peers. However, these stages are not only associated with age or biological maturation since they can also occur in adolescence or adulthood if they are not completed during childhood. Indeed, though biological maturation enables skill acquisition, it is insufficient if an individual lacks practice or the repetition of a skill.

2.2.3 Measures

Assessment tools have a critical role in identifying typical motor development as well as diagnosing and evaluating motor difficulties in childhood (Cools et al. 2009; Griffiths, Toovey, Morgan, & Spittle 2018) due to measuring different aspects of MC (Cools et al. 2009; Khodaverdi et al. 2020; Logan et al. 2018; Lopes, Santos, Coelho-e-Silva, Draper, Mota, Jidovtseff, Clark, et al. 2021; Xin et al. 2020). Even the correlates related to MC may differ according to the assessment tool used (Barnett, Lai, et al. 2016). For this reason, the aim of the research is important to bear in mind when choosing the appropriate MC assessment tool (Cools et al.

2009; Scheuer et al. 2019). In the following section, there will be a short description of the MC assessment tools that are most used in the field of MC research with young children. Nevertheless, there are more assessment tools currently used in the field (e.g. Basic Motor Competencies [MOBAK]; Motor Skills Development as Basis for Learning [MUGI]; Scheuer et al. 2019). Despite this, as the results of the current literature review assessment tools tend to be 'the same old', therefore, to better understand MC and its correlates, new assessment tools are warranted in the future (Pill & Harvey 2019; Lopes et al. 2021).

MC assessment tools can be subdivided into two subscales of product- and process-oriented measures (Logan et al. 2018; Malina et al. 2004; True et al. 2017). Product-oriented measures assess the outcome of the movement (e.g. duration, number of items, length and time), while process-oriented assessments examine the qualitative aspects (e.g. movement patterns) of movement. In addition, a subdivision for norm-referenced and criterion-referenced measures is commonly used (Cools et al. 2009). The norm-referenced measures compare the child's performance to a normative group and quantifies the child's movement skill competence based on that normative group. In the criterion-referenced measures, the child's performance is compared to predetermined criteria taking into account the qualitative aspects of the child's movements which are required to successfully perform the movement skill item (Cools et al. 2009). In the current thesis, the subdivision for product- and process-oriented measures is used.

In a systematic review and meta-analysis by Barnett, Lai, et al. (2016), more than half of the studies used product-oriented assessment tools for MC measures. In this thesis, Körperkoordinationtest für Kinder (KTK) (Kiphard & Schilling 2007) is an example of a product-oriented assessment tool measuring the outcome of the child's performance in the given body coordination and balance skills. Others mostly used product-oriented assessment tools are for example the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP), which also has an updated version (version 2) (Bruininks 1978; Bruininks & Bruininks 2005) measuring fine and gross movement skill development; the Movement Assessment Battery for Children (M-ABC) (Henderson & Sugden 1992; Henderson et al. 2007) assessing the manual dexterity skills as well as ball and balance skills; and the Peabody Developmental Motor Scales 2 (PDMS-2) (Folio & Fewell 1983, 2000) measuring fine and gross movement skills. In the Finnish context, the APM Inventory (Numminen 1995) is also used in which the test items are classified into the domains of balance, LM and BS. All these MC assessment tools are suitable for children in childcare. M-ABC-2 is often considered the 'golden standard' assessment tool for MC in children; nevertheless, it lacked factorial validity (Scheuer et al. 2019) at the time the data collection of the current thesis was executed, and, therefore, other assessment tools were selected. The lack of factorial validity bases solely on the theoretical framework lacking empirical evidence (Scheuer et al. 2019).

In more recent systematic reviews by Logan et al. (2018) and Xin et al. (2020), there were fewer studies using product- rather than process-oriented assessment tools due to the large number of studies mainly using the Test of Gross Motor

Development (TGMD) (Ulrich 1985) assessment tool's second version (Ulrich 2000). The TGMD is considered a process-oriented measure that examines the qualitative aspects of the child's LM skills and BS, and it is included in this thesis as process-oriented measure of MC. The most recent (third) version of the test battery (Ulrich 2019) is used in the current thesis. Other commonly used product-oriented assessment tools in relation to MC are Get Skilled Get Active (NSW Department of Education and Training 2000), including LM skills, BS and balance skills, and Motoriktest für vier- bis sechsjährige Kinder (MOT 4-6), (Zimmer & Volkamer 1987) measuring LM skills, BS and the stability and fine motor skills of children aged four to six years old.

Only a minority of the studies mix both product- and process-oriented approaches in their assessment tools. An example is the Maastrichtse Motoriek Test (MMT) (Vles, Kroes, & Feron 2004), which objectively assesses qualitative aspects of movement skill patterns in addition to quantitative movement skill performance. The MMT measures the fine as well as gross movement skills of children aged five to six years. In the past, with children under eight years of age, only a few studies used both process- and product-oriented measures in their research (Duncan et al. 2018; Kemp & Pienaar 2013; Khodaverdi et al. 2020; True et al. 2017). Nevertheless, the use of two complementary assessment tools for measuring MC is highly recommended (Bardid, Huyben et al. 2016; Ré et al. 2018) as in every assessment tool there are pros and cons to take into consideration when interpreting the results (Cools et al. 2009).

In the current thesis, MC assessment tools for both process- (TGMD-3) and product-oriented measures (KTK) are utilised. The selection of the assessment tools was based on the feasibility of the assessments as well as wide use nationally (Laukkanen, Pesola, Heikkinen, Sääkslahti, & Finni 2015; Rintala, Sääkslahti, & Iivonen 2017; Slotte et al. 2015) and internationally (Bardid et al. 2015; Brian et al. 2018; Laukkanen et al. 2019), which enables comparison between data samples. Most importantly, these two measures were considered complementary as the TGMD-3 is a quality-based measure including LM skills and BS, and KTK is result-based and includes the body coordination and balance skills of the child (Cools et al. 2009).

2.3 Perceived motor competence

In recent decades, several definitions and measures have been utilised when assessing PMC among children in childcare (Estevan & Barnett 2018). In this section, there will first be a short overview of the definitions and terminology of PMC, followed by a description of the development of a child's PMC and, finally, an overview of PMC assessment tools.

2.3.1 Definitions, terminology and construction of PMC

In this thesis, PMC is defined as a child's reflection of expectations and convictions of being competent in motor tasks (Estevan & Barnett 2018). PMC has been conceptualised by Stodden et al. (2008) and Hulteen et al. (2018) in their conceptual frameworks as a mediator for MC and PMC in relation to PA (Estevan & Barnett 2018). There are also studies referring to the concepts of perceived physical competence (or ability), physical self-perception and perceived athletic or sport competence. The use of terminology varies across studies because there are several measures identifying divergent aspects of global self-concept, specifically in relation to physical self-perception. Therefore, the hierarchical model of a multidimensional structure of self-perception is important to understand (Figure 4).

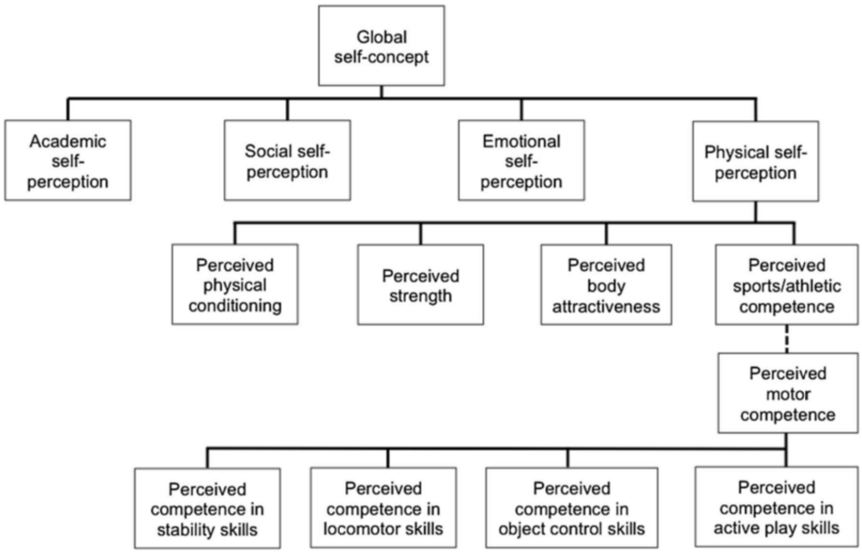


FIGURE 4 Hierarchical model of the multidimensional structure of self-perception with PMC as the correspondent domain of perceived sport competence in children (Estevan & Barnett 2018, p. 2690). Reprinted by permission from Springer Nature: Springer, Sports Medicine, Considerations related to the definition, measurement and analysis of perceived motor competence, Estevan & Barnett, 2018.

The construct of global self-perception includes various competence areas, such as academic, social, emotional and physical self-perception. Even though children may evaluate their competence in a number of areas, perceptions of academic, social and physical competence are particularly important for children and adolescents (Harter 1999). The importance of domain-specific self-perceptions is highlighted as these are significant determinants of competence-related behaviours, thoughts and affective responses (Harter 1999) and are highly related to motivation towards the given tasks (Weiss & Amorose 2005). That is, if a child has a high self-perception in physical competence, more specifically, for example, in PMC, the child is more willing to engage in motor tasks and have positive, engaging and inspiring thoughts towards motor tasks as well as a sense of capacity for achieving the goals of the given tasks. Finally, a child has positive affective responses when engaging in motor tasks in relation to encouraging words from his/her parents and/or social interaction with peers.

Physical self-concept usually includes items related to competences, such as strength, conditioning, body attractiveness or sport/athletics (Babic et al. 2014; Harter 1982). PMC, in turn, is related to perceptions of stability skills, LM skills, BS and active play skills. In the current thesis, the terminology used is based on the conceptual framework by Stodden et al. (2008) and the use of a measure which assesses perceptions in regard to LM skills and BS. PMC was examined in close relationship with actual MC measured with the TGMD-3.

Related to PMC terminology, on one hand, the terms 'level' and 'accuracy' are often highlighted. PMC can be examined via the level or accuracy of the perception of the actual MC. The level of PMC is usually assessed by how high or low the child rates their actual MC (Weiss & Amorose 2005). Accuracy, in contrast to level, of PMC refers to the discrepancy between perceived and actual MC (Weiss & Amorose 2005). Both the level and accuracy of PMC are important for understanding achievement behaviours, cognitions and affect (Weiss & Amorose 2005) and are also closely related to the development of the child's PMC. On the other hand, when children evaluate their PMC, they use internal or external sources of feedback based on which they form their PMC. According to Harter's competence motivation theory (1978), internal sources are, for example, effort exerted or performance improvement, while external sources can be for example, parental feedback or peer comparison, which both help the child to form PMC.

2.3.2 Role in growth and development

PMC evolves over time and is closely related to the cognitive maturation process which enables older children to make more accurate evaluations about their MC (Harter 1999). In the development of PMC, the level and accuracy of PMC plays an important role (Harter 1999; Harter & Pike 1984; Robinson et al. 2015; Stodden et al. 2008; Weiss & Amorose 2005) as does the age and experiences of the child. Interestingly, the relationship between age and PMC is negative, while in MC the effect of age related to MC is the opposite. Age differences in the level and accuracy of PMC have been explained by the sources of information children use to judge their competence (Weiss & Amorose 2005) as well as changes in the cognitive capacity of the child (Harter 1999).

During early childhood, at the age of three to six years old, the child tends to have a high level of PMC (Brian et al. 2018; LeGear et al. 2012; Lopes et al. 2018; Pönkkö 1999), lacking accuracy in regard to the actual MC level (De Meester et al. 2018; Hall et al. 2019; Lopes, Barnett, & Rodrigues 2016; Lopes et al. 2018; Pönkkö 1999; Spessato, Gabbard, Robinson, et al. 2013; True et al. 2017) even though some studies have demonstrated the opposite (Duncan et al. 2018; LeGear et al. 2012; Robinson 2011). These high levels of PMC are due to young children's cognitive incapacity to make realistic evaluations about their actual skills. During this phase, it is best to ask the child about concrete and narrow aspects of PMC as (s)he has not yet mastered the abstract concepts of 'global self-esteem' and has difficulty answering broad, general questions such as 'how good are you at exercising?' This phase with high levels of PMC is important for the child's development as children with inflated PMC may select challenging tasks, enjoy the learning process, exhibit higher self-esteem, exert greater effort to master skills and persist in the face of difficulty (Harter 1999). Additionally, this inflated PMC can lead to increased levels of engagement (De Meester, Stodden et al. 2016; Khodaverdi et al. 2013) and persistence in PA behaviour despite unsuccessful outcomes (Harter 1982). In contrast, if a child has low PMC, (s)he may act in the opposite way, losing interest in and persistence towards difficult motor tasks (Harter & Pike 1984; Harter 1999; Stodden et al. 2008). During this phase of PMC development, the child heavily engages the sources of task mastery, effort and parental feedback to evaluate their level of PMC (Weiss & Amorose 2005).

After seven years of age, the level of children's PMC decreases and approximates more closely the actual MC level of the child (Harter 1999; Sarlin 1995; Stodden et al. 2008; Weiss & Amorose 2005). There are several studies affirming this expectation (Babic et al. 2014; Kokko & Mehtälä 2016; Tietjens et al. 2020; True et al. 2017) at least partly (Crane et al. 2017). Therefore, even though there is a decline in the level, the accuracy of the PMC increases. Nevertheless, there are also research results that are in contrast to this, stating that children's PMC stabilises rather than declines over a one year period of time around the age of eight to eleven years (Van Veen et al. 2020). However, this finding may be because the children have already gained some level of cognition to support more realistic PMC. At this age, due to cognitive maturation, more abstract concepts, comparisons and evaluations are possible for the child. Also, there is a change in the sources the children prefer to use in their evaluation of their competence in a given task; they start to value peer evaluation and comparison more ('Am I better/worse than him/her?'). This increased accuracy of the PMC protects children from expectations that are too high and risks of failure (Harter 1982).

In later adolescence, more abstract concepts can be grasped. This capacity influences the evaluations of the youngster. The sources of information are still peer comparison and social evaluation; nevertheless, the youngster is also able to emphasise the self-comparison processes, such as skill improvement and the achievement of self-set goals, as well as internal criteria, such as attraction to the activity, exerted effort and personal expectations (Weiss & Amorose 2005). The self-perception seems to be more stable (Lintunen 1995). In summary, the development of PMC is closely related to the cognitive capacity, age and sources of information the child uses while evaluating the actual MC level. Within this development, the level of PMC accuracy increases while the PMC level decreases.

2.3.3 Measures

This section presents a short description of the PMC assessment tools that are most used in the field of PMC research. As PMC is a rather novel and emerging research area, it is common for the assessments used to identify children's PMC to be originally developed for aims other than to assess PMC (Estevan & Barnett 2018).

Due to children's high level of PMC in the early years and their tendency to confuse the desired competency with the actual MC, many researchers suggest that measures of PMC should be used only for children over five years of age (Barnett, Ridgers, Zask, & Salmon 2015; Harter & Pike 1984). The measures are suggested to be age-appropriate with pictorial elements, have the ability to provide an appropriate number of choices per item (e.g. two choices instead of four), reduce the tendency for children to give socially desirable responses and include scales adapted to the specific age range (Harter 1982, 1999).

The most commonly used measure for PMC is the Pictorial Movement Skill Competence (PMSC) test for young children developed by Barnett, Ridgers, Zask, et al. (2015). Since it was launched, it has been utilised in many countries, such as Australia (Barnett, Ridgers, & Salmon 2015; Barnett, Robinson, Webster, & Ridgers 2015; Barnett, Vazou, et al. 2016), Portugal (Lopes, Barnett, & Saraiva et al. 2016), Spain (Estevan, Molina-Garcìa, Abbott et al. 2018), Greece (Venetsanou, Kossyva, Valentini, Afthentopoulou, & Barnett 2018), England (Duncan et al. 2018), the US (Brian et al. 2018), Brazil (Valentini et al. 2018), and China (Diao et al. 2018). The measure has demonstrated good reliability and validity for assessing young children's PMC (Barnett, Ridgers, Zask, et al. 2015; Diao et al. 2018; Estevan et al. 2017; Venetsanou et al. 2018). In the current thesis, the measure in question has been utilised as it is precise in the motor skills that it assesses and is aligned with the TGMD-2 and TGMD-3 actual MC assessment tools measuring the perception of LM skills and BS.

There are also other measures for assessing young children's perceptions. One of the most often used is the Pictorial Scale of Perceived Competence and Social Acceptance (Physical Competence Subscale) by Harter and Pike (1984), which has been used in several studies (Pönkkö 1999; Spessato, Gabbard, Robinson, et al. 2013; True et al. 2017). This six-item subscale assesses children's self-perceptions in relation to the psychomotor domains of the ability to run, hop, swing, climb, tie shoelaces and skip. Another is the physical ability subscale of the Physical Self-Description Questionnaire (SDQ-1) developed by Marsh (1996), which has been utilised in studies by Khodaverdi et al. (2013, 2016). The SDQ-1 includes eight items using a five-point response scale about different sport abilities. There is also the Physical Self-Perception Profile (PSPP)–assessment tool by Fox and Corbin (1989), which has been utilised in several Finnish studies (Jaakkola, Yli-Piipari, Watt, & Liukkonen 2016; Kokko & Mehtälä 2016). Later on, the PSPP was modified by Whitehead (1995) as the 'Children's Physical Self-Perception Profile', which was utilised in a study by De Meester, Maes et al. (2016). Finally, the athletic competence subscale of the Self-Perception Profile for Children or Adolescents originally developed by Harter (1982) has been utilised, for example, in study by Bardid, De Meester et al. (2016).

2.4 Socioecological factors associated with motor competence and perceived motor competence

Using a socioecological model, the following discussion briefly considers the commonly studied factors that may affect MC and PMC during early childhood. Moving from the innermost level to the outside, these structures are described below.

Introducing MC and PMC and the factors associated with these dependent variables will enable the identification of those factors that are potentially modifiable correlates of MC and PMC in young people. This will make the findings important and relevant to interventionists seeking to find ways of improving the MC and PMC of children, as has been suggested previously (Gabbard 2009).

However, it is crucial to underscore that as MC and PA are closely related (Robinson et al. 2015; Stodden et al. 2008), and as the socioecological model is based on the interaction between different levels (Bronfenbrenner 1994), making certain distinctions may be difficult. An example in which a child is more active outdoors rather than indoors, and his/her physically active parents encourage the child to spend time outdoors and furthermore provide equipment and safe surroundings for time spent outdoors, illustrates the factors influencing every level of the socioecological model adapted in this thesis. Specifically, the child spending more time outdoors is an individual factor (child's behaviour), the parents being physically active and encouraging the child to be active is a family factor and there being space and equipment in the environment presents an environmental factor. In this case, it is almost impossible to clearly distinguish these layers of the socioecological model and behaviours affecting MC, PA and PMC. Therefore, in this section, the strong interaction between these underlying mechanisms is crucial to bear in mind.

2.4.1 Individual factors

In MC and PMC, recent studies have found positive or negative associations with several divergent individual correlates according to a socioecological model (Bronfenbrenner 1994). One systematic review (Barnett, Lai, et al. 2016) stated that the evidence for some correlates differs according to how MC is operationalised. Moreover, a study by Barnett et al. (2013) concluded that the most important correlates of MC seem to exist at the individual level of the socioecological model. In PMC, the most-studied correlates seem to be biological factors such as age (Crane et al. 2017; Jozsa, Wang, Barrett, & Morgan 2014; Lopes et al. 2018; Tietjens et al. 2020; True et al. 2017), gender (Afthentopoulou, Venetsanou, Zounhia, & Petrogiannis 2018; Estevan, Molina-Garcìa, Abbott et al. 2018; LeGear et al. 2012; Lopes et al. 2018; Pesce et al. 2018; Slykerman, Ridgers, Stevenson, & Barnett 2016), body weight or BMI (Jones, Okely, Caputi, & Cliff 2010; Spessato, Gabbard, Robinson, et al. 2013; Toftegaard-Stoeckel et al. 2010) or behavioural factors such as participation (Pesce et al. 2018) or motivation towards organised sport (Bardid, De Meester, et al. 2016). Moreover, correlations between PMC and MC (Barnett, Morgan, van Beurden, & Beard 2008; Farmer, Belton, & O'Brien 2017; Liong et al. 2015; Lopes, Barnett, & Rodrigues 2016; Lopes et al. 2018) as well as PA (Lopes, Barnett, & Rodrigues 2016) are often reported, all of which are categorised as individual factors.

This section presents the most commonly found correlations between MC and PMC with biological factors, such as a child's age, gender, weight or BMI status and temperament, and secondly the behavioural factors affecting MC and PMC, such as time spent outdoors, participation in organised sport, PA and SB.

2.4.1.1 Biological factors

The most reported biological factors seem to be a child's age and gender. Previous studies have provided information that both age and gender play an important role in the development of MC and PMC. However, the associations between MC and PMC seem to be slightly different, at least in relation to age.

Age plays a crucial role in MC and PMC. In MC, there is compelling evidence-based knowledge that children's MC increases as a function of age (Bardid et al. 2015; Barnett, Lai, et al. 2016; Iivonen & Sääkslahti 2014; Khodaverdi et al. 2020; Laukkanen et al. 2019; Logan, Webster, Getchell, Pfeiffer, & Robinson 2015; Rintala, Sääkslahti, & Iivonen 2016; Tietjens et al. 2020) due to the rapid biological development during these early years (Venetsanou & Kambas 2011), wherein the high plasticity of the nervous system contributes to a major improvement in coordination (Adolph & Franchak 2017; Malina et al. 2004). However, children do not develop MC solely through maturational processes as coordinative movements need to be learned, practised and reinforced (Logan, Robinson, Wilson, & Lucas 2012) with increased possibilities for engaging in PA (Gallahue et al. 2012; Robinson et al. 2015; Stodden et al. 2008). In PMC, previous studies have found affirming information based on frameworks (Harter 1999, 2012; Robinson et al. 2015; Stodden et al. 2008) that a child's younger age seem to be associated with inflated perceptions, thus in higher PMC (Jozsa et al. 2014; Lopes, Barnett, & Rodrigues 2016; Schmidt, Valkanover, & Conzelmann 2013; True et al. 2017). As a function of age, as expected based on frameworks, the child's PMC starts to decline and approximate their actual MC due to cognitive maturation (Harter 1999). In contrast, as stated in section 2.3.2, some findings reveal that between the ages of eight to eleven years, the children's PMC stabilises rather than declines (Van Veen et al. 2020).

Also gender differences are widely studied in MC (Barnett, Lai, et al. 2016; Iivonen & Sääkslahti 2014; Lubans et al. 2010; Pill & Harvey 2019; Rintala et al. 2016; Tietjens et al. 2020) and PMC (Afthentopoulou et al. 2018; Estevan, Molina-Garcìa, Abbott et al. 2018; LeGear et al. 2012; Lopes et al. 2018; Pesce et al. 2018; Slykerman et al. 2016). In MC, the majority of studies report some gender differences (Bardid et al. 2015; Barnett, Lai, et al. 2016; Iivonen & Sääkslahti 2014; Laukkanen et al. 2019; Spessato, Gabbard, Valentini, & Rudisill 2013) even though there are also studies reporting no gender differences (Kokštejn, Musálek,

& Tufano 2017), at least in some aspects of MC (Barnett, Lai, et al. 2016). Based on divergent skill categories, most studies have found that boys had better overall MC than girls (Bardid et al. 2015; Barnett, Lai, et al. 2016; Laukkanen et al. 2019; Spessato, Gabbard, Valentini, et al. 2013). Additionally, boys seem to have better BS (Barnett, Lai, et al. 2016; Goodway, Robinson, & Crowe 2010; LeGear et al. 2012; Rintala et al. 2016; Spessato, Gabbard, Valentini, et al. 2013; Tietjens et al. 2020), while some studies proclaim girls having better LM skills (Hardy, King, Farrell, Macniven, & Howlett 2010; LeGear et al. 2012; Tietjens et al. 2020). Finally, in a study conducted with the M-ABC-2 assessment tool, girls outperformed boys in manual dexterity and in total score (Fairbairn et al. 2020) in addition to balance and body coordination skills (Krombholz 2006; Venetsanou & Kambas 2011). However, the gender differences seem to be most evident in BS.

These differences in MC based on gender may result in an outcome of a variety of items. For example, the choice of assessment tools is crucial (Barnett, Lai, et al. 2016; LeGear et al. 2012; Spessato, Gabbard, Valentini, et al. 2013), and it is important to use several assessment tools covering divergent aspects of MC (Bardid, Huyben et al. 2016; Cools et al. 2009; Ré et al. 2018). There is also evidence that gender differences are greater in populations where the overall MC level is lower (Laukkanen et al. 2019) or when children do not participate in organised sport (Queiroz, Ré, Henrique, Moura, & Cattuzzo 2014). Importantly, it is suggested that gender differences in early childhood are not based on biological factors (Gallahue et al. 2012) but are more likely related to family, environmental and sociocultural contexts (Eather et al. 2018; Iivonen & Sääkslahti 2014; Krombholz 2006; Spessato, Gabbard, Valentini, et al. 2013); therefore, regardless of the gender of the child, all children should be provided equal possibilities for MC and PA (Okely, Booth, & Chey 2004; Queiroz et al. 2014).

In PMC, differences between boys and girls are widely studied, and the findings are slightly contradictory. The majority of the studies have stated that boys seem to have higher overall PMC compared to girls (Clark, Moran, Drury, Venetsanou, & Fernandes 2018; Duncan et al. 2018; Slykerman et al. 2016) even though there are several studies reporting no gender differences (Lintunen 1995; Lopes, Barnett, & Rodrigues 2016; Lopes et al. 2018; Pönkkö 1999). There are also studies showing gender differences related to boys having better perception of BS (Afthentopoulou et al. 2018; Barnett, Ridgers, & Salmon 2015; Carcamo-Oyarzun et al. 2020; Estevan, Molina-Garcìa, Abbott et al. 2018; LeGear et al. 2012; Liong et al. 2015; Slykerman et al. 2016; Tietjens et al. 2020). Perception of LM skills seem to be less distinctive between the genders. One study stated that girls perceived themselves as higher than boys in body control skills (Carcamo-Oyarzun et al. 2020). Interestingly, however, Pesce et al. (2018) showed that related to gender differences in PMC, most girls underestimated and most boys overestimated their actual BS. The same tendency was reflected in the study by Tietjens et al. (2020), where girls were better in actual LM skills but nevertheless did not perceive themselves to be better than boys. However, in the same study, boys were better in actual BS and were also perceived to be better than girls.

Consequently, it remains to be discovered how gender differences may emerge in PMC.

Both MC and PMC are associated with lower weight status. Several studies have found evidence that MC has an inverse association with body weight or BMI (D'Hondt et al. 2013; D'Hondt et al. 2014; Laukkanen et al. 2019; Lopes, Stodden, Bianchi, Maia, & Rodrigues 2012; Matarma et al. 2018; Slotte et al. 2015). This finding is in line with the hypothesis of the conceptual framework by Stodden et al. (2008). Systematic reviews of Lubans et al. (2010) and Barnett, Lai, et al. (2016) revealed that healthy weight status was a positive correlate of MC. Additionally, Utesch et al. (2019) stated that there is a moderate-to-large positive relationship between MC and physical fitness, which strengthens with age. Similarly, in relation to PMC, higher PMC has been related inversely to BMI or body weight (Carcamo-Oyarzun et al. 2020; Jones et al. 2010; Spessato, Gabbard, Robinson, et al. 2013; Toftegaard-Stoeckel et al. 2010), underscoring the fact that children with positive PMC are most likely of normal weight.

To date, there is evidence-based knowledge that a child's individual reaction style, called temperament, is associated with the child's PA (Song, Corwyn, Bradley, & Lumeng 2017), amount of screen time (Leppänen et al. 2020; Määttä et al. 2020) and PA parenting (Laukkanen et al. 2018; Song et al. 2017). In contrast, a study conducted with two and a half to five year old Canadian children did not find any association between parental-reported temperament traits and objectively measured PA and SB in children (Irwin, Johnson, Vanderloo, Burke, & Tucker 2015). However, in another North American study, Song et al. (2017) found that a high temperament activity level at the age of four and a half years was associated with higher levels of MVPA at the age of nine years. This association was moderated by parental support for PA. Similarly, a study by Laukkanen et al. (2018) demonstrated that children with an agreeable temperament (referring to a factor created from the total scores for sociability, activity and attention span persistence) tended to have more parental support for PA.

Temperament is rather stable (Rowe & Plomin 1977; Zentner & Bates 2008) over time, and it is often divided into the following three dimensions: (1) surgency, characterised, for example, by a high activity level and impulsivity; (2) effortful control, characterised, for example, by inhibitory control and low-intensity pleasure; and (3) negative affectivity, characterised, for example, by sadness, fear and being difficult to soothe (Putnam & Rothbart 2006). As children can be differentially sensitive to the effects of the environment depending on their temperament (Boyce & Ellis 2005), it has been hypothesised that a child's self-regulation (i.e. the capacity to engage in goal-directed behaviour) may be linked to health behaviours (Miller & Lumeng 2018), such as eating habits (Anderson, Bandini, Dietz, & Must 2004; Bergmeier, Skouteris, Horwood, Hooley, & Richardson 2014), PA (Irwin et al. 2015; Song et al. 2017), the development of a physically (in)active lifestyle (Yang et al. 2017) and screen time (Leppänen et al. 2020; Määttä et al. 2020). According to a systematic review by Bergmeier et al. (2014), a child's temperament was associated with maternal feeding behaviours in early childhood, which, consequently, have been shown to influence childhood overweight and obesity. Interestingly, this emerging area of research lacks studies that further examine this relationship between temperament and obesogenic risk factors in preschool-aged children. Additionally, Anderson et al. (2004) claimed that girls with a high-activity temperament were leaner than girls with a low-activity temperament. Hence, they suggested that movement may play a role in the development of obesity. On one hand, it is well-documented that movement and PA prevent obesity (Barnett, Lai, et al. 2016; Lubans et al. 2010); on the other hand, it is not well-known whether temperament has influence on BMI, weight gain, PA and, directly or indirectly, also to MC and PMC.

2.4.1.2 Behavioural factors

Behavioural factors are situated at the individual level of the socioecological model. These factors are crucial for providing opportunities for children to engage in PA play and, consequently, to enhance their MC. In the literature, there is information about the association between MC, PA and PMC with time spent outdoors, participation in organised sport and SB.

Time spent outdoors is known to increase PA as children tend to be more active outside than inside (Baranowski, Thompson, Durant, Baranowski, & Puhl 1993; Boldemann et al. 2006; Hinkley, Salmon, Crawford, Okely, & Hesketh 2016; Sallis et al. 2000). Among young children, PA is typically achieved in the form of active play behaviour (Truelove, Vanderloo, & Tucker 2017), which is described as 'a form of gross motor or total body movement in which young children exert energy in a freely chosen, fun, and unstructured manner' (Truelove et al. 2017, p. 164), for which the outdoors provide an excellent environment. However, there are differences between the genders as boys tend to spend more time outdoors than girls (Baranowski et al. 1993; Hinkley et al. 2016), and boys tend to be more active than girls (Kokko & Mehtälä 2016). Moreover, the positive factors to increase the time that children spend outdoors are different between girls and boys (Cleland et al. 2010). For younger boys, social opportunities were important, while for girls and for older boys, parental encouragement and supervision increased their time spent outdoors (Cleland et al. 2010). According to Blatchford, Baines and Pellegrini (2003), boys are more socially oriented in their play and more likely to engage in activities such as ball games, while girls prefer to play in smaller groups, involving more conversation, sedentary play, jump-skipping and verbal games. These differences in forms of play may reflect the differences in time spent outdoors, at least partly.

Previous studies have suggested that children are less physically active in cold seasons (Atkin et al. 2016; Carson & Spence 2010; Fisher et al. 2015). Furthermore, the safety of the living environment is crucial for parents letting children spent time outdoors. Burdette and Whitaker (2005) found that if mothers perceived their neighbourhood as unsafe, it was associated with less time spent outdoors and more time spent sedentary watching television inside. Indeed, safe and less inhabited areas may contain more natural, unbuilt parks, including several different landforms. These landforms enable children to practise, for example, balance and coordination skills (Fjørtoft 2001) or BS (Iivonen & Sääkslahti 2014) as there is no lack of space in the natural environment. In contrast, in cities and more densely populated areas, there are more opportunities for parks and play areas that include fixed equipment, such as slides, climbing bars, jungle gyms and tunnels. These types of equipment allow children to practise mainly balancing and strength-demanding skills (Donnelly et al. 2017; Laukkanen 2016). According to Finnish School-age Physical Activity (FSPA [LIITU]) research (Kokko & Mehtälä 2016, p. 91), the best places for children and youths to be physically active 'would consist of versatile PA environments, which are located nearby children's homes (apartments and yards), city blocks and residential areas in villages or rural areas. These kinds of facilities could be built up by the housing cooperatives and real estate themselves'. Therefore, residential density may make a difference in the time spent outdoors; nevertheless, it seems to be equally important for PA levels and MC and PMC skills (see also section 2.4.3).

Residential density may also affect the opportunities that children have to participate in organised sport. There is evidence that participation in organised sport is associated with better MC (Holfelder & Schott 2014; Queiroz et al. 2014; Vandendriessche et al. 2012; Vandorpe et al. 2012), and there is some associated research related to PMC already available (Bardid, De Meester et al. 2016; Pesce et al. 2018). According to Queiroz et al. (2014), children benefit from participation in organised sport even in early childhood regardless of the gender. Several studies affirm this result (Barnett et al. 2013; Krombholz 2006; Vandorpe et al. 2012) even though some studies suggest that there are differences in which kind of hobbies the different genders prefer. Girls tend to participate more in organised sport involving LM skills, such as dance (Barnett et al. 2013), while boys engage more in hobbies that include the mastery of BS (Westendorp et al. 2014).

In a follow-up study with Flemish children from six to eight years old, Vandorpe et al. (2012) found that sport participation not only supported better coordination skills but that better stability skills were also an indicator for later sport participation. Interestingly, Pesce et al. (2018) found that children who overestimate their LM skills participated more often in sport training than their realist counterparts related to PMC. Additionally, higher PMC was associated with motivation towards sport participation (Bardid, De Meester et al. 2016). Currently in Finland, nine to 15 years old Finnish children often participate in organised sport as 62% of the children were reported to participate therein (Kokko & Mehtälä 2016). In a study by Vella and colleagues (2014), the correlates associated positively with eight years old Australian children's participation in organised sport were gender (boy), fewer people in household, higher household income, main language spoken at home (English), higher parental education, child taken to a sporting event and access to a specialist PE teacher during primary school. In contrast, four correlates predicted dropping out of organised sport within couple of years, including lower household income, main language spoken at home (non-English), lower parental education and child not taken to a sporting event (Vella et al. 2014). In Finnish nine to 15 years old children, the main obstacles for PA and sport participation were low PMC, low SES and inaccessibility of physical activities (Kokko & Mehtälä 2016). In essence, participation in organised sport is not always related to a child's willingness to participate but is more influenced by the SES of the family (Kokko & Mehtälä 2016; Vandendriessche et al. 2012) (see also section 2.4.2). Therefore, Vandendriessche et al. (2012) underscores the importance of offering equal opportunities to all children, regardless of SES, but especially to those with lower SES so that they can experience the beneficial effects of sport participation through which they can enhance levels of MC, PA and PMC.

SB is important in this thesis due to its link with PA and consequently with MC and PMC. It can be defined as any waking behaviour associated with an energy expenditure ≤1.5 metabolic equivalent of task (MET) and a sitting or reclining posture and is considered separate and distinct from a lack of MVPA (Tremblay, Colley, Saunders, Healy, & Owen 2010). For children under five years of age, SB includes time spent restrained in car seat, highchair, stroller, pram or carrying device or on a caregiver's back or time spent sitting quietly listening to a story (World Health Organization 2019). Based on the recent guidelines of the World Health Organization (2019), children under five years of age should not be restrained for more than one hour at a time. Moreover, sedentary screen time should be no more than one hour per day. The guidelines stipulate that the less time a child spends sedentary, the better. However, at any age, engaging in activities such as reading and storytelling with a caregiver is encouraged (World Health Organization 2019). In Finland, the recommendation for daily PA (Varhaisvuosien fyysisen aktiivisuuden suositukset [Recommendations for physical activity in early childhood] 2016) is a minimum of three hours, including activities with varying PA intensities – in light activity, brisk outdoor activities and MVPA. In relation to SB, sedentary periods lasting longer than one hour should be avoided, and shorter inactive periods should also include short breaks suitable for children.

There is a large body of evidence which suggests that decreasing any type of SB is associated with lower health risk at the age of under (LeBlanc et al. 2012) and over five years (Carson et al. 2016; Tremblay et al. 2011). A systematic review of children under five years of age showed that there was low-to moderate-quality evidence suggesting that increased television viewing is associated with unfavourable measures of adiposity and decreased scores on measures of psychosocial health and cognitive development (LeBlanc et al. 2012) of children. In children and youth aged five to 17 years old, systematic reviews (Carson et al. 2016; Tremblay et al. 2011) showed that watching television for more than two hours per day was associated with unfavourable body composition, decreased fitness, lowered scores for self-esteem and pro-social behaviour and decreased academic achievement. In contrast, however, Carson and collegues (2016) found that higher durations of reading and doing homework were associated with higher academic achievement. Therefore, it is important to be mindful of the quality and content of the time the child spends sedentary, as the World Health Organization (2019) has emphasised.

In these systematic reviews, there was a lack of studies concerning motor skill development in relation to SB (LeBlanc et al. 2012). The few studies that have analysed the association between SB and MC in young children found no relationship (Cliff, Okely, Smith, & McKeen 2009; Graf et al. 2004; Rodrigues et al. 2016). However, the most recent study by Martins, Ribeiro Bandeira, Filho, Bezerra, Clark, Webster, Mota and Duncan (2021) found an association between combined compliance and sleep time, screen exposure and PA recommendations with children's BS but not with their LM skills. Moreover, Martins, et al. (2021) stated that the combination of screen time and sleep adherence was positively associated with children's LM skills but negatively associated with children's BS. In older children, a significant negative association between SB and MC was found (Wrotniak, Epstein, Dorn, Jones, & Kondilis 2006). In one cross-sectional study, SB significantly discriminated between children with low and high motor coordination (Lopes, Santos, Pereira, & Lopes 2012). In relation to PMC, only a minority of studies have researched, or shown, associations between PMC and SB (Lopes, Barnett, & Rodrigues 2016). Thus, it is suggested that factors other than PMC are more important for young children's SB although future research is warranted to confirm this (Lopes, Barnett, & Rodrigues 2016).

2.4.2 Family factors

In the socioecological model, family factors are situated at the next level from the individual factors. This level interacts closely with the child and his/her individual factors. In early childhood, parents play a critical role – on one hand, as a behavioural example, and on the other hand, increasing or decreasing the amount of PA opportunities. Moreover, parental encouragement and the quality of instruction is important (Donnelly et al. 2017; Gallahue & Donnelly 2003). Thus, these levels of family and environmental factors are crucial for a child's MC and PMC. Therefore, parental influence on these factors will also be discussed. In this study, family factors are related to the parents' educational level attained and the parents' own PA.

Parental educational level and the amount of parental PA have shown positive associations with a child's MC development and PA levels. On one hand, a cross-sectional study conducted in Belgium identified positive associations of MC performance with parental education level, father's PA, transport to school by bicycle and a high value being placed by parents on sport-specific aspects of children's PA (Cools et al. 2011). On the other hand, higher educational level may be associated with higher income level and in the family context is often related to financial support for sport participation. In high SES families, children participated more in organised sport (Vandendriessche et al. 2012). Still, there are conflicting findings regarding the influence of SES on MC (Pill & Harvey 2019) as one study found no consistent association between SES and MC (Okely & Booth 2004), while some other studies have reported that children of high SES outperformed students of lower SES (McPhillips & Jordan-Black 2007; Rudd, Barnett, Butson, Farrow, & Berry 2015). Importantly, one study underscored that daily activities, which represent an aspect of the environment that is highly dependent on parental generation of situations that are conducive to motor skill development, are independent of family SES (Freitas, Gabbard, Cacola, Montebelo, & Santos 2013).

In relation to PMC, fewer studies are available in relation to parental educational level or SES. In a study by Robinson (2011), the participants were four years old children living in the US. The majority were black with a low SES. This is one of the few studies in which children of young age have reported low PMC. The reason remains unclear, especially, as Goodway and Rudisill (1997) did not find low PMC in children living in the US having low SES. Finally, several studies (Robinson 2011; Zeng et al. 2019) proclaim that future studies should incorporate diverse populations related to SES and race/ethnicity to better understand these associations with children's PMC.

Concerning the parents' PA behaviour, a study found associations between the child's PA and the mother's PA (Matarma et al. 2017), underscoring the importance of both parents in regard to PA parenting (Garriguet, Colley, & Bushnik 2017; Laukkanen et al. 2018). Variables negatively associated with preschool children's MC included father–child interaction in TV-viewing and reading books and high importance placed by parents on winning and performance in children's PA (Cools et al. 2011).

Interestingly, Laukkanen, Sääkslahti and Aunola (2020) showed that there is a fine line between demandingness and supportiveness for PA according to children. They found that children felt satisfaction towards their parents' support for PA if the parents were high in responsiveness and low in demandingness. In other words, children appreciated support for autonomy, parental involvement and structure that could be considered as access to sport facilities, hobbies or providing suitable equipment. Additionally, perceptions of high demandingness and high responsiveness in PA parenting, specifically parental expectations and facilitation of PA, were also associated with the satisfaction of the child. That is, if a parent is highly demanding but is still involved in the task and helps the child in the task, the child perceived this as support for PA. Therefore, it seems possible to identify different types of PA parenting practices associated with children's motivation for PA (Laukkanen et al. 2020) and encouragement towards MC. Still, the fact that parents are active together with the child seems to be important (Barnett, Hnatiuk, Salmon, & Hesketh 2019a; Laukkanen et al. 2020) even though the mother's own PA frequency separately from the child was associated with lower LM skills in children in an Australian study (Barnett, Hnatiuk, Salmon, & Hesketh 2019b).

2.4.3 Environmental factors

Environmental factors are first considered from the close point of view of (home) and then the distant (yard and near surroundings) environment. According to the socioecological model, the importance of environment is related to the possibilities the child has to interact actively with the environment. In this thesis, environmental factors include access to electronic devices, sport facilities and the physical environment of the residence based on geographical location and residential density.

According to several studies (Barnett et al. 2019a; Freitas et al. 2013), the home environment is crucial for children's MC, and the age of the child should be taken into consideration. For toddlers, the freedom to move is important as it reinforces the opportunities for PA opportunities to gain MC (Stodden et al. 2008). For older children, equipment that challenges and motivates children to move is also beneficial (Barnett et al. 2019a; Cools et al. 2011; Freitas et al. 2013; Laukkanen et al. 2020) as the amount of equipment available at home was associated with better LM skills (Barnett et al. 2013; Barnett et al. 2019a) and BS (Barnett et al. 2019a). Nevertheless, some differences may occur between genders. Cools et al. (2011) noticed that for girls, the frequency of providing equipment was a positive correlate for MC but not for boys.

In the home environment, there are nowadays many electronic devices and screens available. As time spent sedentary is associated with lower PA levels (Carson et al. 2016; LeBlanc et al. 2012; Tremblay et al. 2011; World Health Organization 2019), these electronic devices and screens can distract parents and children, leading to more time spent inside. Research has also found that in relation to SB and the amount of electronic devices available at home, if parents placed greater importance on limiting children's screen time (Määttä et al. 2017) or offered children frequent visits to places enabling PA (Määttä et al. 2020), these factors were associated with lower SB, which, in turn, may benefit MC and PMC development. In contrast, if parents' perceived barriers in the environment related to children's outside PA, this was associated with more time spent sedentary with electronic devices or screens in home settings. Furthermore, if parents reported more frequent time with their child in their own yard or out in nature, this time was associated with children's lower SB (Määttä et al. 2018).

In essence, it seems that the more variation and affordances the home and near environment provide, the more possibilities the child may have for divergent motor learning (Gabbard 2009; Kokko & Mehtälä 2016). Thus, the benefit of affordances is two-folded related to MC and consequently to PMC: the variety of affordances enhances the willingness to spend time outdoors, which can lead to more advanced motor skills and more PA within the day. Also, reduced possibilities to use electronic devices and time spent sedentary can be associated with higher MC and/or PA.

The geographical location and residential density of the home's location may modify the facilities, amount of equipment, nature and landscapes that the child has available for the development of MC and PMC. Some studies have reported that MC, PA and HRF are different between children living in urban areas and those in rural areas (Cools et al. 2011; Drenowatz et al. 2020; Goodway et al. 2010; Muthuri et al. 2014; Neto et al. 2014; Walhain, van Gorp, Lamur, Veeger, & Lebedt 2016). There is evidence that the urban living environment was associated with higher body weight and lower HRF in children aged six to 11 years old living in Austria (Drenowatz et al. 2020). Similarly, in a study conducted by Walhain et al. (2016), it was found that urban children scored lower in HRF on the cardiorespiratory component and on some KTK items measuring the body coordination of the children. Additionally, urban children were reported to have significantly more SB and less PA than rural children (Muthuri et al. 2014; Neto et al. 2014; Walhain et al. 2016). However, the time spent in SB was reported to be high in both rural and urban contexts, and, interestingly, there was no association with PA recommendation compliance (Neto et al. 2014). In contrast, higher population density of the preschool children's living area in the Northern part of Belgium showed a trend towards a significant positive association with preschool boys' MC but not girls with children aged two and a half to six years of age.

In summary, there seem to be some differences between divergent regions within one country due to a lack of space, safety level, differences in SES and possibilities to engage in PA (Drenowatz et al. 2020; Goodway et al. 2010). However, it can be assumed that environmental differences are greater between countries than between regions within one country.

Cross-cultural differences are based on diversity in sociocultural and geographical aspects, which can cause differences in MC (Feitoza et al. 2018; Hulteen et al. 2018). To date, some cross-cultural comparisons of children's MC have been available (Bardid et al. 2015; Brian et al. 2018; Chow, Henderson & Barnett 2001; Laukkanen et al. 2019; Tietjens et al. 2020) despite the lack of universal agreement about what may constitute a 'gold standard' MC assessment. Therefore, cross-cultural collaboration and comparisons can be difficult to execute, especially if the data have already been collected. In brief terms, the studies that managed a cross-cultural comparison found differences in LM skills (Brian et al. 2018; Luz et al. 2019; Tietjens et al. 2020), BS (Brian et al. 2018; Tietjens et al. 2020), body coordination (Bardid et al. 2015; Laukkanen et al. 2019), manual dexterity and balance skills (Chow et al. 2001) and fitness (Tietjens et al. 2020). More specifically, Bardid et al. (2015) found that Belgian children outperformed Australian children in body coordination measured with KTK. Brian et al. (2018) found differences among Belgian and US children as Belgian children performed significantly higher on LM skills and BS than US children measured with the TGMD-2. In a comparison between Australian and German seven to 10 years old children, German children outperformed Australians in LM skills, while Australian children were better in BS. In a study by Luz et al. (2019), the results indicated that Portuguese children, irrespective of gender, presented better performances in LM skills than US children, while US children outperformed Portuguese children in throwing and handgrip tests. Comparing Chinese and US children, Chinese children performed significantly better in manual dexterity and dynamic balance, whereas US children were better at the projection and reception of moving objects measured with Movement ABC (Chow et al. 2001). Finally, Laukkanen et al. (2019) found differences between Finnish, Belgian and Portuguese children as Portuguese children were at greater risk of lacking sufficient MC as assessed by KTK.

Even though some cross-cultural differences in MC may emerge, the prevalence of probable developmental coordination disorder (DCD) across gender and country was similar based on a parental questionnaire carried out in the Netherlands and Spain (Delgado-Lobete et al. 2020). However, a study conducted in Ireland by McPhillips & Jordan-Black (2007) showed that within one country, children growing up in socially disadvantaged areas may be at particular risk of motor – including neurodevelopmental – delays as well as language and reading difficulties. Therefore, it is important to note that even though between countries the levels of MC may vary, there is no evidence to date that children of certain countries are more at risk of having motor coordination problems, such as DCD. However, within one country, some differences between regions may be found.

Cross-cultural differences are less well known in PMC. A study by Brian et al. (2018) reported that PMC is similar in Belgian and US children for both LM skills and BS. This may reflect the fact that children tend to have globally inflated perceptions, thus, there is less variation between the countries. Feitoza et al. (2018) studied differences between four countries including five to eight years old children from Brazil, Australia, Portugal and the US. They found that US children, both girls and boys, perceived their actual MC to be higher than children from the other countries. Additionally, Brazilian children had the lowest perceptions. Also a comparative study found that Australian children had higher perceptions than peers living in Germany (Tietjens et al. 2020). Finally, a study conducted with children aged seven to 19 years old in the US, China and Hungary showed that there was a decline of PMC measured with the Dimensions of Mastery Questionnaire in children under 10 years of age regardless of the culture (Jozsa et al. 2014). Interestingly, in children aged 11 to 17 years, only in the Chinese sample did the competence self-ratings decline, while in US and Hungarian children they did not. Thus, the decline of PMC seems to be a global phenomenon in children under 10 years of age; however, for future research, the significance of cultural differences may be interesting to study more in children over 10 years of age, including the effect that ethnicity or race may have in the development of PMC (Robinson 2011; Zeng et al. 2019).

The reasons for cross-cultural differences in MC and PMC may be several. There are hypotheses stating that cultural differences in physical education curricula and leisure time activities such as sport participation may impact differences in MC (Luz et al. 2019; Tietjens et al. 2020) and PMC (Feitoza et al. 2018) or differences in active transportation (Bardid et al. 2015; Drenowatz et al. 2020) or government strategies to promote PA (Laukkanen et al. 2019) between countries. Additionally, Drenowatz and collegues (2020) highlighted the importance of the availability of safe spaces that enable (un)structured PA. For example, in the US, there is an increased emphasis on BS for different types of sport (e.g. baseball, softball, basketball), which can contribute to higher MC (Luz et al. 2019) and PMC levels in US children in BS (Feitoza et al. 2018). In fact, according to Feitoza et al. (2018), for MC and PMC it is important, firstly, that the skill or sport exists within the culture, secondly, that the skill is popular and, finally, that there are opportunities to engage in the organised practise of specific skills/sport. Indeed, for Australian children, a strike in baseball is not as familiar as for children in the US; the former tend to think that a strike is related to cricket (Barnett, Ridgers, Zask, et al. 2015), and Finnish children may think it is related to Finnish baseball.

From an environmental perspective, the need for different skills may vary. For example, in countries next to the ocean, canals and lakes, swimming skills are essential, while in countries situated far from water, opportunities to practise swimming are reduced. Hence, the skill itself may be less important, or there are reduced possibilities to engage in such activity. Additionally, climate and weather conditions may be associated with children's PA levels and therefore mediate or moderate MC development. Previous studies have suggested that children tend to be less physically active in cold seasons (Atkin et al. 2016; Carson & Spence 2010; Fisher et al. 2015) and that families would benefit from PA interventions, especially during the winter season (Laukkanen 2016). It has been also stated that MC develops more during summertime compared to winter in the Finnish context (Sääkslahti 2005). In contrast to these findings, Soini et al. (2014) found that in Finnish children aged three years old, the impact of the seasonal variation on PA levels seemed to be minimal. In conclusion, all of these cultural and environmental differences among children may result in differences in the development of MC and PMC.

3 THE AIMS OF THE STUDY

The aims of the study were firstly to provide novel information and secondly to consolidate the previous knowledge on children's MC and PMC in Finland. A large number of individual, family and environmental factors, adapted based on the socioecological model, enables a deepening of the current knowledge on the factors associated with MC and PMC in Finnish children. Additionally, due to large study sample, a national-level comparison can enhance our understanding on the environmental factors that are associated positively or negatively with young children's MC and PMC development.

The aims of this thesis were as follows:

1) To examine MC and PMC in children in childcare centres in different regions of Finland (I, II, III). More specifically,

- To examine age and gender differences in MC and PMC between boys and girls (I, II, III)
- To examine the associations between the daily environment (i.e. geographical location and residential density) and children's MC, PMC, time spent outdoors and participation in organised sport (II)

2) To examine which factors are associated with MC and PMC (I, II, III, IV). More specifically, to investigate

- Which socioecological factors are associated with MC and PMC (I, III)
- How time spent outdoors and participation in organised sport are associated with MC and PMC (II)
- How different profiles of PMC relate to socioecological factors (IV)

4 METHODS

4.1 Study design

The aim of the larger study, Skilled Kids (Laukkanen et al. 2018; Sääkslahti et al. 2019), was to examine Finnish children' MC and PMC and its covariates. The aim of the design was to have a geographically representative sample of 1000 children aged three to seven years from Finnish childcare centres. For the Skilled Kids study, 37 of 2600 childcare centres were randomly selected from the Finnish National Registry of Early Educators in 2015. Based on this registry, cluster-random sampling was carried out with probability proportional to size and with regional stratification and clustering. The childcare centre was the primary sampling unit. Thus, childcare centres were chosen randomly from different geographical locations – Southern, Central and Northern Finland – based on postal codes. The number of childcare centres involved in one region was weighted by the population density of the area, creating in total four residential density groups of the metropolitan area, cities, rural areas and countryside. The cluster-random sampling was done according to the research protocol of the international Health Behaviour in School-aged Children (HBSC) research conducted in Finland for the last 40 years (World Health Organization 2020).

4.2 Ethical considerations

The Ethics Committee of the University of Jyväskylä, Finland, granted approval for the Skilled Kids study on October 31, 2015. Additionally, many regions, for example the metropolitan area, had their own ethical approval that had to be fulfilled, validated and approved before contacting the childcare centres. If the permission was given by the early childhood education director of the region, the director of the childcare centre could be contacted.

During the data collection, in every stage of the study, the children and their guardians were informed about all study procedures and their right to opt out of participation at any time without consequences. The study participation was voluntary for all (Figure 5).

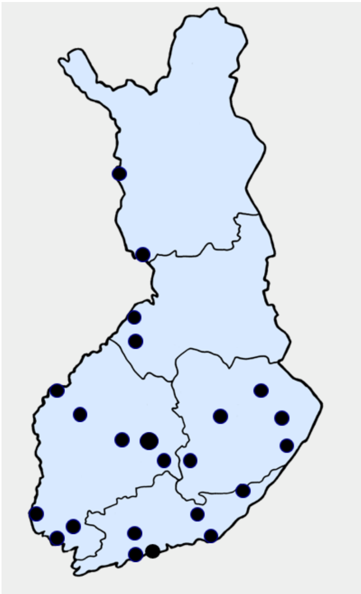


FIGURE 5 Localities of the childcare centres in Finland based on cluster randomisation.

4.3 Recruitment

The recruitment of childcare centres for the Skilled Kids study took place in autumn 2015. When recruiting childcare centres, first, all the regions' early childhood education directors were contacted. The regional directors were asked if it was possible to contact the director of the childcare centres. If permission was given, the director of the childcare centre was approached (Appendix 1). If the director of the childcare centre approved study participation, the staff was informed about the study and its timetable, and brief instructions were sent to help arrange the normal daily activities for the data collection days.

Two weeks before data collection commenced, the staff received informed written consent forms and questionnaires (n = 1579) and passed them on to guardian(s). Guardians were asked to give written consent (Appendix 2) and complete the questionnaires (Appendices 3 and 4) and hand them back to childcare centres staff or researchers in prepaid envelopes. In total, 1239 children (78.5%) received consent for study participation.

4.4 Participants

Altogether 1239 children and their guardian(s) participated in the study. However, there were some challenges in returning the questionnaires, which affected to the number of participants. First, there were missing data from approximately 166 children, depending on the variable. Second, some families of the children did not return the parental questionnaire at all. Thus, 122 children participating in the TGMD-3 and 66 children participating in KTK and PMSC lacked date of birth information. Consequently, we decided not to use the MC or PMC scores of those children as both are associated with age (Barnett, Lai, et al. 2016; Harter 1999; Robinson et al. 2015; Stodden et al. 2008).

In the TGMD-3 measurements, all children between the ages of three (having fulfilled 36 months) and seven years old could attend to the measurements. The age limit for participation was determined by the assessment tools used (Table 1), and the TGMD-3 is suggested to be used only with children over three years of age (Ulrich 2019). The TGMD-3 assessments included altogether 945 children (mean 5.42 yrs., boys n = 473 / 50.1%).

In the KTK analysis, children over five years old (having fulfilled 59 months) were included in the analysis (n = 444, mean 6.2 yrs., boys n = 234 / 52.7%) according to the suggestion in the KTK manual (Kiphard & Schilling 2007). The descriptive data of the study sample in MC are described in more detail in Table 1 and publications I and II.

The PMC studies included all children who were over five years old (having fulfilled 59 months) and who had completed the PMSC assessment. Again, the age limit was set to support the assessment tool's suggestion (Barnett, Ridgers, & Salmon 2015). The study participants comprised 472 children who were five to seven years old (n = 472; mean 6.2 yrs., boys n = 247 / 52.3%). Please see publications III and IV.

TABLE 1 Mean ages (SD) of the children.

Assessment tool (scale of points)	n (%)	Mean age (SD)	Min	Max
TGMD-3 (scale from 0 to 100)	945 (100.0)	5.42 (1.12)	3.08	7.75
Boys	473 (50.1)	5.45 (1.11)	3.08	7.75
Girls	472 (49.9)	5.38 (1.13)	3.08	7.25
KTK (scale from 0 to 193)	437 (100.0)	6.21 (0.62)	5.00	7.75
Boys	229 (52.4)	6.22 (0.60)	5.00	7.75
Girls	208 (47.6)	6.19 (0.64)	5.00	7.25
PMSC (scale from 14 to 52)	472 (100.0)	6.22 (0.63)	5.00	7.75
Boys	247 (52.3)	6.22 (0.62)	5.00	7.75
Girls	225 (47.7)	6.23 (0.65)	5.00	7.25

SD = Standard deviation, n = Number of children, % = Percent, Min = Minimum, Max. = Maximum, TGMD-3 = Test of Gross Motor Development – third edition, KTK = Körperkoordinationstest für Kinder, PMSC = Pictorial Scale of Perceived Movement Skill Competence.

4.5 Data collection

Measurements were conducted in childcare centre settings between November 2015 and September 2016 by two researchers (DN & AS) with two research assistants. Altogether 37 childcare centres participated – six from the metropolitan area, 11 from the southern region, 13 from the central region and seven from Northern Finland. A total of 10 childcare centres (27%) refused to participate. The main reasons were lack of space, interest and/or time or a low number of children. If a randomly chosen childcare centre declined to participate, the following one on the list was recruited from the same area.

Overall, most of the assessments in childcare centres (n = 35 out of 37) were conducted during the scholastic year 2015–2016. However, to have a statistically valid and representative sample of children from all localities, there was a need to have supplementary assessments with the TGMD-3 in two localities (the metropolitan area and a city in Southern Finland) during September 2016. The timetable of the data collection period can be seen in the Table 2 below.

TABLE 2 Timetable and the number of children that participated during the data collection.

Month	Localities (n)	Childcare centres (n)	TGMD-3 (n)	KTK (n)	PMSC (n)
2015					
November	3	3	106	53	50
December	1	3	54	24	25
2016					
January	2	3	79	40	40
February	3	4	107	46	43
March	2	7	172	88	90
April	8	10	253	113	144
May	4	4	105	61	68
June	1	1	17	12	12
September	2	2	52	0	0
Total	24	37	945	437	472

n = Number of children, TGMD-3 = Test of Gross Motor Development – third edition, KTK = Körperkoordinationstest für Kinder, PMSC = Perceived Movement Skill Competence.

During the data collection days, the researchers collaborated with the childcare centre's staff as they and the director of the centre preferred and suggested. The timetable of the data collection days was organised so that the first group of children started after breakfast at 8:30, and the assessments continued until lunch time (approximately until 11:00). Every hour there was a new group of three to five children in the measurements. After naptime and the afternoon snack, around 14:00, there was the possibility to continue the data collection with one or two groups depending on what time the guardians came to pick the children up from the childcare centre.

In general, a group would spend from 45 to 60 minutes in assessments. Altogether, in one day, approximately 20 children took part in the measurements; thus, on average, five groups of three to four children were measured. If a child completed both MC assessments (TGMD-3 and KTK), they were measured on separate days so that the child participated in the PMSC and KTK assessments on the first day, and on the second day, the TGMD-3 with height and weight was carried out.

After the data collection, every childcare centre received a feedback form from the researchers. Feedback was given about those motor skills that the children or group of children scored highly on and mentioned if certain motor skills should be practised in the future. Some individual pieces of feedback could also be added to the feedback form. See Appendix 5.

4.6 Measurements

In this section, first the MC and PMC assessment tools are described. For MC we used two internationally well-known test batteries (TGMD-3 and KTK) to glean information on different aspects of MC. PMC was assessed with PMSC. To obtain information about the socioecological factors possibly influencing MC and PMC, further information was collected via parental questionnaires and some additional measures (see 4.6.4–4.6.4.3).

4.6.1 Motor competence: Test of Gross Motor Development – third version (TGMD-3)

Qualitative aspects of the children's MC were evaluated using the TGMD-3 (Ulrich 2019). The TGMD-3 is a direct observation assessment tool that measures the performance of 13 motor skills subdivided into two divergent skill categories; LM skills, in total six skills, and BS, in total seven skills. These 13 skills comprise the sum of the TGMD-3 gross motor index, which is the most reliable score of the test (Ulrich 2019) and therefore is utilised in this study with its raw scores. According to the author, the test can be used to identify children who are significantly behind their peers in MC, to plan programmes to improve motor skills in children showing delays and to assess changes as a function of increasing age, experience, instruction or intervention from three to 10 years old.

The qualitative aspects of each skill and their scoring are reported in more detail below. First is a summary of six LM skills evaluated by points with their performance criteria, as follows:

1. Run (0-8 points) for 15 metres, with criteria such as 1) arms move in opposition to legs with elbows bent, 2) brief period where both feet are off the ground, 3) narrow foot placement landing on heel or toes (not flat-footed), 4) non-support leg bent about 90 degrees so foot is close to buttocks;
2. Gallop (0-8 points) for seven metres, with criteria such as 1) arms flexed and swinging forward, 2) a step forward with the lead foot followed by the trailing foot landing beside or a little behind the lead foot (not in front of the lead foot), 3) brief period where both feet come off the ground, 4) maintains a rhythmic pattern for four consecutive gallops;
3. Hop (0-8 points) for a minimum of five metres, with criteria such as 1) non-hopping leg swings forward in pendular fashion to produce force, 2) foot of non-hopping leg remains behind hopping leg (does not cross in front of), 3) arms flex and swing forward to produce force, 4) hops four consecutive times on the preferred foot before stopping;
4. Skip (0-6 points) for a minimum of nine metres, with criteria such as 1) a step forward followed by a hop on the same foot, 2) arms are flexed and move in opposition to legs to produce force, 3) completes four continuous rhythmical alternating skips;

5. Horizontal jump (0-8 points), with criteria such as 1) prior to take off, both knees are flexed and arms are extended behind the back, 2) arms extend forcefully forward and upward, reaching above the head, 3) both feet come off the ground together and land together, 4) both arms are forced downward during landing;
6. Slide (0-8 points) for a minimum of seven metres, with criteria for the preferred side (first three criteria) and for non-preferred side (fourth criterion) including 1) body is turned sideways so shoulders remain aligned with the line on the ground, 2) a step sideways with the lead foot followed by a slide with the trailing foot where both feet come off the ground briefly, 3) four continuous slides (preferred side), 4) four continuous slides (non-preferred side).

Each child performed each skill twice, and his/her evaluation score was the sum of the received points during these two performances. These two trials were observed and analysed by an educated observer (DN or PMH) based on the fulfilment of the given criteria (three to four criteria for one skill), who accordingly evaluated each skill (zero points if the given criteria were not fulfilled, one point if they were met). Consequently, the maximum total of points in LM skills was 46 points. The same protocol was followed in BS; a summary of the seven skills follows:

7. Two-hand strike of a stationary ball (0-10 points) replaced at the child's waist level, with criteria such as 1) child's preferred hand grips bat above non-preferred hand, 2) child's non-preferred hip/shoulder faces straight ahead, 3) hip and shoulder rotation during swing, 4) steps with non-preferred foot, 5) hits ball, sending it straight ahead;
8. One-hand forehand strike (0-8 points) from waist height off the bounce, with criteria such as 1) child takes a backswing with the paddle when the ball is bounced, 2) steps with non-preferred foot, 3) strikes the ball towards the wall, 4) paddle follows through towards non-preferred shoulder;
9. One-hand stationary dribble (0-6 points), with criteria such as 1) contacts ball with one hand at about waist level, 2) pushes the ball with fingertips (not slapping at the ball), 3) maintains control of the ball for at least four consecutive bounces without moving the feet to retrieve the ball;
10. Two-hand catch (0-6 points) from four metres distance, with criteria such as 1) child's hands are positioned in front of the body with the elbows flexed, 2) arms extend reaching for the ball as it arrives, 3) ball is caught by hands only;
11. Kicking a stationary ball (0-8 points), which is replaced in six metres and the child runs from two metres towards the stationary ball and kicks it. The performance criteria for the kick include 1) rapid, continuous approach to the ball, 2) child takes an elongated stride or leap just prior to ball contact, 3) non-kicking foot placed close to the ball, 4) kicks ball with insteps or inside of preferred foot (not the toes);

12. Overhand throw (0-8 points) with a tennis ball onto a wall with a distance of six metres, with criteria such as 1) windup is initiated with a downward movement of a hand and arm, 2) rotates hip and shoulder to a point where the non-throwing side faces the wall, 3) steps with the foot opposite the throwing hand towards the wall, 4) throwing hand follows through after the ball's release across the body towards the hip of the non-throwing side;
13. Underhand throw (0-8 points) with a tennis ball onto a wall with a distance of four metres, with criteria such as 1) preferred hand swings down and back, reaching behind the trunk, 2) steps forward with the foot opposite the throwing hand, 3) ball is tossed forward, hitting the wall without a bounce, 4) hand follows through after ball release to at least chest level.

As each child performed each skill twice, his/her evaluation score was the sum of the received points during these two performances. The maximum total points for BS was 54 points. Finally, the TGMD-3 gross motor index, which is the sum of the LM skills and BS, has a theoretical maximum of 100 points (Appendix 6).

In the measurements, according to the manual's instructions, each child had three trials. The first was a practise trial, where child could have a try at the given task after researcher had demonstrated the task. Children completed the practise trial together in a queue or side by side, depending on the space. Afterwards, each child completed the two sequential trials in turn. The proper assessment trials were done one by one. During the data collection, the children completed the assessments in groups of three to five children. One session with each group took approximately 45 to 60 minutes.

Before starting the data collection, two observers were trained to observe the children's performance, and both (DN & PMH) passed Ulrich's official TGDM-3 reliability test performed via video-analysis. However, as the majority of the data were analysed based on live observation in Skilled Kids, we also video-analysed the performances at the beginning of the data collection to be sure that the measurements were observed in reliable manner and to assure that the interrater reliability between the observers was appropriate. Therefore, during autumn 2015, all the assessments were observed live (DN) and additionally video observed (PMH). The results and evaluations were compared (n = 167) and analysed to obtain reliability for the observation. To determine interrater reliability between the two observers, both coded the same performance for the 167 children. Interrater reliability was calculated based on a two-way random model of consistency for single measures. Interrater reliability between the observers for the TGMD-3 gross motor index was 0.88 (95% CI = 0.85–0.92). This is considered to be excellent (Nunnaly & Bernstein 1994). To conclude, overall, the TGMD-3 has been demonstrated to have good to excellent intrarater and interrater reliability (Ulrich 2019), and it has been found to be valid and reliable both internationally (Cools et al. 2009) and nationally (Rintala et al. 2017).

4.6.2 Motor competence: Körperkoordinationstest für Kinder (KTK)

To have complementary information about the gross motor coordination, balance and body control of children aged five to seven years in the Skilled Kids study, participants also completed the Körperkoordinationstest für Kinder (KTK) assessment (Kiphard & Schilling 2007). In this product-oriented assessment tool, evaluation is based on the total score of the four items included in the test battery. As the test is result-based, the theoretical total maximum points cannot be specified. However, in this study sample, the maximum value of one child was 197 points.

According to the authors, KTK is suitable for typically developed children as well as for identifying motor problems and impairments in children until the age of 14. Contrary to the TGMD-3, it is not based on single movement skills, and therefore, it is not quickly learned (Cools et al. 2009). The four test items include the following:

1. Walking backwards eight steps on balance beams (length 3 m, height 5 cm) with divergent widths of 6.0 cm, 4.5 cm and 3.0 cm. The first of the three trials was performed from the widest beam. The maximum for each trial was eight successful steps, resulting an overall maximum score of 24 points per width (3 × 8 points). The maximum score for walking backwards including all widths was 72 points (3 × 24 points);
2. Hopping for height on one leg over an increasing obstacle (width 60 cm, depth 20 cm, height 5 cm each). The first, second and third trial of each height gave three, two or one point(s), respectively. The maximum score for one leg was 39 points, thus the theoretical maximum for both legs was 78 points;
3. Jumping laterally from side to side for 15 seconds over a thin wooden lath (60 cm × 4 cm × 2 cm) on a jumping base (100 cm × 60 cm). There were two trials, and the sum of the number of correct jumps in two trials was the scoring of this item;
4. Shifting between two platforms (size 25 cm × 25 cm, height 5.7 cm) as quickly as possible for 20 seconds. Transitions were performed in the same direction with the two given trials. The result was the sum of the number of points in the two trials.

Each skill was performed and observed carefully following the manual's instructions by experienced observers (DN, AS, VN & PMH). During the data collection, each child completed the assessment within a group of three to five children. For one child, the test took approximately 20 to 30 minutes. Finally, the sum of these latter scores yielded the total sum score for the KTK test (Appendix 7). The raw score was used in the present analysis, as recommended (Bardid, Huyben et al. 2016; Iivonen et al. 2015).

With this study sample, we did not specifically analyse the intrarater reliability between the observers, as KTK is considered to be highly reliable internationally, most likely because it is result-based. KTK's test-retest reliability coefficient for the total score is 0.97, and the subtests range between 0.80 and 0.96 (Kiphard & Schilling 2007).

4.6.3 Perceived motor competence: The Pictorial Scale of Perceived Movement Skill Competence (PMSC)

PMC was measured with the Pictorial Scale of PMSC (Barnett, Ridgers, Zask, et al. 2015) for young children. It is aligned with the items of the TGMD-3 (Ulrich 2019), and therefore, the skills are the same. Thus, the PMSC scale contains 13 items subdivided into two subscales, LM skills (run, gallop, hop, skip, horizontal jump and slide) and BS (two-hand strike of a stationary ball, one-hand forehand strike, one-hand stationary dribble, two-hand catch, kick a stationary ball, overhand throw and underhand throw) using gender-specific booklets (Appendix 8). However, there were some changes regarding the skill names compared to the TGMD-3 protocol to assure better understanding for the children in the PMSC. In the original English version, these modifications were done for slide, which was termed the 'step and slide,' horizontal jump ('jumping forward'), strike ('hitting a ball') and dribble ('bouncing a ball') (Barnett, Ridgers, Zask, et al. 2015). These name changes were to accommodate a younger child's understanding of the activities while asking child's perceptions.

Before starting the data collection, to be able to use this PMSC scale for Finnish children, we needed first to translate it. For that purpose, two researchers (DN & AS) translated the questions into Finnish consulting co-workers. The Finnish team worked closely with Barnett, who is the creator of the test. The translation process was adapted and culturally translated modifying the instructions of the World Health Organization (n.d.). A pilot of the translation was conducted with five children aged from four to eight years. Based on these interviews, the translation was deemed satisfactory. The children understood the pictures, and if not, a physical demonstration helped them to understand the skill. However, two modifications were made with the names of the skills 'jumping forward', which was translated into 'hypätä pituushyppyä', and 'hitting a ball' was translated into 'lyödä palloa mailalla'. Concerning the rest of the translation process, the most difficult part was the answer options translation. Thus, 'really good' was translated into 'tosi hyvä', 'pretty good' into 'aika hyvä', 'sort of good' into 'jonkin verran hyvä' and, finally, 'not that good' into 'ei niin hyvä'. We were mainly concerned about these answer options as we could not be sure if non-native Finnish speakers would still sense these differences in accent around the word 'good'. Nevertheless, the same challenge is in the original English version of the test. A more detailed description of the translation can be found in Appendix 9.

During the data collection, the test was done one on one, with each child in a quiet room. As part of the PMSC administration, children were shown 13 pictures of skills in the TGMD-3 assessment from the gender-specific PMSC booklet. The first question was intended to find out if the child knew what the skill was in the picture. A physical demonstration of any unknown skills was performed by the researcher. The skills that were most often demonstrated were LM skills, such as skip and gallop, and BS, such as one-hand forehand strike and underhand throw. Based on the data collection, it seemed the LM skills were more difficult to recognise from the pictures than BS. This is in line with Barnett, Ridgers, Zask et al. (2015) as they claimed that physical demonstrations of the 'gallop' and the 'step and slide' were most commonly demonstrated by the researcher. Also Moulton, Cole, Ridgers, Pepin and Barnett (2018) have stated that LM skills are less easy for children to recognise.

According to the instructions of the manual, we then showed the picture to the child and asked, 'Have you tried this skill before?' If the child responded 'yes', (s)he was then asked to specify which of the following picture options was most like him/her. If the child had never tried the skill before, (s)he was asked to imagine how good (s)he would be at the given task with answer options (described in more detail below). The test per child took on average 10 minutes, and it was done before the actual MC measurements.

Each item in the subscale was presented in the form of bipolar statements accompanied by a picture for each statement; for example, two images show a boy leaping. The child was asked, 'this child is pretty good at leaping, this child is not that good at leaping, which child is most like you?' After the child picked one of the two pictures, he was asked further to specify his answer. If the child chose the more competent child, he could then choose between 'really good' (4 points) or 'pretty good' (3 points) in leaping. If the child chose the less competent child, he could then choose between 'sort of good' (2 points) or 'not that good' (1 point) in leaping. Skills for each subscale were ordered in a sequence so that the picture of 'good' competence alternated in position on the page with the picture of 'poor' competence (Figures 6 and 7).

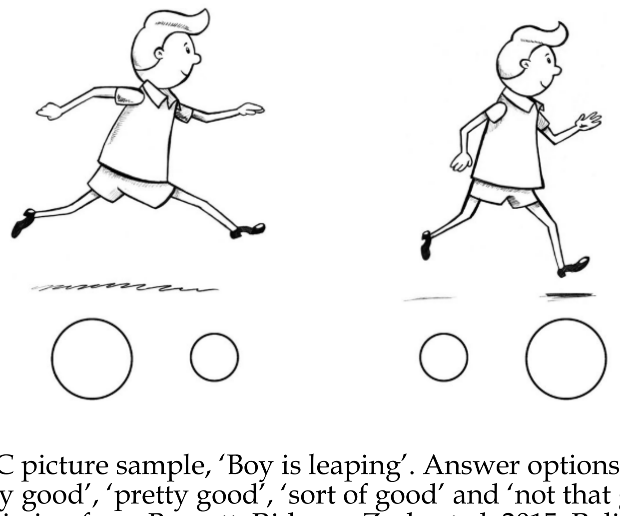


FIGURE 6 PMSC picture sample, 'Boy is leaping'. Answer options from left to the right: 'really good', 'pretty good', 'sort of good' and 'not that good'. Reprinted with permission from Barnett, Ridgers, Zask, et al. 2015, Reliability of the Pictorial Scale of Perceived Movement Skill Competence (PMSC) in 2 Diverse Samples of Young Children, Journal of Physical Activity & Health 12 (8): 1045–51, page 1046. http://dx.doi.org/10.1123/jpah.2014-0141.

An example for girls show a girl striking a ball. The child is asked if she is like the child who is competent or the child who is not so competent in striking. After the child picks one of the pictures, she is asked to further specify her answer. If the child chooses the more competent child, she then chooses between 'really good' (four points) or 'pretty good' (three points) in striking. If the child chooses the less competent child, she then chooses between 'sort of good' (two points) or 'not that good' (one point) in striking (Figure 7). Finally, the points for each skill are summed up, thus the maximum score of one item was four. Consequently, the maximum sum score for perception of LM skills was 24 points (6 × 4) and for perception of BS 28 points (7 × 4). The maximum total score for PMSC was 52 points. The higher the child scores, the higher the PMC.

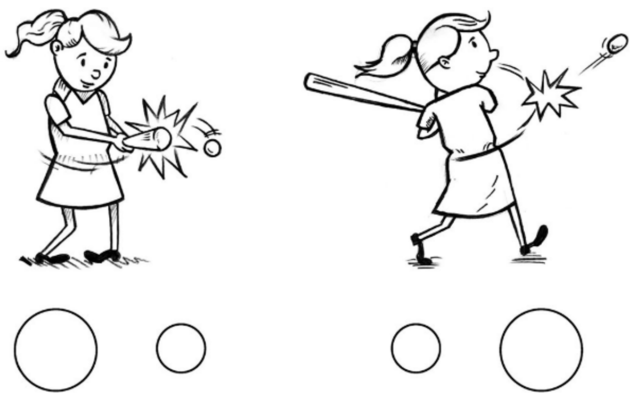


FIGURE 7 PMSC picture sample, 'Girl is striking'. Answer options from left to the right: 'not that good', 'sort of good', 'pretty good' and 'really good'. Reprinted with permission from Barnett, Ridgers, Zask, et al. 2015, Reliability of the Pictorial Scale of Perceived Movement Skill Competence (PMSC) in 2 Diverse Samples of Young Children, Journal of Physical Activity & Health 12 (8): 1045–51, page 1046. http://dx.doi.org/10.1123/jpah.2014-0141.

In the present sample, the test–retest reliability of the PMSC (conducted over 14 days) was tested with 53 children. An intra-class correlation (ICC) < 0.40 was rated as poor agreement, 0.40–0.75 as fair to good agreement and > 0.75 as excellent agreement (Nunnaly & Bernstein 1994). The ICC of LM skills was fair to good (ICC 0.75) and excellent for BS (ICC 0.82) and total PMSC (ICC 0.85). Internationally, this version of the PMSC has demonstrated fair to good to excellent face validity and test–retest reliability in children of a similar age in perception of six LM skills (ICC 0.62) (Diao et al. 2018) and in perception of seven BS (ICC 0.86) (Johnson, Ridgers, Hulteen, Mellecker, & Barnett 2016). The total PMSC (ICC 0.78) showed good internal consistency (alpha coefficient range = 0.73–0.87) (Diao et al. 2018).

4.6.4 Socioecological factors

To obtain information about the socioecological factors possibly influencing MC and PMC, we collected individual– such as biological and behavioural – factors as well as family- and environmental-related factors via parental questionnaire. Additionally, some factors were measures, for example biological factors such as weight and height of the child. For further information, please see below.

In the Skilled Kids parental questionnaire, one guardian of choice answered questions related to the child's individual (e.g. biological and behavioural), family and environmental factors. The questions in the Skilled Kids questionnaire were modified for the Finnish culture from the following three internationally valid and reliable questionnaires: the Children's Leisure Activities Study Survey (CLASS) (Telford, Salmon, Jolley, & Crawford 2004), Affordances in the Home Environment for Motor Development Self-Report (AHEMD-SR) (Rodrigues, Saraiva, & Gabbard 2005) and the Family Physical Activity Environment (FPAE) questionnaire for assessing parental support of children's PA, which has been validated by Cleland et al. (2011). We mostly used questions related to the CLASS survey as it was also valid for children over three and a half years old in contrast to AHEMD-SR. FPAE was used only for parental support for PA questions. Moreover, the CLASS and AHEMD-SR surveys were long, both having more than 63 questions. Therefore, we wanted to closely evaluate every question included in the Skilled Kids questionnaire so that guardians would be motivated to answer.

The translation process of the questionnaire was performed in multiple phases adapted from the recommendations of the World Health Organization (n.d.). First, a group of professionals gathered and listed all the possible factors influencing young children's PA behaviours, MC or PMC. Then, several internationally well-known questionnaires were studied. The critical questions were translated into Finnish, and, if needed, new ones were created. Consequently, a first pilot with 30 guardians was executed. Based on the feedback given by the guardians, some modifications tailored to the Finnish culture were made. Lastly, the parental questionnaire was retested for test-retest reliability. For more about the translation into Finnish and the derivation from questions in the Skilled Kids questionnaire, see Appendix 10. The test-retest reliability of all the items is described below (sections 4.6.4.1–4.6.4.3).

4.6.4.1 Individual factors

Based on the socioecological model, some individual factors related to a child's biological or behavioural factors were queried via parental questionnaires, and some were measured. In this study, these variables were categorised as biological, such as the child's age, gender, height, weight and BMI SDS, temperament, and behavioural factors, such as time spent sedentary or outdoors and participation in organised sport and finally, parent's reported child health issue (Table 3).

First, each *child's exact age in months* was reported by their parent (question number 3). Second, the age in months was calculated (the date of the assessment minus date of birth) with an accuracy within one month based on the date of birth reported on the questionnaire. Statistical analyses were conducted with the value of age in months. Further on, however, the age is reported in years due to a common convention. If the date of birth was not reported by the parent, the results were not utilised in the research. Additionally, the *gender* of the child was queried via the questionnaire (question number 2) with options of 'girl' or 'boy'.

Additionally, biological factors such as *weight and height* were measured during the data collection. The children's weight (Seca 877) and height (Charder HM 200P) were measured directly within the accuracy of a decimal. Weight and height were measured with bare feet and with light clothing such as a t-shirt and trousers on.

Further on, the weight and height information was utilised when calculating the *BMI* of the child. BMI was calculated based on weight/height^2 (kg/m^2). To use age-appropriate BMI scores, BMI was later converted to BMI standard deviation (SD) scores (BMI SDS) using Finnish national BMI references, which were analysed based on data of Finnish children conducted between 1986 and 2008 (Saari et al. 2011). The raw BMI SDS were used in the analysis.

The child's temperament was queried through the parental rating instrument the Colorado Childhood Temperament Inventory (CCTI) questionnaire, which is suitable for children up to seven years old (Rowe & Plomin 1977). We also considered using the EAS Temperament Survey for Children (Buss & Plomin 1984); however, after careful consideration, we preferred using the CCTI for the following reasons. First, it was feasible for use in Finnish, and it has been used in other Finnish studies as well (Ottelin 2015). Second, the CCTI and EAS are similar to each other, however, in CCTI there are more questions related to characteristics such as attention span persistence and characteristics related to impulsivity that were broken down into scales of attention span persistence and soothability – all of the characteristics that we had hypothesised to be worth studying related to MC and PMC. Third, in CCTI there were questions that could reveal important characteristics related to team or group work, which are important characteristics when considering games and PA behaviour with peers, possibly influencing motor development as well.

The CCTI is constructed from six dimensions of personality. Later on, these dimensions of personality were called scales, namely sociability (questions 1, 3, 5, 6, 9), emotionality (questions 2, 4, 7, 8, 10), activity (questions 11, 13, 14, 16, 18), attention span persistence (questions 12, 15, 17, 19, 20), reaction to food (questions 21, 23, 25, 26, 28) and soothability (questions 22, 24, 27, 29, 30). See Appendices 4 (the questionnaire in Finnish) and 11 (the question translations from English to Finnish). Each scale was constructed from five specific statements. Following are statements representing each scale: Sociability: 'The child makes friends easily'; Emotionality: 'The child reacts intensely when upset'; Activity: 'The child is very energetic'; Attention span persistence: 'Plays with a single toy for long periods of time'; Reaction to food: 'Rarely accepts a new food without fussing'; Soothability: 'Whenever the child starts crying, (s)he can be easily distracted'.

For responses to the likelihood scale, the guardian marked every statement from one ('not at all like the child') to five ('a lot like the child'). In total, there were 30 statements, five in every scale. Consequently, the maximum points for one scale was 25 points (5 × 5). In the statistical analysis, the six scales were used separately in summing the responses related to each scale together. CCTI's validity is reported to be considerable and its reliability moderately high (Rowe & Plomin 1977).

Behavioural factors such as a child's sedentary time, time spent outdoors and participation in organised sport in addition to parent's reported child health issue were queried with the Skilled Kids parental questionnaire. The test-retest reliability of all the items was investigated according to 30 responses from parents (obtained over 21 days); these are marked in parentheses with an ICC coefficient and a 95% confidence interval (CI) after each item. *Sedentary time* (ICC = 0.45; 95% CI −0.09–0.80) was assessed through the following questions (questions 40–41): 'Think about your child's typical day and situations when (s)he is sitting or lying down or is sedentary in some other way (e.g. in a car, in a sandbox or in a trolley, in front of the TV or while playing with a puzzle). For how long, at the most, does such sedentary activity approximately last continuously and without breaks?' (1 = >15 min, 2 = 30 min, 3 = 60 min and 4 = ≥90 min) and 'How often is your child engaged in long and continuous sedentary activities in a day?' (1 = once, 2 = twice or thrice, 3 = four to five times and 4 = ≥ six times). The amount of sedentary time (min) in a day was calculated using the aforementioned information (min/time × times/day).

Time spent outdoors (ICC = 0.62; 95% CI = −0.12–1.0) was obtained by asking (questions 31–32) 'How much time, on average, does your child spend outdoors after a preschool day/on weekends?' The scale for weekdays ranged from 0 to 3 (0 = not at all, 1 = under 30 min/day, 2 = approximately 30–60 min/day and 3 = over 60 min/day), while the scale for weekends ranged from 0 to 4 (0 = not at all, 1 = under 30 min/day, 2 = approximately 30–60 min/day, 3 = 1–2 h/day and 4 = over 2 h/day). The total score from both the scales was used to represent the time spent outdoors, with 7 being the maximum score.

Participation in organised sport (ICC = 0.81; 95% CI = 0.60–0.91) was assessed by asking the following (question 36): 'Does your child participate in organised PA or sport in a group or sport club?' If the answer was 'yes', further questions regarding the activities were asked, as follows: 'How many times a week?' and 'For how many minutes at a time?' The total time (min) spent on organised sport per week was calculated and used in the analyses.

Finally, *parent's reported child health issue* (ICC 0.79; 95% CI = 0.60-0.89) was asked in publication IV. The parents were asked to answer a dichotomous question about any additional factors that could have influenced their children's development/PA. If the respondent answered 'yes', a more specific description was required.

4.6.4.2 Family factors

Based on the socioecological model, some family factors were selected based on previous knowledge about variables possibly associated with MC or PMC in young children. The variables presented in this study were queried via parental questionnaire. In this study, these variables included the respondent's gender, parent mean education level, the respondent's PA frequency and PA parenting (Table 3).

As to the respondent's gender, we decided to use the concepts of respondent and partner instead of referring directly to mother or father (questions 11, 18) due to divergent family backgrounds. This decision was made after the pilot of the Skilled Kids questionnaire due to feedback given. Later on, in this study, female respondents were called mothers and males fathers and to conclude, quardians as parents.

Parent mean education level was a mean value of the respondent's (question 12) and partner's (question 19) educational level (1 = comprehensive school; 2 = high school/vocational school; 3 = polytechnic; 4 = university). Parent mean education level was used instead of separating the covariates into respondent and partner so that single parents would not be eliminated from the regression models when analysing the associations between MC and PMC and socioecological factors. *The respondent's own PA frequency* (question 13) was divided on a scale from 0 to 4 (0 = not at all; 1 = randomly few times a month; 2 = approximately once a week; 3 = 2–3 times a week; 4 = over four times a week).

Physical activity parenting (PAP) questions were assessed using the FPAE questionnaire, which has been validated by Cleland et al. (2011). It has also showed to be valid in use with Finnish children (Laukkanen et al. 2018). The questions refer to the sum and mean values of the following three types of parenting practices: Parents' direct support for PA (questions 44–45), reinforcement for PA (questions 46–47) and family participation in PA (question 48). The first section, regarding parents' direct support for PA, consists of the following items: 'Evaluate how often you/your partner provide support for your child's participation in PA, such as taking him or her to a PA hobby or training, providing money for participation and buying sport clothing/equipment'. The second section, regarding reinforcement for PA, was queried with the following items: 'Evaluate how often you/your partner praise your child for participating in PA, such as saying positive things to him or her for being physically active or physically skilful'. The third section asked about family participation in PA with at least one adult involved (not just supervising) with the following question: 'Evaluate how often you engage in PA, such as cycling, walking, playing outdoors or indoors, hiking and playing games, together as a family so that at least one parent is actively involved'. The frequency of PAP was queried using a six-point scale for each item (never, less than once per week, 1–2 times per week, 3–4 times per week, 5–6 times per week or daily). To simplify the interpretation of the numerical analyses, the answers were quantified as follows: 'never' = 0, 'less than once per week' = 0.5, '1–2 times per week' = 1.5, '3–4 times per week' =

3.5, '5–6 times per week' = 5.5 and 'daily' = 7. The PAP questions have been found to be a reliable tool for assessing parental support in Australian children aged five to 12 years (test-retest ICC = 0.65–0.90, n = 540) (Cleland et al. 2011; Nunnaly & Bernstein 1994). With this study sample, the test-retest reliability was slightly lower 0.58 (95% CI 0.28–0.77, n = 30), most probably due to lower number of respondents.

4.6.4.3 Environmental factors

The environmental factors in this study included four items. In this study, environmental factors refer to those that may mediate a child's opportunities to be physically active and thus develop motor skills from home indoors to outdoor surroundings to, finally, the community level (Table 3).

Firstly, we asked via the Skilled Kids questionnaire information about children's number of electronic devices in use at home and, secondly, access to sport facilities nearby their living area. *Number of electronic devices* was assessed by asking, 'Does your child have access to any or some of the following?: 1) TV, 2) game console, 3) computer, 4) smartphone, tablet, IPad or other smart device, 5) something else, what?'. The sum of the number of accessible electronic devices was used in the analyses.

Secondly, the parental questionnaire included questions about *the child's access to sport facilities*, for example, 'Evaluate how often your child has used sport or outdoor facilities situated in your own locality or municipality nearby'. The questionnaire included 10 divergent and organised sport facilities (e.g. playing field, playground, swimming hall, indoor sport hall) and an open space for facilities that were being used but were not listed. Additionally, the respondents were asked to estimate 'Is there a large area for the child's free play in your home yard (front or backyard, garden, etc.)?' and furthermore, 'How often is your child allowed to play in the yard?' Use of each facility was scored on a scale from 0 to 4 (0 = no access to a facility; 1 = nearly never; 2 = randomly; 3 = weekly; 4 = approximately daily). Total access to sport facility use was calculated by summing all the respondents' evaluations.

Finally, the two remaining environmental factors, concerning the physical environment of the child, *geographical location* and *residential density of the location of the child's childcare centre,* were evaluated indirectly by using the set of postal codes of the childcare centres as the reference and the national population density registry for the categorisation. Thus, Finland was divided into three geographical regions: Northern, Central and Southern Finland. Additionally, as the residential density may affect the possibilities for the children's time spent outdoors and for organised sport, and therefore mediate the MC and PMC of the child, the rest of the country was classified according to residential density, comprising four categories of the metropolitan area, cities, rural areas and the countryside (Table 7).

TABLE 3 Socioecological variables included in the study.

Individual factors	Units of analysis	
Biological factors		
Age	in months / years	
Gender	n	girls = 1 boys = 2
Weight	kg	
Height	cm	
BMI SDS		
Temperament		
Sociability	scale from 5 to 25	
Emotionality	scale from 5 to 25	
Activity	scale from 5 to 25	
Attention span persistence	scale from 5 to 25	
Reaction to food	scale from 5 to 25	
Soothability	scale from 5 to 25	
Behavioural factors		
TGMD-3	scale from 0 to 100	
KTK	scale from 0 to 193	
PMSC	scale from 13 to 52	
Sedentary time	mins/day	
Time spent outdoors	scale from 1 to 7	
Participation in organised sport	mins/week	
Parent reported child health issue	scale from 0 to 1	0 = no, 1 = yes
Family factors		
Respondent's gender	n	female = 1 male = 2
Parent's mean education level	scale from 1 to 4	
Respondent's physical activity	mins/week	
Physical activity parenting (PAP)		
Environmental factors		
Electronic devices in use	n	
Access to sport facilities	scale from 0 to 44	
Geographical location	n	Northern = 161, Central = 335, Southern Finland = 449
Residential density	n	Metropolitan area=189, cities = 421, rural areas = 183, countryside = 152

n = Number, kg = Kilogram, cm = centimetre, BMI SDS = Body mass index standard deviation score, TGMD-3 = Test of Gross Motor Development – third version, KTK = Körperkoordinationstest für Kinder, PMSC = Pictorial Scale of Perceived Movement Skill Competence, mins = minutes.

4.7 Data analysis

The use of statistical analysis is presented according to the two research questions which represent the aims of the study (Table 4). First, the descriptive statistics and the group differences between age, gender and daily environment are described. Secondly, regression models and correlations are described, and thirdly, the creation of three profiles of PMC and their associations with socioecological factors is presented. In the analysis, IBM SPSS version 24.0 (IBM Corp., Armonk, NY, USA) was used, and the level of significance was set at $p < 0.05$.

4.7.1 Descriptive statistics and group differences

Within the first research question, the MC and PMC of the participating children were analysed in addition to age and gender differences in the TGMD-3, KTK and PMSC assessment tools. Moreover, differences in MC and PMC based on the physical environment of the residence (i.e. geographical location and residential density) were studied.

MC and PMC are described using *descriptive statistics* (mean and SD, minimum and maximum values) in relation to all explaining and depending variables. *Age differences* were examined using one-way ANOVA. *Gender differences* in explaining variables were examined with a t-test for MC (TGMD-3 and KTK) and with the Mann-Whitney U-test for PMC due to normal distribution in MC and non-normal in PMC.

As to differences in the MC and PMC within divergent physical living environments, such as geographical location and residential density, previous studies (Afthentopoulou et al. 2018; Barnett, Lai, et al. 2016) and the present study (Table 5) showed differences in MC and PMC between boys and girls. Consequently, further analyses were performed separately for girls and boys to take into account these differences and to be able to analyse more closely the differences within the physical living environments without interfering with the topic of gender differences.

To analyse the differences between *geographical locations* (Southern, Central and Northern Finland) and *residential density* (metropolitan area, cities, rural areas and countryside) in MC (LM skills, BS, TGMD-3 gross motor index and KTK total score), time spent outdoors and participation in organised sport, a linear mixed-effects model was used (Figures 20 and 21). A random effect of childcare centre was added as the previous study (Sääkslahti et al. 2019) with this dataset showed that childcare centres were associated with MC in children. Moreover, the child's age was adjusted in the model. All dependent variables were used as separate outcome variables using geographical location and residential density as categorical explanatory variables one at a time.

In the PMSC total score, the childcare centre was not included as a random factor as it was shown to be insignificant when examining dependencies of PMC (see publication III). Thus, in PMC, the differences were analysed with one-way ANOVA adjusted for age.

4.7.2 Regression models and correlations

For associations between the socioecological factors and the two MC assessment tools (TGMD-3 and KTK), *a linear regression model* with the enter method was carried out. As the previous study (Sääkslahti et al. 2019) with this dataset showed that childcare centres were associated with MC, the goodness of fit of the models was tested with and without childcare centre random intercept. In both MC models, the goodness of fit was significantly better when linear mixed models with a childcare centre random intercept were used (for both models, $p < 0.001$). Therefore, in the final MC analyses with the TGMD-3 and KTK, the linear mixed models were used, and in the model with PMC, the linear single-level regression model was used without the childcare centre random effect.

In model 1, for all assessment tools (TGMD-3, KTK and PMSC), all the socioecological factors predicting the TGMD-3 (Table 8), KTK (Table 9) and PMSC (Table 10) were entered into model. The least significant factors were removed from model 1 one at a time. The order of removal from the models is represented in Tables 8, 9 and 10. Model 1 was re-run with all the remaining factors until there were only significant factors left and this was called model 2. An exception was in the model of the TGMD-3 and PMSC, where gender was left in the model even though its result was insignificant. This decision was made as there is strong evidence of gender differences in MC (Barnett, Lai, et al. 2016; Spessato, Gabbard, Valentini, et al. 2013) and PMC (Afthentopoulou et al. 2018). This so-called backwards method made it possible to take the interdependency (mutual covariance) of predictors into account at each step of modelling. In all the above-mentioned models of the TGMD-3, KTK and PMSC, in base model 1 and final model 2, the number of items varied due to missing data in remaining variables in the models. Finally, the *correlations* between time spent outdoors and participation in organised sport with MC and PMC were analysed with partial correlations adjusting for age in months (Table 11).

4.7.3 Creation and associations of three PMC profiles

In the final part of the research, the three profiles of PMC were created, and their differences related to socioecological factors were analysed. At the beginning, all the children who were over 59 months old (4.9 yrs.) and who had PMSC and the TGMD-3 gross motor index results were included in the analysis. Children were categorised based on z-scores into three PMC profiles of underestimation (UE), realistic estimation (RE) and overestimation (OE). First tested was the $z = 1$ limit for creation of the profiles according to previous studies (Pesce et al. 2018; Schmidt et al. 2013). However, as young children tend to have relatively high PMC (Lopes, Barnett, & Rodrigues 2016; Stodden et al. 2008), the typically used $z = 1$ did not allot enough children into the UE and OE profiles. The aim was to closely identify 10% of the children who had the highest and the lowest scores in

MC and PMC relative to the child's age. Those children who had lower PMC than MC belonged to the UE profile, and those who had higher PMC than MC belonged to the OE profile. Therefore, both the PMC and MC z-scores were modified as follows based on the data: low z <= -1.5, middle z = -1.49 to 1.24 and high z =>1.25. Adjustments were made by calculating z-scores for each age group (5, 6 and 7 yrs.) by gender. Subsequently, the groups were unified so that regardless of age or gender, three profiles were established. For example, a child with high PMC and low MC was classified into the positive profile (OE), a child with middle PMC and high MC was classified into the negative profile (UE) and a child with consistent evaluations was classified into the RE profile.

To examine associations with the PMC-MC ratio and socioecological factors, a multinomial logistic regression was used. The factors were added to the multinomial logistic regression model simultaneously, and the variables were excluded one by one if the p-value was less than 0.05. Gender was retained in the final model regardless of its statistical insignificance as it has been shown to be associated with PMC (Pesce et al. 2018; Robinson 2011) and MC (Barnett et al. 2013; Barnett, Lai, et al. 2016; Iivonen & Sääkslahti 2014). The model's goodness of fit showed that it was suitable for the data (Pearson χ2 = 812.698, df = 792, p = 0.297; Deviance χ2 = 656.045, df = 792, p = 1.000). The likelihood ratio tests for comparing the intercept only model and the model with covariates were significant (χ2 = 22.814, df = 10, p = 0.011), so the final model with covariates (gender, age, parent's reported child health issue, parental support, residential density) was significantly better than the model without any covariates. There was no evidence of multicollinearity between covariates (maximum VIF-value 1.03).

For the PMC-MC ratio model, the Nagelgerke pseudo R-square was 0.064. The overall correct classification percentage was 69.4%, showing that it would be possible to re-classify 69.4% of the children to the profiles where they originally were classified. See publication IV.

TABLE 4 Summary of statistical methods based on the research questions.

Research question	Assessment tool	Statistical methods
Research question 1: To examine motor competence and perceived motor competence in childcare centre children in different regions of Finland		
Descriptive statics	TGMD-3, KTK, PMSC	Mean and SD, minimum and maximum values
Age differences	TGMD-3, KTK, PMSC	One-way ANOVA
Gender differences	TGMD-3, KTK PMSC	T-test Mann-Whitney U-test
Associations between physical living environment in MC, time spent outdoors and participation in organised sport	TGMD-3 and KTK	Linear mixed regression model with the enter method (random effect for childcare centre)
Associations between physical living environment in PMC	PMSC	One-way ANOVA (adjusted for age)
Research question 2: To examine what factors are associated with MC and PMC		
Socioecological factors with MC	TGMD-3, KTK	Linear mixed regression model with the enter method (random effect for childcare centre)
Socioecological factors with PMC	PMSC	Linear regression model with enter method
Correlations between time spent outdoors and participation in organised sport with MC and PMC	TGMD-3, KTK, PMSC	Partial correlation adjusted for age in months
Creation of three PMC profiles	PMSC	Z-scores
Socioecological factors with three profiles of PMC	PMSC	Multinomial logistic regression

TGMD-3 = Test of Gross Motor Development – third edition, KTK = Körperkoordinationstest für Kinder, PMSC = Pictorial Scale of Perceived Movement Skill Competence, SD = Standard deviation, MC = Motor competence, PMC = Perceived motor competence.

5 RESULTS

The main findings of the thesis are presented in this chapter. The original papers (I–IV) should be consulted for additional details.

5.1 Characteristics of participants

The participating children (n = 945, boys 473; 50.1%) were three to seven years old and attended Finnish childcare centres during the data collection period of 2015–2016. The descriptive statistics of the study sample are presented in Table 5. Based on the socioecological model, the variables are subdivided into individual (i.e. biological and behavioural), family and environmental factors.

TABLE 5 Characteristics of the participating children (n = 945).

	n	Mean (SD) all	Min	Max	Mean (SD) boys	Mean (SD) girls	Gender dif. p-value
Individual factors							
Biological factors							
Age (years)	945	5.42 (1.12)	3.08	7.75	5.45 (1.11)	5.38 (1.13)	0.357
BMI SDS	943	0.19 (1.05)	-4.55	3.45	0.17 (0.98)	0.21 (1.13)	0.613
Significantly underweight (%)	15	1.6			0.6	2.5	
Underweight (%)	22	2.3			2.5	2.1	
Normal weight (%)	687	72.9			68.6	77.1	
Over-weight/obesity (%)	219	23.2			28.3	18.2	

continues

Table continues

	n	Mean (SD) all	Min	Max	Mean (SD) boys	Mean (SD) girls	Gender dif. p-value
Height (cm)	943	113.52 (9.73)	86.30	137.30	114.40 (9.32)	112.64 (10.06)	0.006
Weight (kg)	943	21.19 (4.47)	11.30	41.60	21.34 (4.19)	21.03 (4.73)	0.291
Temperament (scale from 5 to 25 in every subscale)							
Sociability	929	18.28 (3.70)	6	25	18.31 (3.77)	18.65 (3.63)	0.819
Emotionality	923	14.80 (3.11)	6	24	14.87 (3.17)	14.72 (3.07)	0.478
Activity	914	18.71 (3.01)	10	25	19.28 (3.00)	18.14 (2.91)	<0.001
Attention span persistence	907	16.46 (3.01)	7	25	16.20 (3.08)	16.73 (2.93)	0.008
Reaction to food	906	13.18 (4.44)	5	25	13.09 (4.61)	13.26 (4.27)	0.573
Soothability	910	16.28 (3.26)	5	25	16.17 (3.47)	16.39 (3.05)	0.296
Behavioural factors							
Sedentary time (mins/day)	923	84.62 (47.31)	15	405	87.20 (48.52)	82.01 (45.95)	0.095
Time spent outdoors (scale from 1 to 7)	938	5.10 (1.17)	2	7	5.22 (1.14)	4.97 (1.19)	0.001
Participation in organised sport (mins/week)	902	49.50 (65.28)	0	421	50.65 (70.27)	48.34 (59.85)	0.596
Motor competence							
LM skills (scale from 0 to 46)	945	27.52 (8.07)	0	46	26.16 (8.13)	28.89 (7.78)	<0.001
BS (scale from 0 to 54)	945	24.87 (9.06)	3	50	27.29 (9.49)	22.43 (7.91)	<0.001
Gross motor index (scale from 0 to 100)	945	52.39 (15.16)	4	88	53.46 (16.08)	51.32 (14.11)	0.030
KTK total score (scale from 0 to 193)	437	103.82 (34.05)	6	193	101.09 (34.86)	105.54 (33.51)	0.187
Perceived motor competence							
PMSC LM skills (scale from 6 to 24)	472	19.99 (3.18)	7	24	19.66 (3.32)	20.26 (3.04)	0.049

continues

Table continues

	n	Mean (SD) all	Min	Max	Mean (SD) boys	Mean (SD) girls	Gender dif. p-value
PMSC BS (scale from 7 to 28)	472	22.16 (4.29)	7	28	22.68 (4.18)	21.64 (4.44)	0.011
PMSC total (scale from 14 to 52)	472	42.15 (6.72)	14	52	42.32 (6.77)	41.85 (6.79)	0.460
Family factors							
Parent's mean educational level	935	2.73 (0.80)	1	4	2.73 (0.79)	2.73 (0.81)	0.995
Respondent's physical activity (mins/week)	845	57.93 (22.63)	2	330	58.06 (24.05)	57.81 (21.12)	0.875
Environmental factors							
Electronic devices in use (n)	923	0.56 (0.92)	0	5	0.62 (0.99)	0.49 (0.84)	0.036
Access to sport facilities (scale from 0 to 44)	939	21.75 (4.17)	2	37	22.03 (4.14)	21.47 (4.19)	0.039

n = Number, SD = Standard deviation, Min. = Minimum, Max. = Maximum, Dif. = Difference, p = p-value, statistically significant difference at the level of $P < 0.05$, BMI SDS = Body mass index standard deviation score, % = Percent, cm = Centimetre, kg = Kilogram, mins. = minutes, LM = locomotor skills, BS = Ball skills, KTK = Körperkoordinationstest für Kinder, PMSC = Pictorial Scale of Perceived Movement Skill Competence.

In the total study sample, aside from MC and PMC, there were gender differences in the individual factors, including biological factors, such as height and temperament traits (activity and attention span persistence), and behavioural factors, such as time spent outdoors. Moreover, gender differences were found in environmental factors, such as electronic devices in use and access to sport facilities. Family-related factors were similar between the genders (Table 5). In essence, boys were taller than girls ($p = 0.006$), they were described as more active based on a temperament trait ($p < 0.001$) and they spent more time outdoors ($p = 0.001$). Moreover, based on the parental questionnaires, boys had more electronic devices in use ($p = 0.036$), and they had more access to sport facilities in their near surroundings ($p = 0.039$). Girls were described as having more attention span persistence based on a temperament trait ($p = 0.008$).

Most of the information gathered in the study was reported by guardians of the participating children. The descriptive data of the respondents who completed the parental questionnaire are presented in Table 6 below.

TABLE 6 Respondents' (n = 936) characteristics.

Variables	n	All (%) or mean (SD)
Gender	936	100
Female	816	87.2
Male	119	12.7
Other	1	0.1
Age, years, mean (SD)	936	35.82 (5.37)
Education (%)*	938	2.85 (1.04)
Elementary school	39	4.2
Secondary school	330	35.2
Polytechnic	303	32.3
University	266	28.4
Family income level (€/year, %)	856	100
Up to 13 999	30	3.5
From 14 000 to 39 999	179	20.9
From 40 000 to 69 999	305	35.6
From 70 000 to 99 999	218	25.5
From 100 000 -	124	14.5
Family status (%)	934	100
Nuclear family	729	78.1
Single parents	97	10.4
Blended family	79	8.5
Other	29	3.1
Type of living house (%)	939	100
Block of flats	261	27.8
Terrace house	170	18.1
Detached house	508	54.1
Number of family members (%)	932	100
From 2 to 3	205	22.0
4	449	48.2
From 5 to 9	278	29.8
Physical activity, mins/week, mean (SD)	845	57.93 (22.63)
Parental support for PAP, scale from 0 to 7, mean (SD)	934	3.23 (1.57)

n = Number, % = Percent, SD = Standard deviation, € = euros, mins. = minutes, PAP = Physical activity parenting. *Please note: Education type is provided here in detail (not mean education level).

5.2 Age differences

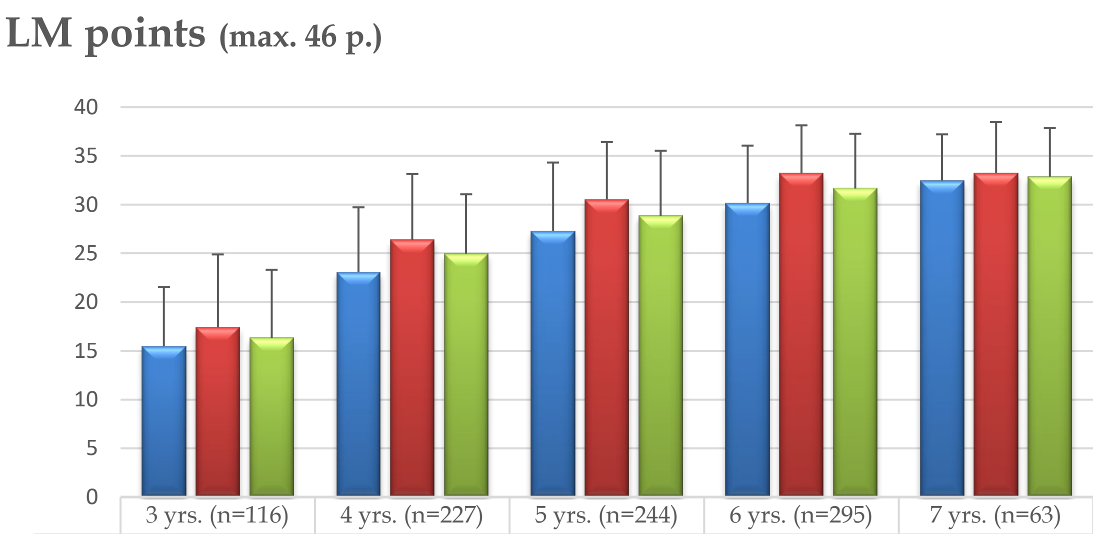
This section describes how age differences were shown in this study in three different assessment tools, in MC (TGMD-3 and KTK) and in PMC (PMSC).

5.2.1 Motor competence

MC was subdivided into the different subscales, measured with two divergent MC assessment tools. The TGMD-3 assessment was divided into LM skills, BS and gross motor index. Moreover, KTK was considered as one sum index to describe the coordination and balance skills of the children.

5.2.1.1 TGMD-3

The TGMD-3 assessment was used with children aged three to seven years (n = 945; boys 473; 50.1%). The level of LM skills increased as a function of age (Figure 8), as three years old children (n = 116) had the lowest LM skills (mean points 16.33; SD 6.99), and the eldest (seven years old, n = 63) had the highest scores (mean points 32.87; SD 4.98). These differences between age groups were statistically significant in all age categories ($p < 0.001$) except in children between six and seven years old ($p = 0.60$).



	3 yrs. (n=116)	4 yrs. (n=227)	5 yrs. (n=244)	6 yrs. (n=295)	7 yrs. (n=63)
Boys	15,46	23,07	27,29	30,15	32,47
Girls	17,41	26,36	30,53	33,2	33,24
All	16,33	24,97	28,84	31,66	32,87

FIGURE 8 Descriptive statistics of LM skills measured with the TGMD-3 (n = 945) according to age. Mean values (SD). LM skills = Locomotor skills, TGMD-3 = Test of Gross Motor Development – third edition, SD = Standard deviation, max. = Maximum amount of points (p.), yrs. = age in years, n = number of children.

Likewise, the level of BS increased as a function of age (Figure 9) as the children aged three years old (n = 116) had the lowest BS (mean points 14.47; SD 5.68), and the eldest (seven years old, n = 63) had the highest scores in BS (mean points 34.24; SD 7.05). Statistically significant differences were found in every age group (p < 0.001).

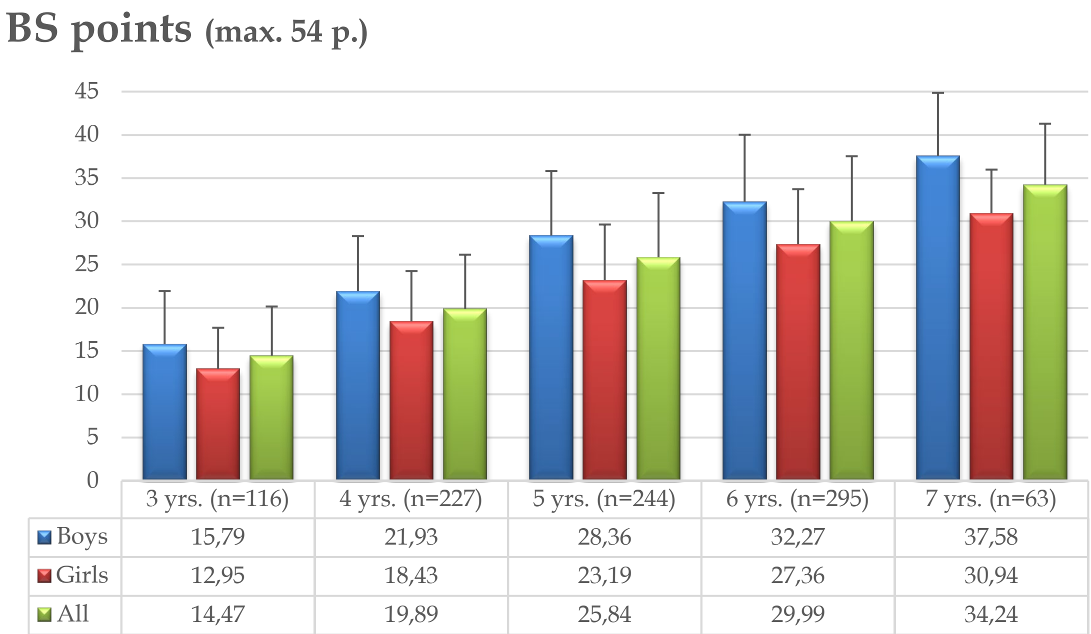
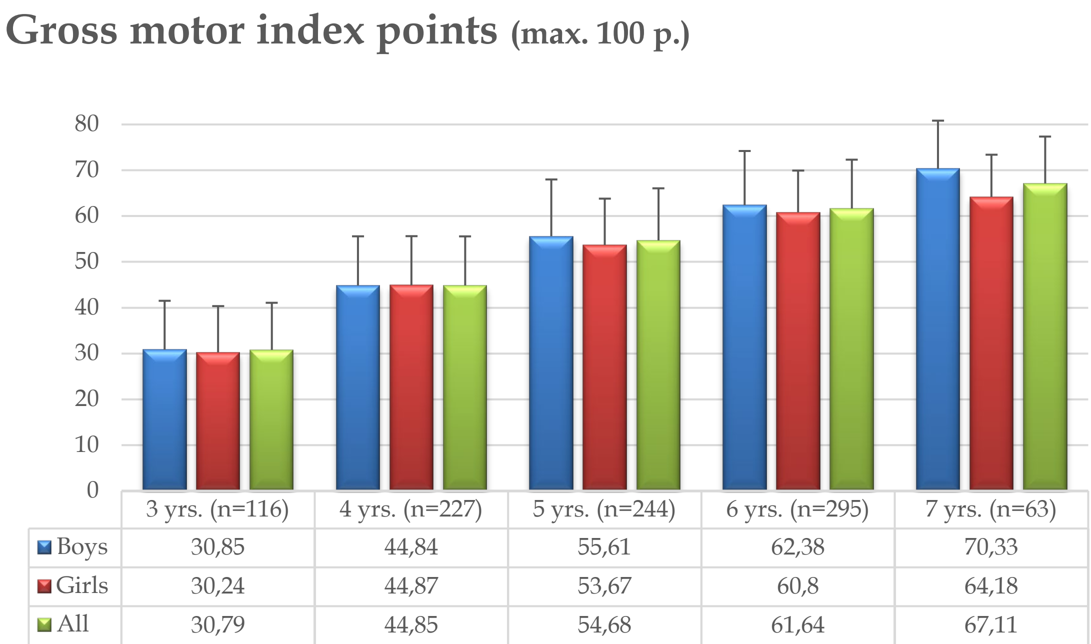


FIGURE 9 Descriptive statistics of BS measured with the TGMD-3 (n = 945) according to age. Mean values (SD). BS = Ball skills, TGMD-3 = Test of Gross Motor Development – third edition, SD = Standard deviation, max. = Maximum amount of points (p.), yrs. = Age in years, n = Number of children.

Finally, the total score of LM skills and BS summed up within the TGMD-3 gross motor index is stated to be the most reliable score of the assessment tool (Figure 10). The level of gross motor index increased also as a function of age as three years old children (n = 116) had the lowest (mean points 30.79; SD 10.29), and the eldest (seven years old, n = 63) had the highest scores in the total gross motor index (mean points 67.11; SD 10.25). Statistically significant differences were found in every age group, between children of three to six years old (p < 0.001) and between children six to seven years old (p = 0.003).

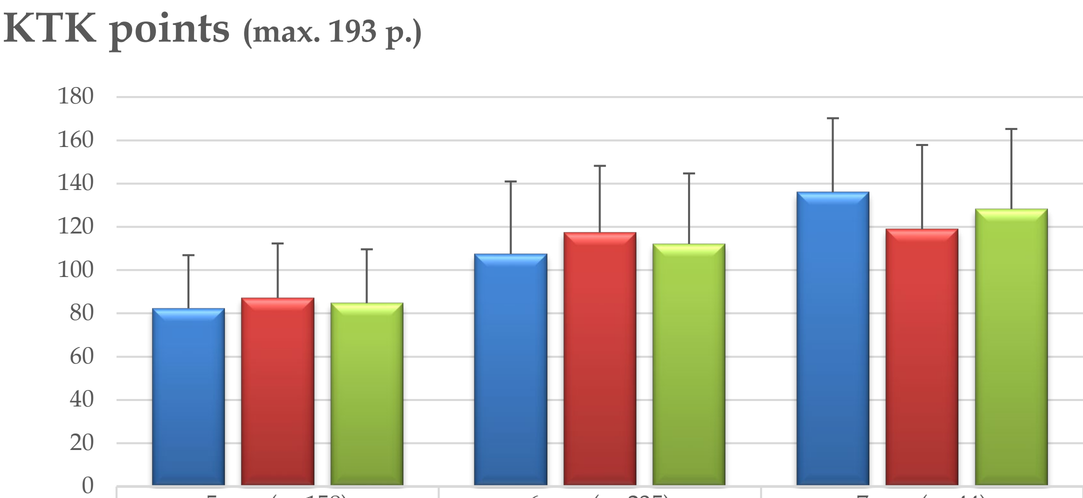


	3 yrs. (n=116)	4 yrs. (n=227)	5 yrs. (n=244)	6 yrs. (n=295)	7 yrs. (n=63)
Boys	30,85	44,84	55,61	62,38	70,33
Girls	30,24	44,87	53,67	60,8	64,18
All	30,79	44,85	54,68	61,64	67,11

FIGURE 10 Descriptive statistics of gross motor index measured with the TGMD-3 (n = 945) according to age. Mean values (SD). TGMD-3 = Test of Gross Motor Development – third edition, SD = Standard deviation, max. = Maximum amount of points (p.), yrs. = Age in years, n = Number of children.

5.2.1.2 KTK

KTK was assessed among children aged five to seven years old (n = 437; boys 229; 52.4%). Similar to the TGMD-3, the KTK total score also increased as a function of age (Figure 11), as five year old children (n = 158) had the lowest (mean points 84.71; SD 24.92), and the children of seven years old (n = 44) had the highest scores (mean points 128.23; SD 37.02). Between age categories, statistically significant differences were found in every age group, between five to six years old and five to seven years old ($p < 0.001$), while the difference between the children aged six and seven years old was the smallest even though statistically significant ($p = 0.05$).



	5 yrs. (n=158)	6 yrs. (n=235)	7 yrs. (n=44)
Boys	82,34	107,45	136
Girls	87,14	117,37	118,9
All	84,71	112,09	128,23

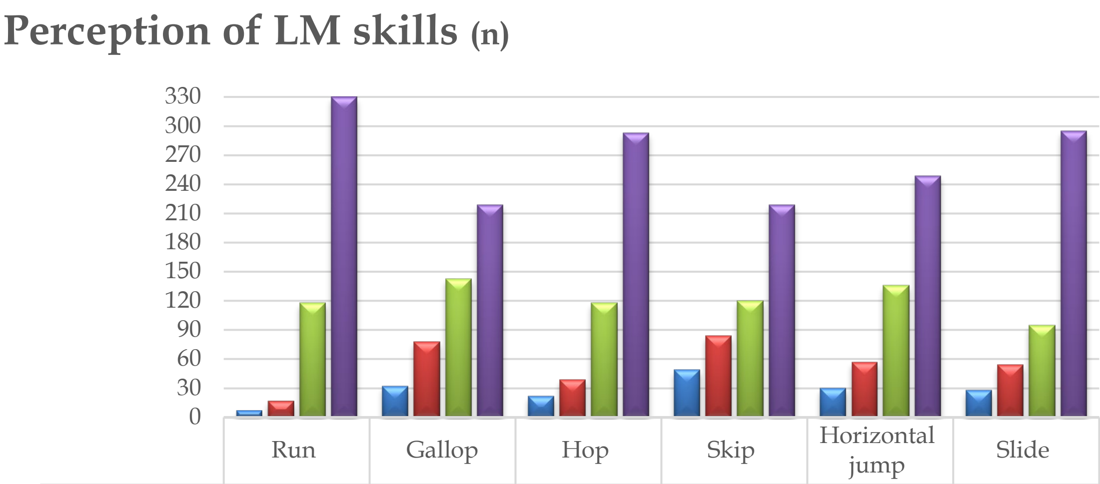
Figure 11 Descriptive statistics of MC measured with KTK (n = 437) according to age. Mean values (SD). MC = Motor competence, KTK = Körperkoordinationstest für Kinder, SD = Standard deviation, max. = Maximum amount of points (p.), yrs. = Age in years, n = Number of children.

5.2.2 Perceived motor competence

For PMC, more careful description of skills that children have or have not tried is described in addition to other descriptive information on PMC. First, there are analyses of specific skills in which children perceive themselves as 'really good' or 'pretty good' (Figures 12-13). Then statistics of skills that children perceive they have tried before are given (Figure 14). Lastly, the age differences in PMC subdivided into perception of LM skills, BS and PMSC total score are analysed.

The PMC was assessed among children aged five to seven years old (n = 472, boys 247; 52.3%). In the total sample, the children's PMC was high, and the majority of the children considered themselves as 'pretty good' or 'really good' in all 13 PMSC skills.

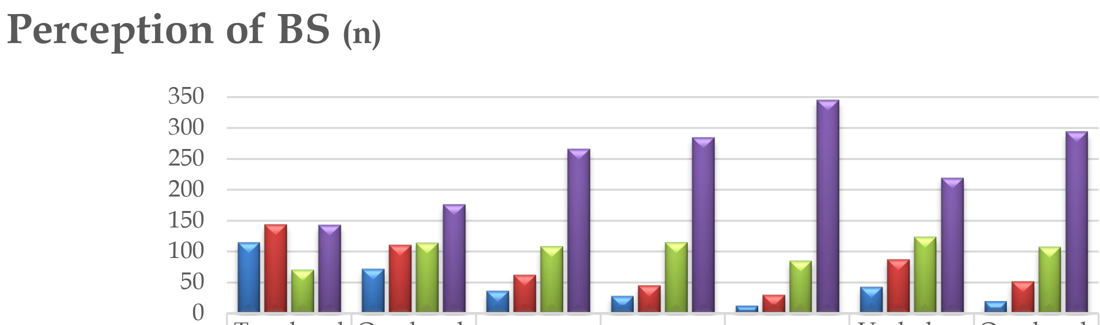
In LM skills, when looking at the number of children who described themselves as 'pretty good' or 'really good' in the individual skills, the percentages were high – for run 95% (n = 448), gallop 77% (n = 362), hop 87% (n = 411), skip 71% (n = 339), horizontal jump 82% (n = 385) and slide 83% (n = 390).



	Run	Gallop	Hop	Skip	Horizontal jump	Slide
Not that good	7	32	22	49	30	28
Sort of good	17	78	39	84	57	54
Pretty good	118	143	118	120	136	95
Really good	330	219	293	219	249	295

FIGURE 12 Perception of LM skills in children (n = 472). Number of children who described his/her perception of locomotor skills in PMSC in these aforementioned skills to be ‘not that good’, ‘sort of good’, ‘pretty good’ and ‘really good’. LM skills = Locomotor skills, PMSC = Pictorial Scale of Perceived Movement Skill Competence, n = Number of children.

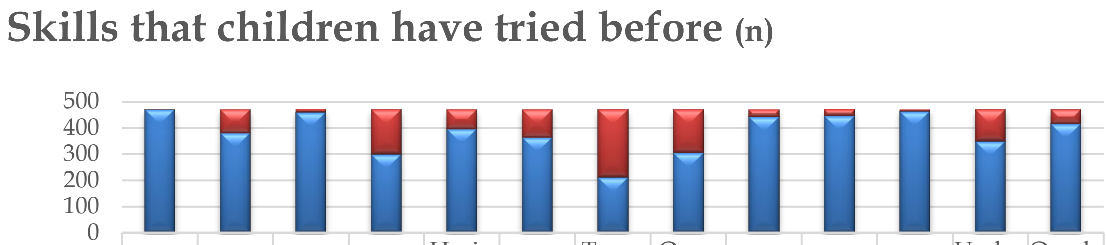
In BS, the number of children who described themselves as ‘pretty good’ or ‘really good’ were as follows: for two-hand strike, 45% (n = 213), one-hand strike 61% (n = 290), dribble 79% (n = 374), catch 85% (n = 399), kick 91% (n = 430), underhand throw 73% (n = 342) and overhand throw 85% (n = 401). Therefore, of the individual skills, children perceived their skills the highest in ‘run‘, ‘kick‘, ‘hop‘ and ‘overhand throw’ and the lowest in the skills of ‘two-hand strike’and’one-hand forehand strike’.



	Two-hand strike	One-hand strike	Dribble	Catch	Kick	Underhand throw	Overhand throw
Not that good	115	72	36	28	12	43	19
Sort of good	144	110	62	45	30	87	52
Pretty good	70	114	108	115	85	123	107
Really good	143	176	266	284	345	219	294

FIGURE 13 Perception of BS in children (n = 472). Number of children who described his/her perception of ball skills in PMSC in these aforementioned skills to be 'not that good', 'sort of good', 'pretty good' and 'really good'. BS = Ball skills, PMSC = Pictorial Scale of Perceived Movement Skill Competence, n = Number of children.

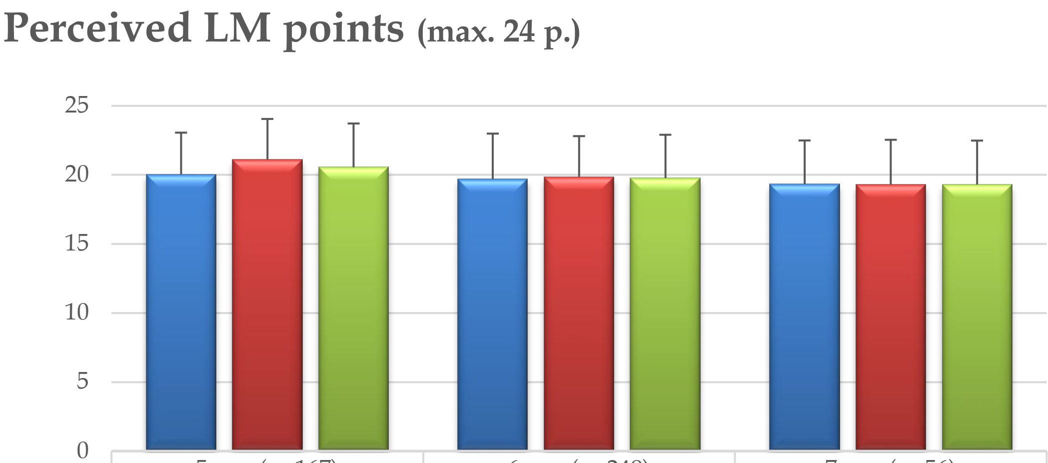
The majority of the children had tried the PMSC tasks before the actual MC measurements (Figure 14). Run (99.8%), kick (98.3%), hop (97.7%) and catch (94.5%) were the most familiar to the children. Two-hand strike (45.1%), skip (63.6%), one-hand strike (64.8%) and slide (77.5%) were the least previously tried skills.



	Run	Gallop	Hop	Skip	Horizontal jump	Slide	Two-hand strike	One-hand strike	Dribble	Catch	Kick	Underhand throw	Overhand throw
No	1	91	11	172	75	106	259	166	30	26	8	123	55
Yes	471	381	461	300	397	366	213	306	442	446	464	349	417

FIGURE 14 Skills that children have/have not tried before (n = 472). n = Number of children.

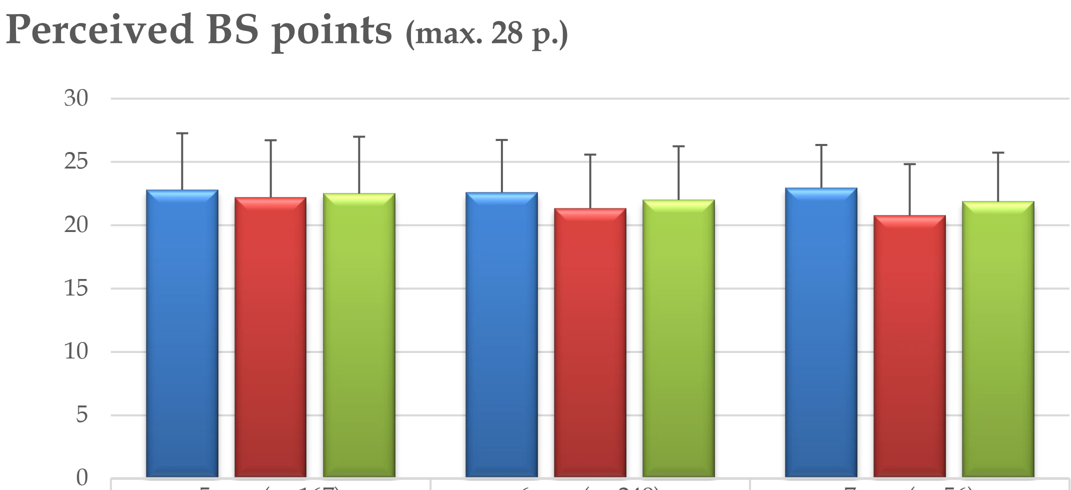
In perceived LM skills, the differences between age groups were almost non-existing (Figure 15) as five years old children (n = 167) had only slightly higher perceptions (mean points 20.55; SD 3.18) than six years old (mean points 19.77; SD 3.14; p = 0.084) and seven years old children (mean points 19.30; SD 3.19; p = 0.065).



	5 yrs. (n=167)	6 yrs. (n=249)	7 yrs. (n=56)
Boys	20,03	19,69	19,32
Girls	21,1	19,86	19,29
All	20,55	19,77	19,3

FIGURE 15 Descriptive statistics of perceived LM skills in children (n = 472) according to age. LM skills = Locomotor skills, max. = Maximum amount of points (p.), yrs. = Age in years, n = Number of children.

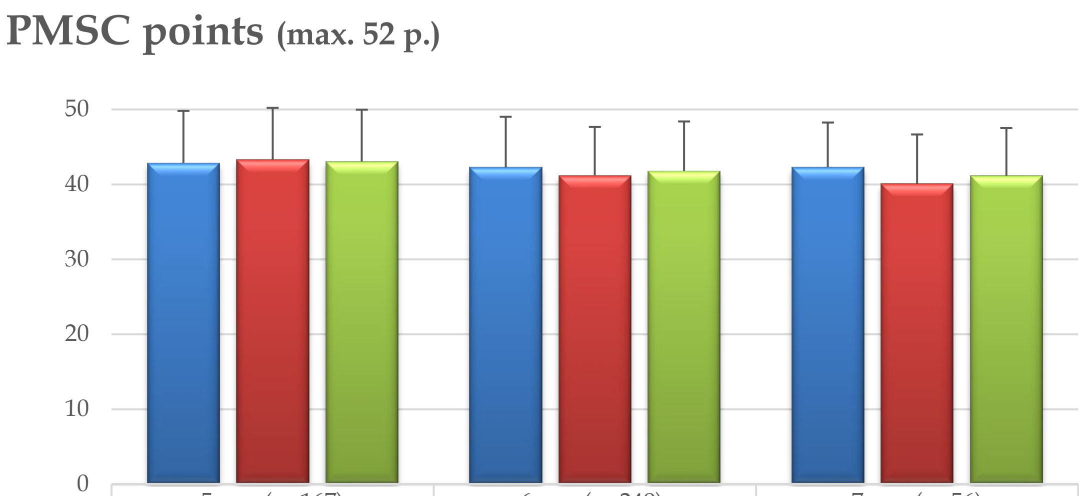
In perceived BS, the differences between age groups were zero (Figure 16) as the difference between age groups were in all categories (p = 1.000).



	5 yrs. (n=167)	6 yrs. (n=249)	7 yrs. (n=56)
Boys	22,8	22,58	22,96
Girls	22,19	21,33	20,75
All	22,5	22	21,86

FIGURE 16 Descriptive statistics of perceived BS in children (n = 472) according to age. BS = Ball skills, max. = Maximum amount of points (p.), yrs. = Age in years, n = Number of children.

In the total score of PMSC, the differences between age groups were minor (Figure 17) as the youngest (five years old, n = 167) had the highest PMC (mean points 43.05; SD 6.92) compared to peers that were six years (mean points 41.77; SD 6.62; p = 0.334) or seven years old (mean points 41.16; SD 6.35; p = 0.409). Therefore, even though it seems that, in contrast to MC development, older children tend to have slightly lower scores in perceptions, statistically significant differences did not exist between age groups in regard to perception of LM skills, BS or total PMSC score.



	5 yrs. (n=167)	6 yrs. (n=249)	7 yrs. (n=56)
Boys	42,84	42,27	42,29
Girls	43,28	41,19	40,04
All	43,05	41,77	41,16

FIGURE 17 Descriptive statistics of PMC in children (n = 472) according to age. PMC = Perceived motor competence, PMSC = Pictorial Scale of Perceived Movement Skill Competence, max. = Maximum amount of points (p.), yrs. = Age in years, n = Number of children.

5.3 Gender differences in MC and PMC

Gender differences are described first for each age category and then for the whole study sample. The gender differences are analysed in the TGMD-3 in three categories (LM skills, BS and TGMD-3 gross motor index). In KTK, the total score is used. Similar to the TGMD-3, PMSC is subdivided into three categories of perception of LM skills, BS and PMSC total score. In PMSC, gender differences in the individual skills of the assessment tool are also described.

5.3.1 Motor competence

5.3.1.1 TGMD-3

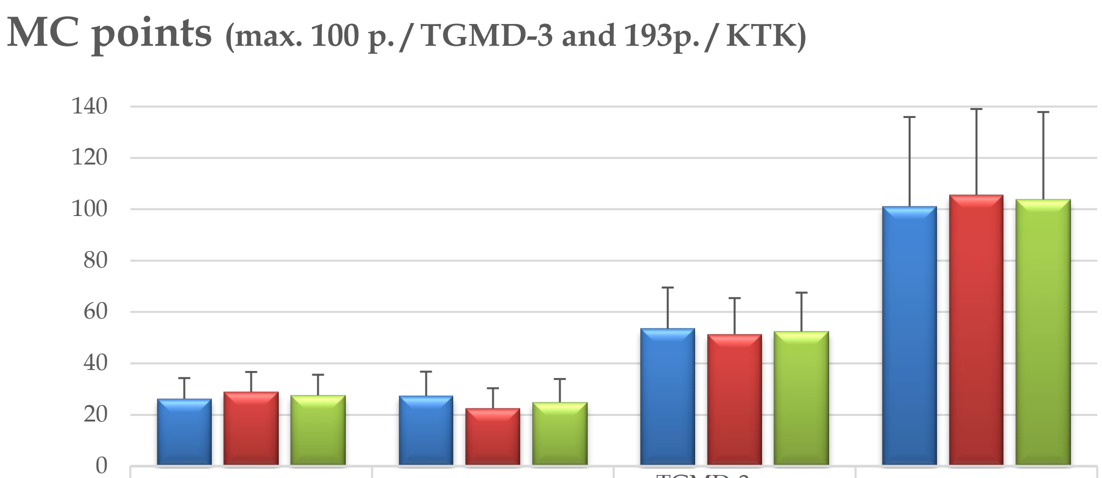
In LM skills, gender differences emerged in three age groups between girls and boys – in four ($p < 0.001$), five ($p < 0.001$) and six years old children ($p < 0.001$) – where girls outperformed boys in LM skills. No statistically significant differences were found with three years old ($p = 0.07$) and seven years old ($p = 0.54$) children. In the total sample with all age categories put together, girls outperformed boys in LM skills ($p < 0.001$).

In BS, boys had higher scores in every age category than girls. Additionally, the differences between the two genders were statistically significant – in children of three years ($p = 0.007$), four years ($p < 0.001$), five years ($p < 0.001$), six years ($p < 0.001$) and, finally, seven years old ($p < 0.001$). In the total sample, boys scored higher in BS than girls ($p < 0.001$).

In the TGMD-3 gross motor index, the gender differences between age groups were statistically significant solely for seven years old children ($p = 0.016$) in which boys had a higher total score than girls. In other age categories, no differences were found in children three years ($p = 0.98$), four years ($p = 0.98$), five years ($p = 0.18$) and six years old ($p = 0.19$). However, in the total sample, boys scored higher in gross motor index than girls ($p = 0.03$).

5.3.1.2 KTK

In KTK, a statistically significant difference emerged between the genders at six years old ($p = 0.02$) as girls scored higher in the KTK total score than boys. No other gender differences between age categories (5 years, $p = 0.23$, and 7 years, $p = 0.13$) or in the total sample ($p = 0.187$) were found. See Table 5 and Figure 18 for the differences in the total sample. For gender differences in divergent age categories measured with the TGMD-3, see Figure 8 for LM skills, Figure 9 for BS and Figure 10 for gross motor index; Figure 11 shows the results measured with KTK.



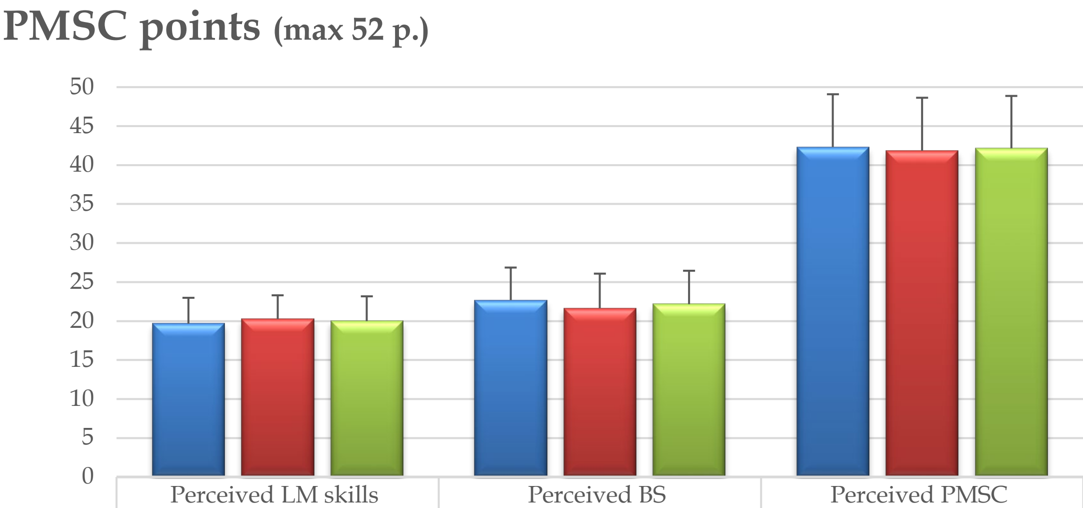
	LM skills	BS	TGMD-3 gross motor index	KTK
Boys	26,16	27,29	53,46	101,09
Girls	28,89	22,43	51,32	105,54
All	27,52	24,87	52,39	103,82

FIGURE 18 Gender differences in MC measured with the TGMD-3 (n = 945) and KTK (n = 437). Mean values (points) and SD. MC = Motor competence, TGMD-3 = Test of Gross Motor Development –third version, KTK = Körperkoordinationstest für Kinder, max. = Maximum amount of points (p.), SD = Standard deviation, n = Number of children.

5.3.2 Perceived motor competence

Considering gender differences in individual perceived skills, girls had higher PMC than boys in 'slide' ($p = 0.002$), and, alternatively, boys had higher PMC in 'two-hand strike' ($p = 0.001$), 'kick' ($p = 0.002$), 'underhand throw' ($p = 0.010$) and 'overhand throw' ($p = 0.027$).

No gender differences were found between the different age categories (Figure 19). However, when considering the main subscales (LM skills, BS and total PMSC), gender differences were found in perceptions of LM skills as girls had higher PMC than boys ($p = 0.049$), and boys had higher PMC in BS than girls ($p < 0.001$).



	Perceived LM skills	Perceived BS	Perceived PMSC
Boys	19,66	22,68	42,32
Girls	20,26	21,64	41,85
All	19,99	22,16	42,15

FIGURE 19 Gender differences in PMC in children (n = 472). Mean values (points) and SD. PMC = Perceived motor competence, PMSC = Pictorial Scale of Perceived Movement Skill Competence, max. = Maximum amount of points (p.), n = Number of children, SD = Standard deviation.

5.4 Living environment: Differences in MC, PMC, time spent outdoors and participation in organised sport

In this section, all the analyses are done with the total scores of the assessment tools and separately for boys and girls. Further information on more detailed differences in the TGMD-3 can be found in publication II. The other assessment tools, KTK and PMSC, and the skills that they measure, were not further studied as the physical living environment seemed to have no differences regarding dependent variables (Table 7).

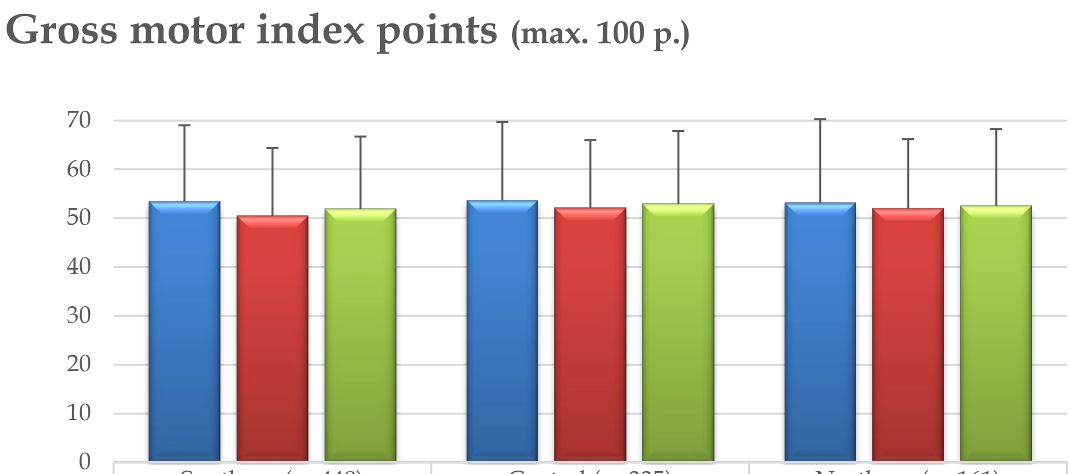
TABLE 7 Characteristics of the living environment with the study sample based on TGMD-3.

Daily environment	**Localities**	**Childcare centres**	**Children (n)**			**% of the study sample**		
Geographic location (°C[1] / h/day[2])	**n**	**n**	**All**	**Girls**	**Boys**	**All**	**Girls**	**Boys**
Southern (-6.6 to +17.7/ 6 to 19)	10	17	449	224	225	47.5	47.4	47.5
Central (-8.1 to +16.8/ 5 to 20)	10	13	335	163	172	35.4	34.5	36.4
Northern (-11.2 to +15.1/ 2.5 to 24)	4	7	161	85	76	17.1	18.1	16.1
Residential density (n/km2)								
Metropolitan (876.4–2,964)	2	6	189	94	95	20.0	19.9	20.0
Cities (24,65–762.9)	13	17	421	211	210	44.5	44.7	44.4
Rural areas (4.93–64.35)	5	7	183	98	85	19.4	20.8	18.0
Countryside (1.49–8.56)	4	7	152	69	83	16.1	14.6	17.5
In total sample	**24**	**37**	**945**	**472**	**473**	**100**	**49.9**	**50.1**

Values are reported as mean (standard deviation) scores or percentages (%).
[1]Mean temperature in February (coldest month) and in July (warmest month).
[2]The amount of daylight in 21st of December (least daylight; winter solstice) and 21st of June (most daylight; summer solstice). TGMD-3 = Test of gross motor development – third version, h = hours, °C = Celsius, km2 = Square kilometre.

5.4.1 Geographical location

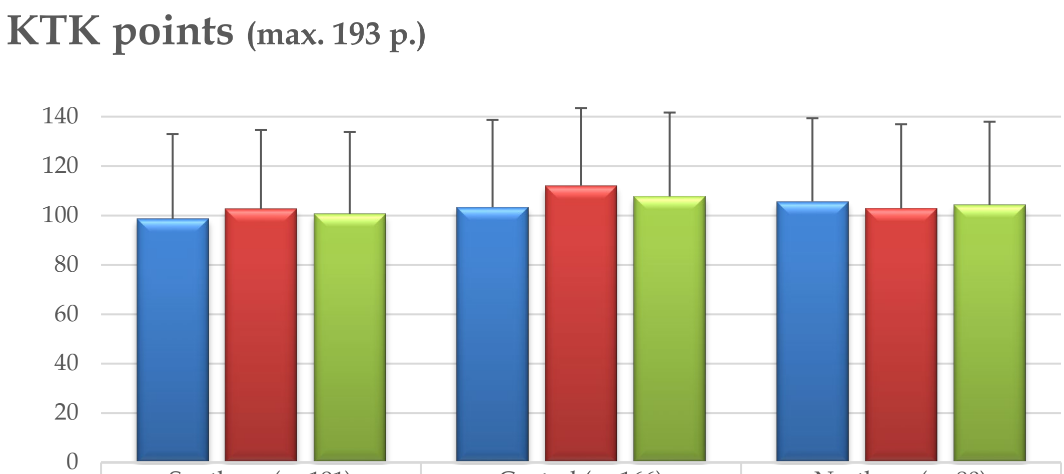
When comparing the TGMD-3 gross motor index between boys and girls in three different geographical locations (Southern, Central and Northern Finland), we found no differences in LM, BS or the TGMD-3 gross motor index (Figure 20) in this study.



	Southern (n=449)	Central (n=335)	Northern (n=161)
Boys	53,42	53,67	53,13
Girls	50,48	52,12	52
All	51,95	52,9	52,57

FIGURE 20 TGMD-3 gross motor index based on geographical location of the residence (n = 945). Mean values adjusted for age in months (points) and SD. TGMD-3 = Test of Gross Motor Development –third version, max. = Maximum amount of points (p.), SD = Standard deviation, n = Number of children.

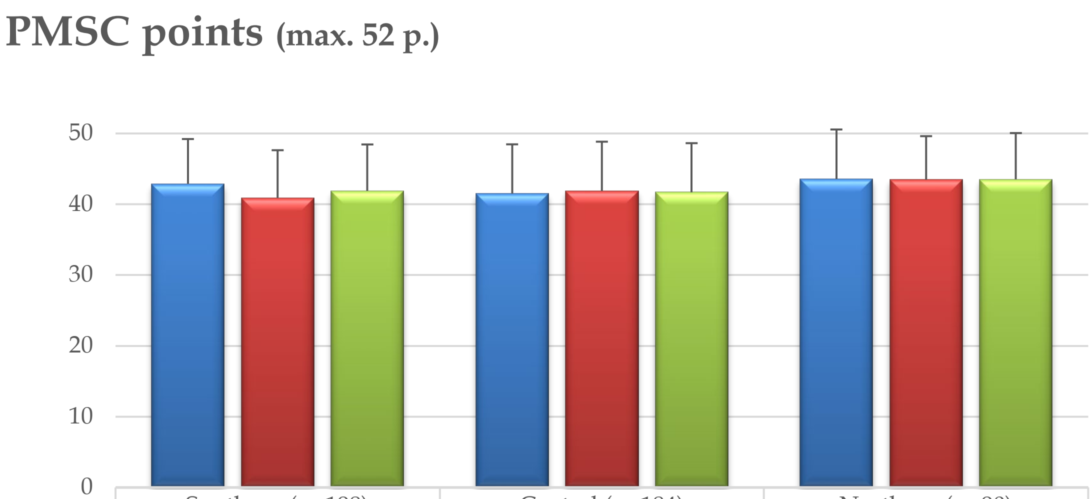
Similarly, no difference was found in the KTK assessment tool concerning geographical locations regardless of the gender of the child. In conclusion, geographical location seems to offer equal opportunities for children to develop their motor skills regardless of the residence locale (Figure 21).



	Southern (n=191)	Central (n=166)	Northern (n=80)
Boys	98,68	103,31	105,66
Girls	102,66	112,09	102,82
All	100,67	107,69	104,24

FIGURE 21 KTK total scores based on geographical location of the residence (n = 437). Mean values adjusted for age in months (points) and SD. KTK = Körperkoordinationstest für Kinder, max. = Maximum amount of points (p.), SD = Standard deviation, n = Number of children.

While investigating differences between three geographical locations in PMC, no differences were found in the PMSC total score regardless of gender (Figure 22).



	Southern (n=198)	Central (n=184)	Northern (n=90)
Boys	42,89	41,51	43,57
Girls	40,89	41,88	43,47
All	41,89	41,69	43,52

FIGURE 22 PMSC total scores based on geographical location of the residence (n = 472). Mean values adjusted for age in months (points) and SD. PMSC = Pictorial Scale of Perceived Movement Skill Competence, max. = Maximum amount of points (p.), SD = Standard deviation, n = Number of children.

Based on geographical location, more differences emerged in the time spent outdoors between boys and girls and in participation in organised sport rather than in MC or PMC. In time spent outdoors, boys from Central Finland spent the most time outdoors (mean 5.53, SD 1.10) and significantly more than boys living in Southern Finland ($p = 0.028$, mean 4.94, SD 1.15). Also, boys from Northern Finland (mean 5.37, SD 1.10) spent more time outdoors than boys from the southern part of the country ($p = 0.031$).

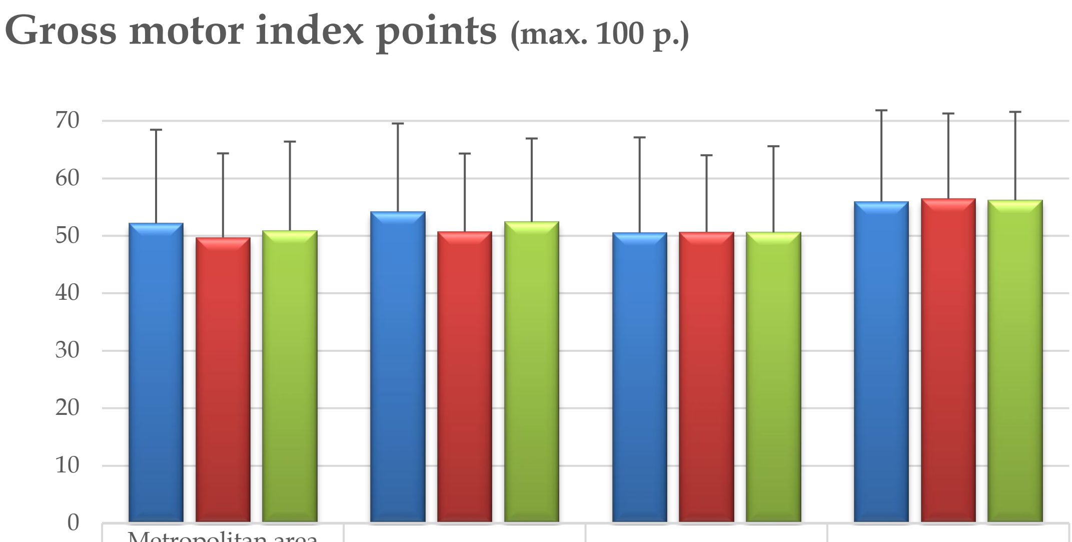
Among girls, the children from Central Finland (mean 5.12, SD 1.24) spent more time outdoors than girls from the southern part of the country ($p = 0.03$, mean 4.83, SD 1.15), while girls from the southern region (mean 56.98 mins/week, SD 63.05) participated more in organised sport than girls from Central Finland ($p = 0.012$, 35.28 mins/week, SD 52.63). For further information, see publication II.

5.4.2 Residential density

Based on residential density, differences were also found between the four residence locales in Finland (metropolitan area, cities, rural areas and countryside) in MC, particularly among girls.

Among boys, those from the countryside outperformed boys from rural areas in LM skills ($p = 0.014$). Boys from the countryside scored higher in BS than boys from the metropolitan area ($p = 0.048$). Boys from the countryside had a higher the TGMD-3 gross motor index than boys from rural areas ($p = 0.030$). To see the mean values and SD, see Figure 23. For further information, see also publication II.

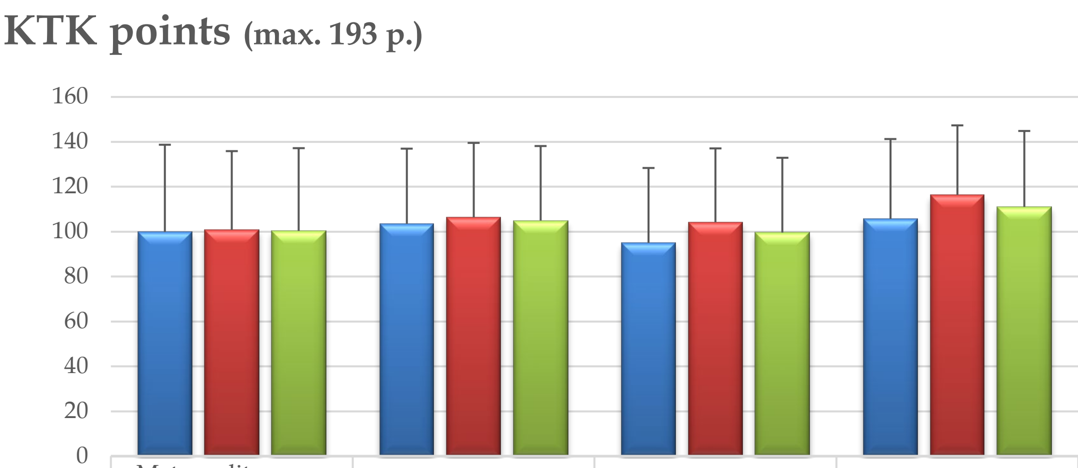
Girls living in the countryside outperformed other girls in LM, BS and the TGMD-3 gross motor index. In LM skills, the differences between girls living in the countryside compared to other categories were as follows: Metropolitan area ($p = 0.05$), cities ($p = 0.025$), and rural areas ($p = 0.015$). In BS, girls living in the countryside outperformed those in the metropolitan area ($p = 0.013$), cities ($p = 0.015$) and rural areas ($p = 0.002$). Finally, in the TGMD-3 gross motor index, girls living in the countryside scored higher as follows: Metropolitan area ($p = 0.011$), cities ($p = 0.010$) and rural areas ($p = 0.024$). Additionally, girls from the metropolitan area had better LM skills than girls from rural areas ($p = 0.025$), while girls from rural areas had better BS ($p = 0.015$) and scored higher in the TGMD-3 gross motor index than girls from the metropolitan area ($p = 0.010$). Mean values and SD are described in Figure 23. For further information, see publication II.



	Metropolitan area (n=189)	Cities (n=421)	Rural areas (n=183)	Countryside (n=152)
Boys	52,13	54,15	50,51	55,95
Girls	49,72	50,67	50,66	56,42
All	50,92	52,41	50,59	56,19

FIGURE 23 TGMD-3 gross motor index based on categorisation with residential density of the place of residence (n = 945). Mean values adjusted for age in months (points) and SD. TGMD-3 = Test of Gross Motor Development –third version, max. = Maximum amount of points (p.), SD = Standard deviation, n = Number of children.

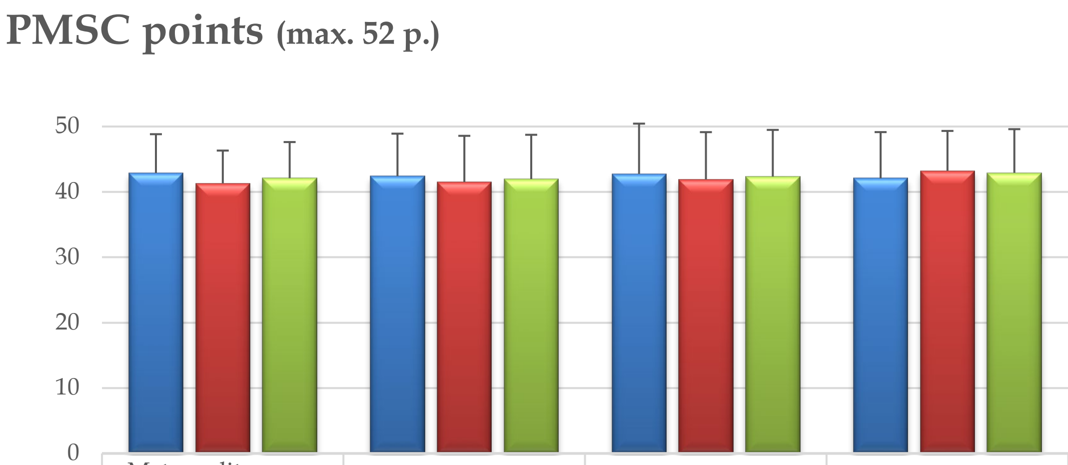
In KTK, based on residential density, differences were found only between girls from the metropolitan area and girls from the countryside. Girls from the countryside outperformed girls from the metropolitan area ($p = 0.041$); however, this difference disappeared ($p = 0.247$) when the results were adjusted for age. No differences were found among boys (Figure 24).



	Metropolitan area (n=72)	Cities (n=212)	Rural areas (n=93)	Countryside (n=60)
Boys	99,87	103,5	94,99	105,7
Girls	100,81	106,38	104,2	116,36
All	100,34	104,94	99,59	111,03

FIGURE 24 KTK total score based on residential density of the place of residence (n = 437). Mean values adjusted for age in months (points) and SD. KTK = Körperkoordinationstest für Kinder, max. = Maximum amount of points (p.), SD = Standard deviation, n = Number of children.

In PMC, no differences were found between residential densities and PMSC total score (Figure 25).



	Metropolitan area (n=75)	Cities (n=223)	Rural areas (n=108)	Countryside (n=66)
Boys	42,89	42,41	42,76	42,07
Girls	41,31	41,51	41,91	43,23
All	42,1	41,96	42,34	42,92

FIGURE 25 PMSC total score based on residential density of the place of residence (n = 472). Mean values adjusted for age in months (points) and SD. PMSC = Pictorial Scale of Perceived Movement Skill Competence, max. = Maximum amount of points (p.), SD = Standard deviation, n = Number of children.

Concerning the differences in time spent outdoors based on residential density, boys from the metropolitan area (mean 4.83, SD 1.17) spent less time outdoors compared to the boys from cities (p = 0.006, mean 5.37, SD 1.09) and the countryside (p = 0.012, mean 5.38, SD 1.07). Additionally, boys living in rural areas (mean 5.16, SD 1.20) spent less time outdoors than boys living in the countryside (p = 0.006).

Among girls, those from the countryside (mean 5.32, SD 1.09) spent more time outdoors than girls from metropolitan (p = 0.011, mean 4.80, SD 1.14) or rural areas (p = 0.010, mean 4.80, SD 1.15). Girls from the metropolitan area participated more in organised sport (65.78 min/week, SD 67.09) than girls from cities (p = 0.030, mean 42.67 min/week, SD 60.61) or rural areas (p = 0.032, mean 41.22 min/week, SD 48.52). Finally, girls from the countryside (mean 52.18 mins/week, SD 59.94) participated more in organised sport than girls from rural areas (p = 0.030). For further information, see publication II.

5.5 Socioecological factors associated with MC and PMC

Possible individual, family and environmental factors associated with the total scores of the two MC assessment tools (TGMD-3 and KTK) and the PMC assessment tool (PMSC) were analysed.

5.5.1 Motor competence

5.5.1.1 TGMD-3

In model 2 (See section 4.7.2), with the TGMD-3 gross motor index as a dependent variable, the child's age (older), participation in organised sport (higher), temperament traits such as activity (higher) and attention span persistence (higher) and PMSC total score (higher) explained 34% of the variance in the TGMD-3 gross motor index (Table 8). Gender was retained in the model even though it was found to be insignificant (see section 4.7.2). In the results, all the remaining factors in the model were individual level factors. Other models examining the TGMD-3 gross motor index with participants between three and seven years old (n = 945), and the level of variance that the models explained, are reported in publication II.

TABLE 8 Socioecological factors associated with children's TGMD-3 gross motor index.

Variables	TGMD-3 gross motor index				
	Model 1 (n = 362)			Model 2 (n = 400)	
Individual factors	Standardised *B* (95% CI)	P	*RE	Standardised *B* (95% CI)	P
Biological factors					
Age (months)	0.04 (0.39; 0.64)	<0.001		0.04 (0.42; 0.65)	<0.001
Gender (1=girls, 2=boys)	0.05 (−0.02; 0.12)	0.18	9#	0.04 (−0.03; 0.10)	0.27
BMI SDS	−0.02 (−0.10; 0.05)	0.58	10		
Temperament					
Sociability	0.04 (−0.04; 0.12)	0.33	5		
Emotionality	−0.05 (−0.13; 0.03)	0.24	6		
Activity	0.09 (0.01; 0.17)	0.02		0.09 (0.03; 0.16)	0.005
Attention span persistence	0.08 (0.00; 0.16)	0.04		0.09 (0.02; 0.15)	0.010
Reaction to food	−0.03 (−0.10; 0.04)	0.45	2		
Soothability	−0.04 (−0.12; 0.04)	0.35	3		
Behavioural factors					
Sedentary time (mins/day)	0.07 (−0.01; 0.14)	0.05	12		
Time spent outdoors (scale from 1 to 7)	0.04 (−0.04; 0.09)	0.33	11		
Participation in organised sport (mins/week)	0.12 (0.05; 0.19)	0.001		0.18 (0.12; 0.24)	<0.001
PMSC (scale from 13 to 52)	0.08 (0.01; 0.15)	0.03		0.08 (0.02; 0.15)	0.015
Family factors					
Parent's mean education level (scale from 1 to 4)	0.07 (−0.01; 0.15)	0.07	8		
Respondent's physical activity (mins/week)	0.02 (−0.07; 0.10)	0.71	1		
Environmental factors					
Electronic devices in use (n)	0.01 (−0.05; 0.08)	0.68	7		
Access to sport facilities (scale from 0 to 44)	0.03 (−0.06; 0.12)	0.56	4		

TGMD-3 = Test of Gross Motor Development –third version, n = Number, 95% CI = Confidence interval, P = p-value, statistically significant difference at the level of P < 0.05. * RE =

Removal order in which explaining variable was deleted from model 1. In the final model (2) only statistically significant factors explaining TGMD-3 gross motor index were left. # = Retained in the model even though insignificant. BMI SDS = Body mass index standard deviation scores, mins = Minutes, PMSC = Pictorial Scale of Perceived Movement Skill Competence.

5.5.1.2 KTK

In model 2 (Table 9), with KTK as a dependent variable, individual factors such as the child's age (older), gender (girls), participation in organised sport (higher), temperament traits such as emotionality (lower), activity (higher) and attention span persistence (higher), and one family factor (higher parental mean educational level) explained 38% of the variance in the KTK total score. The amount of variance explained by the model without including the PMSC total score is reported in publication II.

TABLE 9 Socioecological factors associated with children's KTK total score.

Variables	KTK total score				
	Model 1 (n = 357)			Model 2 (n = 392)	
Individual factors	Standardised *B* (95% CI)	P	*RE	Standardised *B* (95% CI)	P
Biological factors					
Age (months)	0.51 (0.42; 0.59)	<0.001		0.50 (0.41; 0.58)	<0.001
Gender (1=girls, 2=boys)	−0.07 (−0.15; 0.02)	0.11		−0.13 (−0.20; −0.04)	0.002
BMI SDS	−0.05 (−0.13; 0.03)	0.22	9		
Temperament					
Sociability	−0.06 (−0.15; 0.03)	0.17	10		
Emotionality	−0.13 (−0.22; −0.04)	0.05		−0.12 (−0.20; −0.04)	0.003
Activity	0.25 (0.16; 0.34)	<0.001		0.23 (0.15; 0.31)	<0.001
Attention span persistence	0.18 (0.10; 0.27)	<0.001		0.16 (0.08; 0.24)	<0.001
Reaction to food	0.04 (−0.05; 0.12)	0.39	5		
Soothability	0.04 (−0.05; 0.12)	0.42	7		

continues

Table continues

Variables	KTK total score				
	Model 1 (n = 357)			Model 2 (n = 392)	
Individual factors	Standardised *B* (95% CI)	P	*RE	Standardised *B* (95% CI)	P
Behavioural factors					
Time spent outdoors (scale from 1 to 7)	0.01 (−0.09; 0.10)	0.90	2		
Participation in organised sport (mins/week)	0.11 (−0.02; 0.20)	0.02		0.12 (0.04; 0.21)	0.003
PMSC (scale from 13 to 52)	0.04 (−0.05; 0.12)	0.37	8		
Family factors					
Parent's mean education level (scale from 1 to 4)	0.09 (−0.00; 0.17)	0.06		0.09 (0.01; 0.17)	0.030
Respondent's physical activity (mins/week)	-0.00 (−0.08; 0.08)	0.99	1		
Environmental factors					
Electronic devices in use (n)	−0.07 (−0.15; 0.01)	0.09	6		
Access to sport facilities (scale from 0 to 44)	0.02 (−0.08; 0.13)	0.64	4		

KTK = Körperkoordinationstest für Kinder, n = Number, 95% CI = Confidence interval, P = p-value, statistically significant difference at the level of $P < 0.05$. * RE = Removal order in which explaining variable was deleted from model 1. In the final model (2) only statistically significant factors explaining KTK result were left. BMI SDS = Body mass index standard deviation scores, mins = Minutes, PMSC = Pictorial Scale of Perceived Movement Skill Competence.

5.5.2 Perceived motor competence

In model 2, with PMSC as a dependent variable, individual factors such as the child's age (younger), gender, BMI SDS (higher), participation in organised sport (higher) and the TGMD-3 gross motor index (higher) explained 8% of the variance in the PMSC total score. The amount of variance explained in LM skills and BS by similar models are reported in publication III. Age was negatively associated with children's PMC in contrast to MC, and gender was retained in the model even though it was found to be insignificant (see section 4.7.2). Thus, in PMC, the younger the children, the higher they evaluated their actual MC to be (Table 10). Additionally, the variance explained was smaller in the PMC than in the MC assessment tools.

TABLE 10 Socioecological factors associated with children's PMSC total score.

Variables	PMSC total score				
	Model 1 (n = 300)			Model 2 (n = 416)	
	Standardised *B* (95% CI)	P	*RE	Standardised *B* (95% CI)	P
Individual factors					
Biological factors					
Age (months)	−0.19 (−0.30; −0.05)	0.005		−0.21 (−0.28; −0.10)	<0.001
Gender (1=girls, 2=boys)	0.01 (−1.48; 1.64)	0.92	4#	0.01 (−1.08; 1.46)	0.77
BMI SDS	0.19 (0.49; 1.98)	0.001		0.15 (0.40; 1.66)	0.001
Temperament					
Sociability	−0.02 (−0.28; 0.19)	0.72	3		
Emotionality	−0.12 (−0.52; 0.03)	0.08	11		
Activity	0.08 (−0.10; 0.48)	0.20	10		
Attention span persistence	0.04 (−0.20; 0.38)	0.54	6		
Reaction to food	0.05 (−0.10; 0.26)	0.38	7		
Soothability	−0.07 (−0.42; 0.11)	0.26	12		
Behavioural factors					
Sedentary time (mins/day)	0.00 (−0.02; 0.02)	0.97	1		
Time spent outdoors (scale from 1 to 7)	−0.08 (−1.24; 0.24)	0.19	9		
Participation in organised sport (mins/week)	0.10 (−0.00; 0.02)	0.13		0.10 (0.00; 0.02)	0.05
TGMD-3 (scale from 0 to 100)	0.17 (0.02; 0.18)	0.02		0.21 (0.06; 0.18)	<0.001
KTK (scale from 0 to 193)	0.01 (−0.03; 0.03)	0.93	2		
Family factors					
Parent mean education level (scale from 1 to 4)	−0.11 (−1.99; 0.11)	0.08	13		
Respondent's physical activity (mins/week)	−0.04 (−0.05; 0.02)	0.45	5		
Environmental factors					
Electronic devices in use (n)	−0.13 (−1.73; -0.12)	0.02	14		
Access to sport facilities (scale from 0 to 44)	0.10 (−0.03; 0.41)	0.10	8		

PMSC = Pictorial Scale of Perceived Movement Skill Competence, n = Number, 95% CI = Confidence interval, P = p-value, statistically significant difference at the level of P < 0.05.
*RE = Removal order in which explaining variable was deleted from model 1. In the final model (2) only statistically significant factors explaining PMSC were left. # = Retained in the model even though insignificant. BMI SDS = Body mass index standard deviation scores, mins = Minutes, TGMD-3 = Test of gross motor development (third version), KTK = Körperkoordinationstest für Kinder.

5.6 Correlations between MC and PMC with time spent outdoors and participation in organised sport

To examine the correlations between MC and PMC with time spent outdoors and participation in organised sport, the subscales for the TGMD-3 and PMSC subdivided into LM skills, BS and total scores were used. In essence, in MC and PMC, there were more associations with participation in organised sport than with time spent outdoors. In fact, participation in organised sport was positively associated with both MC assessment tools and in PMSC. Time spent outdoors correlated positively with BS and the TGMD-3 gross motor index.

For the total sample, the correlations can be found in Table 11. Further information about correlations between time spent outdoors and participation in organised sport in girls and boys based on living environment (geographical location and residential density of the place of residence) and MC are described in publication II. In the overall sample (n = 894), the correlation between the time spent outdoors and participation in organised sport was p = 0.010 (r = 0.758).

TABLE 11 Correlations in the total sample with the time spent outdoors and participation in organised sport.

	Time spent outdoors			Participation in organised sport		
	Boys	Girls	All	Boys	Girls	All
Actual MC						
LM skills (n = 898)	0.060	0.084	0.048	0.103*	0.180***	0.133***
BS (n = 909)	0.117*	0.141*	0.151***	0.282***	0.133*	0.212***
Gross motor index (n = 894)	0.108*	0.135*	0.127***	0.234***	0.204***	0.226***
KTK total score (n = 410)	0.051	0.122	0.075	0.126	0.262	0.189***
Perceived MC						
PMSC LM skills (n = 446)	-0.131*	0.075	-0.044	0.109	0.124	0.123*
PMSC BS (n = 449)	0.015	0.096	0.063	0.147*	0.100	0.136*
PMSC total score (n = 446)	-0.051	0.092	0.019	0.142*	0.119	0.143*

Values are reported as Pearson correlation coefficient (r-values). MC = Motor competence, LM skills = Locomotor skills, n = Number of children, *statistically significant difference at the level of $P < 0.05$. ***Statistically significant difference at the level of $P \leqslant 0.001$, BS = Ball skills, KTK = Körperkoordinationstest für Kinder, PMSC = Pictorial Scale of Perceived Movement Skill Competence.

5.7 Socioecological factors associated with three profiles of PMC

The three profiles of PMC were analysed as one of the study's aims was to understand more deeply whether there are some socioecological factors that help to prevent the decline in PMC over the years. PMC was measured with children from five to seven years old (mean 6.2 yrs., SD = 0.64). About half of the 441 children were boys (n = 229; 52%). The descriptive statistics of each profile can be found in Table 12 below.

The majority of the children were realistic in their PMC, and more children overestimated than underestimated themselves. The children in the RE profile were likely to be older and to live in denser areas of population. Parents were more likely to report their child to have some health issue if the child belonged to the OE profile. The four most common additional factors possibly influencing development in these children (n = 41/441) were asthma (n = 9; 21.9%), ADHD (n = 6; 14.6%), verbal difficulties in producing or understanding speech (n = 5; 12.2%) or diabetes (n = 3; 7.3%). Finally, parents of children in the UE profile proclaimed the most parental support for PA for their child (Table 13).

TABLE 13 Comparison of the three profiles' differences in perception of motor competence.

Total PMSC	UE vs. RE		RE vs. OE		UE vs. OE	
Individual factors	P	Exp(B) (95% CI)	P	Exp(B) (95% CI)	P	Exp(B) (95% CI)
Gender (1=female, 2=male)	0.84	0.94 (0.51-1.73)	0.08	0.64 (0.38-1.06)	0.17	0.60 (0.29-1.24)
Age (in months)	0.38	0.98 (0.94-1.02)	0.04*	0.97 (0.93-1.00)	0.03*	0.95 (0.90-1.00)
Health issue (parent reported) (0=no, 1=yes)	0.22	0.54 (0.20-1.43)	0.03§	2.33 (1.08-5.03)	0.68	1.25 (0.43-3.69)
Family factors						
Parental support (scale from 0.5 to 7)	0.04#	0.82 (0.68-0.99)	0.81	0.98 (0.83-1.16)	0.06	0.80 (0.64-1.01)
Environmental factors						
Residential intensity (scale from 1 to 4)	0.03¤	0.68 (0.49-0.95)	0.34	1.14 (0.87-1.50)	0.21	0.78 (0.53-1.15)

PMSC = Pictorial Scale of Perceived Movement Skill Competence in young children, UE = Under estimation, vs. = Versus, RE = Realistic estimation, OE = Over estimation, P = p-value, 95% CI = Confidence interval, * Children in the OE profile tended to be the youngest **§** Children in RE profile were likely to have less health issues reported by parents than children in OE profile, # Children in the UE profile tended to receive more parental support for physical activity than children in RE profile, ¤ Children in the RE profile were likely to live in denser areas than those children that belonged to UE profile. Statistically significant difference at the level of P < 0.05.

Table 12. Descriptive statistics of the three profiles of children with different combinations of perceived and actual motor competence.

	Unit of analysis	Under-estimators (n=54; 12.2% girls n=24; 5.4% boys n=30; 6.8%)			Realistic estimators (n=306; 69.4% girls n=143; 32.4%, boys n=163; 37.0%)			Over-estimators (n=81; 18.4% girls n=45; 10.2%, boys n=36; 8.2%)		
Individual factors		Mean (SD)	Mean (SD) girls	Mean (SD) boys	Mean (SD)	Mean (SD) girls	Mean (SD) boys	Mean (SD)	Mean (SD) girls	Mean (SD) boys
Age	months	74.98 (7.50)	77.10 (7.30)	78.49 (6.85)	75.04 (7.75)	75.70 (7.61)	74.48 (7.21)	72.77 (7.01)	70.16 (7.17)	71.39 (6.84)
BMI SDS	z-score	0.11 (1.07)	-0.85 (1.22)	0.075 (1.05)	0.16 (1.03)	0.14 (1.09)	0.16 (0.90)	0.25 (0.96)	0.48 (1.07)	0.22 (0.86)
Child's independent walking	at months	12.21 (2.14)	11.88 (2.07)	11.85 (1.77)	12.03 (1.91)	12.16 (2.14)	12.11 (1.87)	12.53 (2.15)	12.28 (1.93)	12.42 (2.09)
Sedentary behavior	mins/d	81.65 (61.19)	79.40 (48.50)	104.29 (65.17)	89.75 (46.73)	89.21 (50.48)	85.79 (42.39)	89.03 (42.13)	87.97 (38.67)	83.57 (37.55)
Time spent outdoors	from 2 to 7	5.46 (1.02)	5.21 (0.98)	5.60 (0.99)	5.27 (1.18)*	5.15 (1.23)	5.38 (1.20)	4.95 (1.27)	4.90 (1.25)	5.02 (1.22)
Participation in organised sports	mins/wk	76.54 (91.57)	62.85 (79.78)	84.70 (88.15)	62.93 (75.55)	59.92 (69.69)	69.66 (86.32)	50.00 (49.07)	49.06 (44.81)	43.63 (51.08)
PMSC LM skills	from 6 to 24	17.17 (3.85)	17.57 (3.34)	17.36 (3.57)	19.90 (2.73)	20.05 (2.60)	19.56 (2.59)	22.06 (2.91)	22.51 (2.40)	21.98 (2.83)
PMSC Ball skills	from 7 to 28	18.15 (5.58)	17.63 (4.53)	20.74 (4.68)	21.95 (3.49)***	20.93 (3.53)	22.22 (3.57)	25.49 (3.65)	25.71 (3.33)	25.25 (3.52)
PMSC total	from 13 to 52	35.31 (8.66)	35.20 (7.14)	38.09 (7.10)	41.85 (5.21)*	40.98 (5.16)	41.78 (5.41)	47.56 (6.13)	48.22 (5.32)	47.24 (5.80)
TGMD-3 LM skills	from 0 to 46	33.56 (6.40)*	36.73 (3.98)	33.96 (5.14)	31.13 (5.65) ***	32.53 (4.65)	28.95 (5.74)	26.74 (6.75)*	28.18 (6.07)	25.58 (6.87)

continues

Table continues

TGMD-3 Ball skills	from 0 to 54	33.57 (9.06)	32.53 (7.85)	37.57 (7.21)	29.37 (7.21)***	26.37 (5.33)	31.22 (6.74)	23.86 (7.64)	21.67 (6.32)	26.15 (8.16)
TGMD-3 gross motor index	from 0 to 100	67.13 (13.40)	69.27 (10.13)	71.53 (11.05)	60.50 (10.05)**	58.89 (8.06)	60.17 (10.03)	50.60 (12.55)	49.86 (10.29)	51.73 (12.71)
Parent's reported child health issue	0=no, 1=yes	0.11 (0.32)	0.30 (0.19)	0.08 (0.27)	0.08 (0.27)*	0.04 (0.19)	0.10 (0.31)	0.15 (0.36)	0.10 (0.31)	0.24 (0.43)
Family factors										
Parent mean education level[1]	from 1 to 4	2.63 (0.82)	2.66 (0.72)	2.76 (0.82)	2.68 (0.73)	2.70 (0.74)	2.70 (0.77)	2.70 (0.84)	2.60 (0.78)	2.59 (0.75)
Respondent's physical activity frequency	from 1 to 4	3.00 (0.97)	3.21 (0.77)	2.89 (0.97)	2.81 (1.07)	2.85 (0.97)	2.77 (1.17)	2.68 (1.01)	2.38 (1.00)	2.86 (1.10)
Respondent's sedentary behavior	mins/d	306.75 (170.32)	347.73 (175.58)	322.50 (159.29)	323.15 (162.23)	348.19 (175.61)	300.63 (145.92)	323.81 (184.63)	317.56 (193.72)	286.50 (160.19)
Physical activity parenting	from 0.5 to 7	3.57 (1.57)	3.45 (1.51)	3.06 (1.51)	3.10 (1.58)	3.14 (1.58)	3.40 (1.66)	3.05 (1.38)	2.74 (1.24)	2.97 (1.50)
Shared family physical activities	from 1 to 5	3.02 (1.15)	2.86 (0.99)	2.66 (1.11)	2.83 (1.17)	2.84 (1.09)	3.06 (1.30)	2.74 (1.14)	2.59 (1.15)	2.75 (1.14)
Environmental factors										
Electronic devices in use	number of devices	0.71 (1.06)	0.69 (0.81)	0.96 (1.23)	0.72 (1.05)	0.58 (0.96)	0.77 (1.12)	0.48 (0.75)	0.53 (0.71)	0.58 (0.95)
Residential density	from 1 to 4	2.61 (0.94)	2.63 (0.96)	2.38 (0.86)	2.30 (0.90)	2.25 (0.87)	2.26 (0.90)	2.43 (0.96)	2.49 (0.94)	2.58 (1.02)

n = Number, % = Percent, SD = Standard deviation, BMI SDS = Body mass index standard deviation scores, mins. = Minutes, d. = Day, wk. = Week, PMSC= Pictorial Scale of Perceived Movement Skill Competence, LM skills = Locomotor skills, TGMD-3 =Test of Gross Motor Development –third edition, Residential density = 1) metropolitan area, 2) city, 3) rural area, or 4) countryside. Statistically significant difference between girls and boys, the level of significance at * p<0.05, **p<0.01 ***p<0.001

6 DISCUSSION

There has been a call to build an evidence base for different conceptual frameworks (Hulteen et al. 2018; Stodden et al. 2008) that predict children's MC and PMC and the correlates that are associated with MC and PMC. A good conceptual framework is essential as it helps in understanding more deeply the underlying mechanisms of MC and PMC related to the physically active lifestyle of young children. Consequently, the aims of this study were, on one hand, to examine MC and PMC in children who attend organised care at childcare centres in different regions (provicens) in Finland. Moreover, differences between age and gender as well as the living environment (i.e. geographical location and residential density) in children's MC, PMC, time spent outdoors and participation in organised sport were examined. On the other hand, the socioecological factors associated with MC and PMC were investigated as well as the association between MC and PMC with time spent outdoors and participation in organised sport. Finally, three profiles based on the accuracy of the PMC were created, and their associations with socioecological factors were examined. These methodological investigations were aimed at contributing to an understanding of developmentally important interactions between MC and PMC and for gaining insight into how socioecological factors can be associated with the development of MC and PMC.

6.1 Motor competence and perceived motor competence in different regions of Finland

When examining the MC and PMC in Finnish children attending childcare, some differences were found between the different regions of Finland in MC measured with the TGMD-3 (publication II). However, no differences were found in MC measured with KTK or in the PMC of the children. More particularly, the PMSC results indicated high levels of PMC in young children across Finland (publication III).

In the current thesis, PMC was generally high, which supports previous investigations (Brian et al. 2018; LeGear et al. 2012; Lopes, Barnett, & Rodrigues 2016; Lopes et al. 2018; Pönkkö 1999). Only one study has reported low perceptions of physical competence in children, which pertained specifically to families of low socio-economic background in the US (Robinson 2011). Past and current investigations have shown that young children possess naturally inflated PMC, lacking accuracy in regard to the actual MC level (De Meester et al. 2018; Hall et al. 2019; Lopes, Barnett, & Rodrigues 2016; Lopes et al. 2018; Pönkkö 1999; Spessato, Gabbard, Robinson, et al. 2013; True et al. 2017) even though some studies have already stated that accuracy between actual and perceived MC may be at least partly found (Duncan et al. 2018; LeGear et al. 2012; Robinson 2011). Yet, according to De Meester et al. (2020) in their profound analysis, age was not associated with the accuracy of the relationship between actual MC and PMC.

According to the previous literature, this inflated PMC is based on young children's limited cognitive ability to evaluate their mastery (Harter & Pike 1984; Harter 1999) or due to the sources of information the young children tend to prefer (e.g. task mastery, effort and parental feedback) (Weiss & Amorose 2005) when evaluating their competences. Nevertheless, the high levels of PMC work in favour of children as these have the propensity to motivate and excite children to be more physically active. This positive spiral of engagement can lead to increased PA and, subsequently, enhanced mastery of MC, supporting HRF and healthy body composition and, hopefully, strengthening relationships between these factors as a function of time (Hulteen et al. 2018; Robinson et al. 2015; Stodden et al. 2008).

6.1.1 Age and gender differences

Age and gender seem to be crucial in MC and PMC. However, in MC based on the age of the child, the level of MC seems to increase, while in PMC the level of PMC decreases as a function of age. Nevertheless, the accuracy of PMC approximates more closely to the actual MC level due to the older age of the child, which can be an important developmental phase of the PMC.

Regarding MC, older children have better MC based on both assessment tools (publication I). In line with previous studies, it was evident that age is a strong predictor of MC in children, affirming the role of age in MC (Barnett, Lai, et al. 2016; Gallahue et al. 2012; Iivonen & Sääkslahti 2014; Logan et al. 2015; Robinson et al. 2015; Stodden et al. 2008). This increase in MC in children aged three to seven years can be explained by the rapid biological development during these early years (Venetsanou & Kambas 2011), wherein the high plasticity of the nervous system contributes to a major improvement in coordination (Adolph & Franchak 2017; Malina et al. 2004). However, children do not develop MC solely through maturational processes as coordinative movements need to be learned, practised and reinforced (Gallahue et al. 2012; Logan et al. 2012; Malina et al. 2004). Therefore, the maturation process alone is insufficient to gain age-appropriate MC, which requires the practice of specific motor skills.

Motor development involves the acquisition and refinement of basic patterns via repetition (Gallahue & Donnelly 2003; Malina et al. 2004), and these basic movement patterns form the foundation of the more specialised and complex skills that a child will achieve later in life (Gallahue & Donnelly 2003; Hulteen et al. 2018; Malina et al. 2004). The mastery of MC is a prerequisite for daily functioning and participation in physical or sport-specific activities later in life (Cools et al. 2009; Gallahue et al. 2012). Moreover, MC contributes to a balanced caloric intake, and contrarily, overweight children often have lower MC (Okely, Booth, & Chey 2004; Slotte et al. 2015). Therefore, PA plays a major role in providing these opportunities for repetition in children. Consequently, as a function of age, children have opportunities to gain these PA experiences.

To achieve these possibilities for increased PA, attention to cities and societies' construction is necessary so that children are afforded possibilities to move safely. For practitioners, teachers, parents and early educators, the ability to provide enough PA for children requires questioning regulations concerning children and whether some limitations can be transformed into possibilities. As the Finnish recommendations for young children's PA (Varhaisvuosien fyysisen aktiivisuuden suositukset [Recommendations for physical activity in early childhood] 2016) mentioned, to promote children's PA, whole communities must be engaged. Therefore, on one hand, future international PA guidelines should include not only recommendations for PA but also specific recommendations for developing MC (Lopes 2021). Indeed, more research on children's PA and MC is warranted. On the other hand, everyone must question whether they themselves currently allow children's movement in real life. Only by collaborating at different levels – firstly, nationally and globally, secondly, through recommendations based on recent studies, and thirdly, by practising theories in everyday life – may we overcome the problem of increased sedentary behaviour across societies by providing sufficient PA for everyone.

A slight decline in PMC levels was observed as a function of age. Nevertheless, this decline in cross-sectional data was not statistically significant (see also publications III and IV). This finding aligns with previous theories (Harter 1999; Stodden et al. 2008; Weiss & Amorose 2005) and studies (Babic et al. 2014; True et al. 2017) stating that declines in PMC start after seven years of age. Importantly, even though there is a decline in the level of PMC, there is an increase in the accuracy of the PMC. This is due to the cognitive development that is enabled after seven years of age, entailing an understanding of more abstract concepts as well as comparison and evaluation. Also, there is a change in the sources the children prefer to use in evaluations of their competence in each task; they start to value more peer evaluation and comparison. This increased accuracy, and decline of the level of PMC, has an important developmental meaning for the child as it protects children from expectations that are too high and the risk of failure (Harter 1982). In summary, the development of PMC is closely related to cognitive capacity, age and the sources of information the child uses when evaluating their actual MC level. Within the development, the level of accuracy increases, while the level of PMC decreases.

However, a recent systematic review and meta-analysis (De Meester et al. 2020) found that age does not moderate the relationship between actual MC and PMC. Indeed, while previous studies have noted that – overall – PMC decreases with age, nothing that this assumption was not adequately tested from an individual development in longitudinal perspective. However, empirical approach is simultaneously important; as such, this assumption did not include longitudinal evidence supported by actual MC assessments. Since the literature in this area has generally used a cross-sectional studies that use for example regression to the mean, it has shown a decrease in mean PMC across ages, supporting previous frameworks' assumptions (Harter 1999; Stodden et al. 2008; Weiss & Amorose 2005). However, since the research related to PMC and its accuracy concerns a rather novel topic, in the future, more longitudinal research is needed to determine whether the assumption about age predicting PMC is due to the assessment tools and data used in the past. Future research needs to better understand what percentage of children experience decreased PMC over time.

There were also gender differences found in MC and PMC. In MC, more specifically, in LM skills, girls outperformed boys, and in BS boys were better than girls. Previous studies suggest that, in general, girls tend to be better in LM skills (Hardy et al. 2010; LeGear et al. 2012; Tietjens et al. 2020) and boys better in BS (Barnett, Lai, et al. 2016; Hardy et al. 2010; Iivonen & Sääkslahti 2014; LeGear et al. 2012; Spessato, Gabbard, Valentini, et al. 2013; Tietjens et al. 2020) although a previous systematic review has found no gender differences in LM skills (Barnett, Lai, et al. 2016). These differences in LM skills and BS between the genders can be a reflection of the different content of the hobbies (Barnett et al. 2013; Spessato, Gabbard, Valentini, et al. 2013; Tietjens et al. 2020; Westendorp et al. 2014) as girls participate more in organised sport involving LM skills, such as dance (Barnett et al. 2013), while boys engage more in hobbies that include mastery of BS (Tietjens et al. 2020; Westendorp et al. 2014). Some researchers suggest that environmental and sociocultural factors may be the reason for gender differences in children's BS (Eather et al. 2018; Iivonen & Sääkslahti 2014), explaining the boys' better performance in BS. Nevertheless, regarding the TGMD-3 gross motor index, the findings of present thesis are less evident as the difference between girls and boys in the total score of TGMD-3 is minor than in subcatogires of LM skills and BS.

In the overall sample, boys outperformed girls in the TGMD-3 gross motor index. Several studies concur with our findings that boys have a better gross motor index than girls (Barnett, Lai, et al. 2016; Spessato, Gabbard, Valentini, et al. 2013). In contrast, some studies have proclaimed that the gender differences may disappear upon unifying LM skills and BS into a gross motor index (Hardy et al. 2010; LeGear et al. 2012). This was also found in the current thesis as in the gross motor index, the difference was smaller between the genders. Furthermore, the results of the current thesis indicate that because boys had higher BS scores than girls, boys may benefit from such unification in the TGMD-3 gross motor index (100 points), as BS (54 points) can offer more points than LM skills (46 points). Therefore, it can be questioned whether there is a significant difference between the genders in the TGMD-3 gross motor index or whether the result is only a reflection of the unbalanced scoring systems between LM skills and BS.

In KTK, no gender differences were found with a t-test. When looking at the effect of gender in the regression models, there was a gender difference in KTK in model 2. The results showed that being a girl was a positive predictor of a higher KTK total score. Previous studies (Krombholz 2006; Venetsanou & Kambas 2011) on balance and body coordination skills during early childhood revealed similar gender differences in some balance skills. However, the effect sizes were small in the current research and in the other studies (Krombholz 2006; Venetsanou & Kambas 2011). Therefore, it is suggested that although gender (being a girl) can positively predict the total KTK score in model 2, the effect size was rather small; thus, greater gender differences were found in the TGMD-3 than in KTK. Thus, both genders seem to have MC strengths, and the differences between the genders are smaller in the total scores of the TGMD-3 and KTK than in the subscales of the assessments.

These gender differences during early childhood are not based on biological factors (Gallahue et al. 2012); rather, the differences seem to be more related to family and environmental and sociocultural contexts (Eather et al. 2018; Iivonen & Sääkslahti 2014; Krombholz 2006; Spessato, Gabbard, Valentini, et al. 2013). Moreover, girls tend to behave differently than boys (Blatchford et al. 2003; Garcia 1994), starting from the situations in which motor skills are learned. Garcia (1994) found that girls interacted in a cooperative, caring and sharing manner, while boys tended to interact in a competitive, individualised and more egocentric manner when learning new motor skills. Moreover, genders tried to maintain the interaction style even when dealing with the opposite gender (Garcia 1994). Thus, questioning whether these behavioural differences in learning new motor skills may, in the long term, be associated with differences between the genders in actual and perceived MC is worthwhile. For example, in actual and perceived BS and ball games, boys may – based on these results (Blatchford et al. 2003; Garcia 1994) – be more eager to participate and not hesitate to 'fight for the ball'. On the contrary, girls may want to 'give the ball away', leading to fewer possibilities to practise BS with other children. Previous studies have also shown that gender differences may become more evident if children do not participate in organised sport (Queiroz et al. 2014) or have lower MC (Laukkanen et al. 2019). In fact, Laukkanen et al. (2019) found smaller gender differences in nationalities that have higher MC regardless of gender. Therefore, several studies have questioned whether the differences in MC may cease to exist in children aged under eight years if girls are provided equivalent opportunities to practice sport (Okely, Booth, & Chey 2004; Queiroz et al. 2014).

In PMC, girls were better in perceived LM skills, while boys were better in perceived BS. Similar to our findings, several studies (Afthentopoulou et al. 2018; Carcamo-Oyarzun et al. 2020; Estevan, Molina-Garcìa, Abbott et al. 2018; Slykerman et al. 2016; Tietjens et al. 2020) have found that boys outperform girls in evaluations of their BS but, in contrast to the findings of the current thesis, not in their evaluations of LM skills. In line with the current thesis, in a study by

LeGear et al. (2012), girls had a higher level of perceived LM skills. However, other similar studies reported associations with gender differences only for total PMC and did not separate perceptions of LM skills from those of BS. Among those studies, some reported higher total PMC in boys (Duncan et al. 2018; Slykerman et al. 2016) and in girls (LeGear et al. 2012) as well as a lack of gender differences (Lopes, Barnett, & Rodrigues 2016).

Interestingly, a recent systematic review and meta-analysis that investigated the strength of associations between MC and PMC/physical self-perception among children, adolescents and young adults between three to 24 years old found no statistically significant gender differences (De Meester et al. 2020). First, the authors questioned whether this result may have been due to methodological issues. More precisely, some of the studies included in the systematic review used MC tests' raw scores while other studies used standardised MC scores, adjusted for specific children's gender. Second, several included studies that used gender-specific assessments were in concurrence with the current thesis' assessment (PMSC), while other studies used unisex assessments to measure participants' PMC (De Meester et al. 2020). Therefore, future research must overcome these methodological challenges to better understand the gender differences in PMC among children, adolescents and adults. Nonetheless, based on the current thesis's results, although the participants were young, their actual MC seemed to be somewhat accurately evaluated, on average, since girls had higher actual and perceived LM skills while boys had better BS. Thus, in MC and PMC, there were some sort of gender differences, however, these differences were more evident if LM skills and BS were considered separately.

6.1.2 Associations between physical living environment

Based on living environment, residential density seems to be more important than geographical location concerning MC. Based on geographical location, differences emerged in the time spent outdoors between boys and girls and in participation in organised sport (in girls) rather than in MC or PMC. Based on residential density, some differences were found in the TGMD-3 gross motor index as children from the countryside outperformed children from other regions. Additionally, they spent the most time outdoors. Children living in the metropolitan area participated the most in organised sport.

Concerning geographical location, no differences emerged in MC or PMC in children. This result may reflect the national curriculum of early education (Varhaiskasvatussuunnitelman perusteet [National Core Curriculum of Early Childhood Education and Care] 2018), which covers the whole nation and supports equal educational actions and recommendations for PA (Varhaisvuosien fyysisen aktiivisuuden suositukset [Recommendations for physical activity in early childhood] 2016) for all children in early education. Furthermore, Finnish children can move around quite freely and independently (Kyttä 1997) due to the right of common access to the environment and its affordances. Therefore, it may be that Finnish children have equal opportunities to develop MC and PMC regardless of geographical location.

Interestingly, regarding time spent outdoors, the children from Central Finland spent the most time outdoors and significantly more than boys and girls living in the Southern Finland. Also, the boys from Northern Finland spent more time outdoors than boys from the southern part of the country. Thus, the geographic characteristics of Southern Finland (the longest daylight period during the winter with the least cold winter temperature) are not advantageous in terms of the time children spent outdoors. Interestingly, some previous studies have shown an inverse association between temperature and PA levels (Atkin et al. 2016; Carson & Spence 2010; Fisher et al. 2015), but the findings with regard to younger children (less than eight years) are inconsistent (Carson & Spence 2010).

In the Finnish context with children three years old, Soini et al. (2014) found that seasons only minimally influence children's PA levels and that other factors (e.g. gender, educational support by parents and teachers) are more significant correlates of PA and motor development in children. As girls from the southern region participated more in organised sport than girls from Central Finland, it can be assumed that differences in time spent outdoors may reflect differences in manner of spending free time. Moreover, in the southern part of the Finland, in many places, there is higher residential density, which can cause a lack of space and safety (Krahnstoever Davison & Lawson 2006; Kyttä, Broberg, & Kahila 2009) for children to move freely outdoors. Thus, in densely populated areas, parents may exert more control or restrictions over their children's time spent outdoors.

Based on residential density, the children from the countryside (with the lowest residential density) had better MC and spent larger amounts of time outdoors than their peers from the metropolitan area (with the highest residential density), especially among girls. As PA and motor development are associated with each other (Hulteen et al. 2018; Robinson et al. 2015; Stodden et al. 2008), the possibility to move freely in less densely populated areas in everyday life may be associated with better MC or more time spent outdoors, as demonstrated by our sample. Children prefer versatile environments near home (Kyttä et al. 2009) that provide large, safe spaces with natural elements that encourage the development of LM skills, BS and balance skills. In line with the theory of affordances (Gibson 1977), it seems that the more variation the environment and affordances provide, the more possibilities the child may have for divergent motor learning. Thus, the result is two-fold: Firstly, the variety of living environments may be greater in less dense areas, which explains why children from the countryside display more advanced MC and, secondly, tend to spend more time outdoors.

Nevertheless, internationally speaking, Kyttä (1997) stated that Finnish children have more freedom than their peers from Western Europe and that less dense areas may provide better possibilities for independent mobility. This suggests that for Finnish children, the freedom of independent mobility increases the pleasure derived from PA. In fact, in a study by Laukkanen et al. (2019), Finnish children had good MC compared to peers from Portugal and Belgium.

Finally, girls from the metropolitan area participated more in organised sport than girls from cities or rural areas. The greater density may enable more participation opportunities for children. Nevertheless, it is not easily explainable why these differences were found only for girls and not for boys. It may be that as boys prefer engaging more in group activities, parents do not start as early engaging boys in hobbies as with girls. According to some researchers (Blatchford et al. 2003), boys are more social and significantly more likely to be involved in ball games, while girls are more likely to play in smaller groups, involving more conversation, sedentary play, jump-skipping and verbal games. Therefore, it may be that parents are more eager to support girls' PA and participation in organised sport to prevent a lack of PA. Also, the content of the sport participation may vary. In early childhood, it may be that there are more available hobbies including dance and LM skills and that only later are ball games offered due to the more complex motor skills required in ball games.

Surprisingly, no regional differences were found in KTK or PMSC based on living environment. In PMSC, the result may be easier to understand as it is common that young children in general have inflated PMC (Brian et al. 2018; LeGear et al. 2012; Lopes et al. 2018), and therefore, there may be lack of diversity in the levels of PMC. Nevertheless, it is interesting that KTK did not present any differences even though the TGMD-3 did. One reason for this result could be that the assessment tools are different in their contents and roles in identifying, diagnosing and evaluating motor difficulties in childhood (Cools et al. 2009; Griffiths et al. 2018) and that they measure different aspects of MC (Cools et al. 2009; Khodaverdi et al. 2020; Logan et al. 2018; Lopes et al. 2021; Xin et al. 2020). In fact, in the current thesis, the TGMD-3 focuses on sport-specific aspects of MC, such as LM skills and BS, while KTK represents more the body coordination and balance skills of the child. Consequently, these differences in assessment tools may explain the different findings of MC in the thesis.

Thus, since both MC and PMC were positively associated with participation in sport, future societies and policies should provide equal opportunities for all children to participate in sport-related hobbies – regardless of their families' SES. Secondly, since time spent outdoors was important for developing certain MC aspects, adults must offer sufficient space, time and possibilities for safe outdoor movement near their homes so that children get enough PA, helping them gain better MC and – possibly – better PMC.

6.2 Factors associated with MC and PMC

To be able to understand more deeply MC and PMC in young children, one must take into account the individual, family and environmental factors that may, on one hand, offer different opportunities for PA experiences and, on the other hand, directly or indirectly affect children's possibilities for MC and PMC development (Barnett, Lai, et al. 2016; Iivonen & Sääkslahti 2014; Laukkanen et al. 2019; Lubans et al. 2010). Therefore, in this thesis, a socioecological model was applied to provide a framework for factors possibly influencing MC and PMC in children.

As a result of including socioecological variables, individual factors, such as biological (e.g. age, gender, temperament traits) and behavioural factors (e.g. participation in organised sport), were mostly associated with MC and PMC. However, there were some differences in the results depending on the MC assessment tool used. In general, the MC and PMC results were influenced in different ways depending on the particular socioecological measures.

6.2.1 Socioecological factors

Regarding socioecological factors, MC was positively associated with age (see section 5.2.1), participation in organised sport and temperament traits such as activity and attention span persistence. Regarding PMC, younger age (see section 5.2.2) and higher levels of BMI SDS, participation in organised sport and the TGMD-3 gross motor index were associated with better PMSC. In the final models of the MC and PMC, the variance explaining the dependent variable differed in the TGMD-3 by 34%, in KTK by 38% and in PMSC by 8%.

The most strongly associated biological factors with MC and PMC were the child's age (section 5.2) and gender (section 5.3). These factors are considered in more detail in section 6.1. Additionally, in contrast to previous studies, there was a positive association between PMC and higher BMI SDS. No association between MC and BMI SDS was found. This is rather interesting as it goes against several theoretical assumptions (Hulteen et al. 2018; Robinson et al. 2015; Stodden et al. 2008) and studies stating that higher BMI or body weight should increase the risk of low MC (Cairney et al. 2010; Cantell et al. 2008; D'Hondt et al. 2013; D'Hondt et al. 2014; Slotte et al. 2015) or low PMC (Jones et al. 2010; Spessato, Gabbard, Robinson, et al. 2013). Thus, it is surprising that, firstly, no association was found between MC and BMI SDS and, secondly, that there was a positive association between PMC and BMI SDS; nevertheless, it was the opposite from that which the conceptual framework suggest. There may be several reasons for this interesting finding.

Concerning the participants of the study, most of them were normal weighted (73%), while 19% were categorised as overweight and 4% as obese. Based on the report by the Finnish Institute for Health and Welfare [Terveyden ja hyvinvoinnin laitos (THL)], in Finland, approximately 25% of boys and 15% of girls are either overweight or obese before starting school, at the age of seven. Boys are more often obese than girls (Lundqvist & Jääskeläinen 2019). The current data, thus, is highly similar to national BMI trends. Nevertheless, the data may include more families, children and parents that have positively elevated attitudes towards PA. Moreover, higher BMI SDS may reflect early maturation and bodily capacity rather than issues with (over)weight or (in)activity, as reflected in the thesis by Sääkslahti (2005). In fact, bodily capacity may bring along greater peer support, admiration and acceptance, which could, on one hand, explain higher PMC in children with higher BMI SDS and, on the other hand, explain why no association between BMI SDS and MC was found.

Furthermore, in relation to PMC, in the study by Spessato, Gabbard, Robinson, et al. (2013), 15% of the children were classified as obese, while in our study, only less than 4% of children were thus classified. The difference in the number of obese children might partly explain the results as the number of overweight children (19%) was similar in these two studies. To conclude, further research is recommended to understand the relationship in children under eight years old and those over eight years old in MC and PMC, at least in Finnish children.

Other biological factors associated with MC, but not PMC, were temperament traits such as activity and attention span persistence. These traits were found to be positively associated with MC using both motor assessment tools. This is a rather novel result as the association between MC and temperament during early childhood has not yet been widely examined. Temperament is rather stable (Rowe & Plomin 1977; Zentner & Bates 2008) over time; thus, children who tend to have an active type of temperament as well as children who show persistency when faced with challenges can be motivated and persistent in learning and rehearsing motor tasks. Interestingly, a recent study by Laukkanen et al. (2018) demonstrated that children with an agreeable temperament (referring to a factor created from the total scores for sociability, activity and attention span persistence) tended to have more parental support for PA. Accordingly, there is evidence that a lack of fit between a child’s temperamental characteristics and parents’ responses (Zentner & Bates 2008) can influence the overall development of the child. Since the parent–child relationship is bidirectional, the child’s behaviour also influences parenting (Sleddens, Gubbels, Kremers, van der Plas, & Thijs 2017). It can be questioned whether some children benefit from temperament traits such as activity and attention span persistence not only in terms of motor development but also in terms of the amount of parental support received for PA.

Additionally, children who were more emotionally regulated had a better KTK total score. This may also mean that during early childhood, as is consistently found in exercise psychology (e.g. the role of emotions), regulating one’s effort control and distractibility during motor performance (Zentner & Bates 2008) may help maintain focus. Thus, temperament can be associated with motor development both directly and indirectly. Interestingly, no such associations were found with PMC. Moreover, only 8% of the variance affecting a child’s PMC could be explained; therefore, it is safe to say that we know more about MC rather than PMC and its associated factors with young children’s motor development.

Regarding the behavioural factors, two correlates had positive association with MC (participation in organised sport and PMC) and with PMC (participation in organised sport and MC). Participation in organised sport is considered in section 6.2.2 more closely. Interestingly, the evaluations of actual MC and PMC were associated positively with the process-oriented measure (TGMD-3) but not measured with the product-oriented measure (KTK). The fact that the PMC test items of the present study (e.g. run, gallop and hop) matched the TGMD-3 but not the KTK items (e.g. walking backwards on balance beams) may explain this result.

In previous studies, Duncan et al. (2018) used both product- and process-oriented measures and found an association between perceived and actual MC in four to seven years old children, whereas True et al. (2017) found no such association in four to five and seven to eight years old children. Even though True et al. (2017) used product- and process-oriented assessment tools, the assessments were not aligned, so there was no match between actual and perceived MC, unlike in Duncan et al. (2018) study. This difference in the assessment tools' alignment may explain the different findings of True et al. (2017) and Duncan et al. (2018). Additionally, other studies have used an aligned process-oriented measure between perceived and actual MC though lacking a product-oriented measure (Barnett, Ridgers, & Salmon 2015; Brian et al. 2018; Liong et al. 2015). These studies found associations between perceived and actual BS in boys (Liong et al. 2015) or in both genders (Barnett, Ridgers, & Salmon 2015; Brian et al. 2018). No associations were found between perceived and actual LM skills. Thus, the alignment of PMC and actual MC assessment tools seems to require consideration when reporting the studies' results.

Interestingly, however, a recent systematic review and meta-analysis investigating the relationship between actual MC and PMC revoked this assumption. Indeed, De Meester et al. (2020) found a positive association between actual MC and PMC/physical self-perception; nevertheless, the strength of this association was generally low, and it was not associated with assessment tools' alignment between actual and perceived MC (De Meester et al. 2020). Again, De Meester et al. (2020) found the relationship not to be moderated by either gender or age. The reasons for this outcome may be, according to the authors, related to age; the study involved a lack of older participants since 60% of its participants were under 12 years of age. Therefore, the authors wonder whether this result pertained to the findings' outcome (De Meester et al. 2020). Indeed, future research must untangle these slightly contradictory findings by searching, for example, for novel methods to overcome past studies' challenges. In any case, based on the majority of the past literature and the results of the current thesis, even for young children, an association is suggested between perceived and actual MC – firstly, if aligned assessment tools are used, and secondly, if the association between actual and perceived MC is analysed using a variable-centred approach.

In contrast to several studies, no family factors, such as parental PA (Cools et al. 2011; Matarma et al. 2017) or education (Cools et al. 2011; Zeng et al. 2019) were associated with MC or PMC (Robinson 2011). The only exception was the regression model of KTK, where higher parental education was associated with higher KTK total score. In a similar vein, a cross-sectional study conducted in Belgium identified positive associations of MC performance with parental education, father's PA, transport to school by bicycle and the high value placed by parents on sport-specific aspects of children's PA (Cools et al. 2011). In a study by Zeng et al. (2019) affirming that socioecological correlates significantly affect four-year-old's LM skills, parental education was the only significant factor at the family level. A systematic review by Barnett, Lai et al. (2016) showed that the socioeconomic background of the child was investigated more often than the associations to parental educational level, and that research demonstrates inconsistent findings. A higher socioeconomic background was positively associated with LM skills, stability and skill composite. This is in line with previous research findings (Cools et al. 2011) even though Finland as a country may have less diversity in parental education levels (Tilastokeskus [Statististics Finland] n.d.) than some other countries. However, this association should be critically evaluated because there was a bias towards highly educated parents in the present sample. Therefore, it can be concluded that the parental educational level being higher in the current study sample may confound the results and associations between the correlates and depending variables in this thesis.

The lack of family factors' associations in MC and PMC may be due to a lack of sensitive measures for this age group. Also, it is possible that objectively measured assessment tools would prevent parents' tendency to offer socially desirable answers. Moreover, the sample may be biased towards parents that have a positive attitude towards PA, and, consequently, this may interfere with the results of the study, confounding the associations between the variables and the dependent variables of MC and PMC. Future research must continue persistently pooling data from different studies around the world to find evidence on the levels, determinants and health-related associations of MC among children (Lopes et al. 2021) in order to better understand these differences and associations at each level of the sociecological model.

Environmental factors associated with MC and PMC are detailed more thoroughly in section 6.1.2.

Finally, in this thesis, higher variance was explained for MC (measured with the TGMD-3 and KTK) than for PMC (measured with PMSC). In the TGMD-3, the current thesis explained 34% of the variance between the children; in KTK, 38% of the variance was explained, while 8% of the variance was explained in PMSC. This result that more variance was explained for MC rather than for PMC may reflect the fact that there are more studies and reviews explaining MC (Barnett et al. 2013; Barnett, Lai, et al. 2016; Cools et al. 2011; Zeng et al. 2019) and PA (Sallis et al. 2000) correlates rather than for PMC. In the current thesis, the variance explained in MC can be considered high. Similarly, in their study, Mota et al. (2020) managed to explain with objectively measured PA and sedentary behaviour, parental reported sleep duration and MC assessed with the TGMD-2, adjusting analysis for age, gender and BMI, 31% of the variance in LM skills, 19% in BS and 35% of the total score assessed with the TGMD-2, respectively. The analyses were done with four year old children. In another study, again with four to five years old children, parent education, BMI and perception of child coordination were positively associated with the child's LM skills; nevertheless, the study explained only 8.8% of the variance in LM skills, and physical environment was positively associated with LM skills, explaining 5.5% of the variance at the environment level (Zeng et al. 2019) using BOTMP, second edition.

One reason for the differences in these studies may be the types of assessment used. In the study by Mota et al. (2020), objective assessment tools were used, while Zeng and collegues (2019) used parental questionnaires, which can be less precise. Moreover, Mota and collegues (2020) used more individual-level factors, including behavioural factors, such as the PA, SB and MC of the children. Indeed, the individual-level correlates seem to be most important for MC development (Barnett et al. 2013) and consequently explain more variance in the models. Finally, as the MC assessment tools often measure different aspects of MC (Cools et al. 2009; Ré et al. 2018), the choice of assessment tool can be crucial for the findings. In the future, a new, international, standardised, field-based MC assessment tool would be beneficial (Lopes et al. 2021) in untangling these challenges, yet no measure is without limitations.

In PMC, previous studies (Barnett, Lubans, Salmon, Timperio, & Ridgers 2017; Crane et al. 2017), in line with the current thesis, have found lower rates of explanatory variables compared to actual MC. For example, a recent study with preschool-aged children showed that actual LM skills and BS explained 10% and 9% of the variance for girls' perceptions, respectively, and 7% and 11% for those of boys, respectively (Crane et al. 2017). Another study with nine to 11 years old children showed that age (decreasing) and long-jump distance (positive) explained 16% of the LM skill perception variance, and gender (boys) explained 13% of the BS perception variance (Barnett et al. 2017). In essence, based on the current research, much remains unknown about the correlates of PMC, and future research is warranted for studies with more correlates that could explain PMC in young children.

6.2.2 Time spent outdoors and participation in organised sport

Time spent outdoors correlated positively with BS and the TGMD-3 gross motor index. No association was found with PMC, KTK or LM skills. In a systematic review, time spent outdoors was associated with higher levels of PA in young children (Sallis et al. 2000). In a more recent systematic review (Dankiw, Tsiros, Baldock & Kumar 2020), play in nature had a consistent positive influence on PA and cognitive play behaviours, such as imaginative and dramatic play, in two to 12 years old children. Additionally, participation in a variety of activities that are not organised sport activities, such as riding a bike or playing outdoor games, is suggested to benefit young children's MC development (Wood, Imai, McMillan, Swift, & DuBose 2019). It has been repeatedly found that time spent outdoors is beneficial for MC as it accumulates PA over the course of the day, and, according to several studies (Baranowski et al. 1993; Boldemann et al. 2006; Hinkley et al. 2016; Sallis et al. 2000), children prefer moving outside. Among young children, PA is typically achieved in the form of active play behaviour (Truelove et al. 2017), for which the outdoors provide an excellent environment. However, the safety of the living environment is crucial for time spent outdoors (Burdette & Whitaker 2005). Thus, for children, safe environments that permit children to practise, for example, balance and coordination skills (Fjørtoft 2001) or BS (Iivonen & Sääkslahti 2014) play a critical role in developing MC. In dense areas, natural elements are often replaced with parks and playing areas that include fixed equipment, allowing children to practise, for example, balance and strength skills (Donnelly et al. 2017; Laukkanen 2016). Yet, despite the positive outcomes of play in nature related to PA, MC and cognitive development, there should be focus on producing an universal definition for it and, consequently, the development of standardised guidelines to inform practice and policy in the design of children's play spaces in different contexts (Dankiw et al. 2020). Finally, to date, the association between PMC and time spent outdoors is not yet widely understood. It may have a mediating role through PA and MC; nevertheless, the current study with its Finnish childcare population could not demonstrate this association.

Participation in organised sport was positively associated in both MC assessment tools and in PMSC. Thus, participation in organised sport seems to be more important for MC and PMC than time spent outdoors, at least based on the results of the current thesis. More specifically, the association between the TGMD-3 and participation in organised sport was stronger than the association between KTK and participation in organised sport. This may reflect the fact that the TGMD-3 is a sport-specific assessment tool (Cools et al. 2009) and, consequently, may therefore benefit more from organised sport participation. Similar to the present study, previous study by Donnelly et al. (2017) have suggested that skilled adults' guidance in organised sport could support children's MC learning, and several studies have stated that participation in organised sport is beneficial for MC development in young children (Queiroz et al. 2014) as well as for older children (Vandendriessche et al. 2012; Vandorpe et al. 2012). In addition, Brian et al. (2018) stated that especially the development of BS is heightened by participation in specific contexts where children receive instructions that enable better MC learning. According to Barnett et al. (2008), developing a high perceived BS predicts more frequent PA participation and fitness in adolescence. Moreover, in relation to PMC and sport participation, on one hand, Pesce et al. (2018) found that children who overestimate their LM skills participated more often in sport training, and on the other hand, higher PMC was associated with motivation towards sport participation (Bardid, De Meester et al. 2016). For future research, this association is suggested to be profound. Nevertheless, in MC, several studies have testified the importance of participation in organised sport to enhance gender equality (Queiroz et al. 2014) or that it equalises the MC levels in young children (Laukkanen et al. 2019). Thus, placing importance of hobbies is crucial for providing equivalent opportunities for all children to practice sport (Okely, Booth, & Chey 2004; Queiroz et al. 2014). However, the majority of sport hobbies cost money, and therefore, there is a possibility that they are not available to all children due to differences in the SES of families (Basterfield et al. 2015; Vella et al. 2014).

According to a previous study with Australian children (n = 4042 children, mean 8.25 yrs.), four variables were identified that predicted dropping out of organised sport within the near future, including having lower household income level and lower levels of parental education (Vella et al. 2014). Basterfield et al. (2015) noticed that the majority (72%) of the children aged nine years old and that a smaller majority (63%) of the children aged 12 years old participated in some kind of organised sport, and this was significantly associated with the SES of the families – fewer children from poorer areas took part. Similarly, in Finland, 62% of the nine to 15 years old children were reported to participate in organised sport, and the high cost of sport hobbies was one of the main obstacles to sport participation (Kokko & Mehtälä 2016). Interestingly, in the current thesis, children living in densely populated areas also participated the most in organised sport, most probably due to higher accessibility to such hobbies. However, even though participation in organised sport was associated with higher MC, the children from the metropolitan area displayed lower MC than children living in the less dense areas, such as the countryside. In the countryside, the children were reported to spend the most time outdoors – and they outperformed the other children in MC. Thus, even though sport-related hobbies are important, one should not forget the importance of outdoor play, everyday life choices and supporting environments that help to accumulate more daily PA in early childhood.

6.2.3 Three PMC profiles and their association with socioecological factors

The PMC of the children can be evaluated with the level and the accuracy of the PMC evaluations in relation to actual MC (Harter & Pike 1984; Harter 1999; Robinson et al. 2015; Stodden et al. 2008; Weiss & Amorose 2005). In the current thesis, there was an intention to find out whether socioecological factors were associated with different PMC profiles. The aim was to facilitate future interventions to better promote in young children's PMC positive yet realistic evaluations of their actual MC. As a result, some differences were found.

Firstly, those belonging to the RE profile (n = 306) were more likely to be older and to live in more densely populated areas. Past studies have suggested that children under eight years of age have inflated PMC (LeGear et al. 2012; Lopes, Barnett, & Rodrigues 2016; Pönkkö 1999; Stodden et al. 2008), and, as a function of age, their PMC approximates their MC more closely (Harter 1999). This is in line with the current thesis result as it concurs that as a function of age, such evaluations decrease.

Secondly, it seems that children living in more densely populated areas were more likely to belong to the RE profile. This result may reflect differences in sources of information. It may be that children living in denser areas may have more peer comparison in the earlier stages of childhood. At least, it has been shown that children in the metropolitan area participated in organised sport approximately 10 minutes more on a weekly basis than children from the rest of the country. Consequently, they may receive more feedback from external sources, such as coaches and peers, supporting their realistic perception. Therefore, residential density can be relevant when investigating PMC profiles.

Thirdly, parents were more likely to report their child to have some health issue if the child belonged to the OE profile. The four most common additional factors possibly influencing development in these children (n = 41/441) were asthma (21.9%), ADHD (14.6%), verbal difficulties in producing or understanding speech (12.2%) and diabetes (7.3%). Interestingly, it has been found that half of the children with ADHD have problems in motor development (Kaiser, Schoemaker, Albaret, & Geuze 2015), and yet they are likely to overestimate their motor skills (Hoza et al. 2004). In the current thesis, ADHD was the second most frequently mentioned additional developmental factor by parents of OEs. In contrast, in a study by Emck et al. (2009), children with emotional, behavioural and pervasive developmental disorders exhibited poorer MC and non-realistic PMC, with certain indications of disorder-specific characteristics. More specifically, children with emotional disorders had balance problems and low PMC, children with behavioural disorders showed poor BS and tended to overestimate their MC and, finally, children with pervasive developmental disorders demonstrated low MC and PMC. As a result, the type of developmental issue or disorder may be associated with children's MC and PMC development leading to non-realistic estimations, such as over- or underestimation. In the case of non-realistic evaluations, Pönkkö (1999) questioned if it was a way to protect one's self-image from failure, a sort of self-defence.

Surprisingly, children who had more parental support for PA tended to underestimate themselves. This is rather interesting. Competence motivation theory (Harter 1978) indicates that PMC is built on internal criteria as well as on external sources, such as parental or peer feedback, which are important while constructing PMC. According to Swann (2011), one challenge of giving feedback is that the receiver mostly tends to assimilate coherent and predictable feedback that promotes the survival of his/her own perception. Hence, children who perceive themselves as competent mostly assimilate positive feedback, and, conversely, children with low PMC are more likely assimilate negative feedback. Therefore, it is plausible that children in the UE profile may have assimilated negative feedback even though their parents thought they were providing support, especially if the parental feedback is not coherent with the children's own perception. Indeed, the source of information matters. Korelitz and Garber (2016) discovered in their meta-analysis that parents' reports were more favourable than their children's reports about the parents' behaviours regarding enhancing PA and PMC. Moreover, Estevan, Molina-García, Bowe et al. (2018) demonstrated that children's PE teachers were the best to report and evaluate the MC of the children compared to the children themselves or their parents. Thus, it can be questioned whether the parents, on one hand, overestimated their positive feedback towards their children or, on the other hand, are not even the best information sources related to parental feedback given to children. In any case, future research focusing on the coherence of parental support and children's perceptions of the amount and quality of such support is needed.

6.3 Strengths and limitations

The publications (I–IV) included in the doctoral thesis have several noteworthy strengths. The data sample was nationally – if not fully representative at least broad – randomly selected, and it considered the geographical location and population density of the place of residence. Hence, a national comparison between different residence locales within one country could be executed (publication II). Also, internationally, the current data sample of young children can be considered large in terms of MC (n = 945; publications I, II) and PMC (n = 472; publications III, IV).

Apart from the data sample, strengths can be found in the assessment tools used in the current thesis. To assess MC, two internationally well-known MC measures were used to provide supplementary information on different aspects of the MC of young children (Cools et al. 2009; Ré et al. 2018), which is highly recommended (Bardid, Huyben et al. 2016; Ré et al. 2018) (publication I). The PMC of young children was measured with PMSC, developed by Barnett, Ridgers, Zask et al. (2015), which is an age-appropriate assessment with pictorial elements, as suggested based on previous studies (Harter 1982, 1999) (publications III, IV). Moreover, PMSC has been validated in several different countries, showing good reliability and validity with children over five years of age (Barnett, Ridgers, Zask, et al. 2015; Diao et al. 2018; Estevan et al. 2017; Venetsanou et al. 2018). Finally, the MC and PMC measures were aligned in assessing the same skills in actual and perceived MC, as recommended (Estevan & Barnett 2018), providing the most accurate information, during the data collection time, about the correlation between MC and PMC (publications III, IV).

To understand more deeply the development of MC and PMC and their associated factors, a wide range of socioecological correlates at the individual, family and environmental levels were examined in relation to MC (publication I) and PMC (publications III, IV). Some of the findings consolidated the previous knowledge about the importance of individual-level correlates (Barnett et al. 2013), such as age and gender, for MC and PMC, respectively; nevertheless, new information was also provided. Firstly, the current thesis examined the temperament traits associated with MC and PMC, providing evidence of some temperament traits' – such as activity and attention span persistence – association with MC. No such association was found with PMC. A deeper understanding of the socioecological correlates associated with MC and PMC provides new insights for future research and planning future interventions to enhance MC and PMC learning.

However, no thesis is without limitations. These limitations should be noted when interpreting the results. Firstly, based on conceptual frameworks (Hulteen et al. 2018; Stodden et al. 2008) and reviews (Robinson et al. 2015), MC, PA and PMC are closely associated with each other. Therefore, the thesis would have benefitted from the use of objectively measured PA. Secondly, even though the socioecological model creates a wide theoretical background with various correlates at several levels of the child's development, these levels of the socioecological model are often hard to distinguish. More specifically, child-related correlates are often influenced by family- and environmental-level correlates. Additionally, in relation to the data sample, regardless of efforts to include a fully representative and randomly selected data sample of Finnish children in childcare, there was a bias towards more highly educated parents and their children. Most probably, it can be assumed that this kind of a study interests' parents with positive attitudes towards a physically active lifestyle. Moreover, most of the respondents to the parental questionnaire were females, most likely mothers, and therefore, the thesis would have benefitted from more responses from males as well. Lastly, the analysis conducted for each age group may have involved a limited sample size for children representing the seven years old group (n = 56). This limitation may have occurred because most children attending childcare centres are three to six years old. At the age of seven, children start schooling; therefore, data collection conducted in a childcare setting may include fewer children aged seven years.

During the data collection, as the measurements were taken in childcare centres, there were differences in terms of available space between locations. This could lead to unequal amounts of space for data collection, which was important while assessing the MC of the children with the TGMD-3 and KTK. Additionally, due to the short duration of data collection periods, missing data could not be avoided. Thus, in the regression models, the number of items may vary, and there may be a lack of some information about the children. Additionally, some children were unwell or absent during the data collection period. In these cases, the families were provided an opportunity to return the incomplete information, such as parental questionnaires, to the researchers later. Despite this, the recovery of the missing data was challenging as the participants and childcare centres involved were busy and distributed around Finland.

6.4 Methodological issues

Various methodological issues arose from the design of the four different studies described in this thesis. The findings of the thesis must be interpreted in light of the methodological choices made, including, for instance, the data sample, MC and PMC measurement methods, parental questionnaires and statistical methods.

All the children enrolled in the studies of this thesis were aged between three to seven years at the time of data collection. All the children who did not fulfil the 36 months of age (three years) criterion by the time the MC assessments were excluded from the analysis. In the measurements, there were different recommendations for each assessment tool, and therefore, the age and the number of children involved in the measures varied between three to seven years old (TGDM-3) and five to seven years old (KTK and PMSC). The parental questionnaires were collected from all the families involved. Yet, the present study sample mainly consists of high SES families and has an underrepresentation of obese participants (at least in some publications of the study). This bias could explain why some individual-related (such as BMI SDS and time spent outdoors) and family-related factors were not distinguishing associated factors in this sample, which contrasts with several other studies.

Various methodological issues can be raised in relation to the TGMD-3 and KTK measurements (see sections 4.6.1 and 4.6.2). These two MC measures assess different aspects of MC (Cools et al. 2009; Ré et al. 2018). Moreover, Barnett, Lai et al. (2016) underscore in their systematic review and meta-analysis that the correlates of MC may vary according to how MC is operationalised. On one hand, the TGMD-3 can be criticised as it lacks balance and coordination skills, is sport-specific and is not an objectively measured assessment tool. Therefore, there may exist differences in interpretation between the observers. On the other hand, KTK is not sport-specific and lacks BS (Cools et al. 2009; Iivonen et al. 2015); nevertheless, as it is a product-oriented measure and only the result of the performances counts, there may be fewer challenges in regard to interpretation of the results, leading to a more reliable assessment tool. However, there existed some differences in the findings between the MC measures as gender differences were more evident in the TGMD-3 than in KTK. This may be due to an unbalanced scoring system as there are more points (54 points) available for BS than for LM skills (46 points).

In PMC, there are some important considerations to note as well. Firstly, the Pictorial Scale is gender-specific, and, to date, it may be discriminatory against those who do not want to specify their gender or do not identify with either of the two genders. For future research, there is a need to extend this narrow gender concept to a wider perspective. Secondly, there may be some inaccuracies related to the pictures in the booklet as some skill pictures may be less precise than others. More specifically, this challenge, according to previous studies, has been noted to be associated with the description and understanding of LM skills (Barnett, Ridgers, Zask, et al. 2015; Moulton et al. 2018). It should be underscored that the pictures in the booklet should help, not confuse, the child and his/her interpretation of the skill.

Moreover, the answer options may be difficult for children to understand as all the options are based on the word 'good' (see section 4.6.3). This may be particularly difficult for children who are not native Finnish speaking or who have delay related to speech. Moreover, in this kind of situation, where the adult researcher is not familiar with the child, there may be differences in how children cope in research situations. Some children with specific personal characteristics may have influenced their performance in the MC and PMC measures. Some reasons for these behaviours were shyness, the desire to give socially acceptable responses and a few of the children messing around.

Personal characteristics were also evident during the data collection as there were differences in how children responded to the PMC questions. Mostly the differences were between personal approaches in that some children preferred to answer according to the extremity of the options, thus, they described themselves as 'really good' or 'not that good' in the given skills. Alternatively, there were also children who acted the opposite, avoiding responses with the extremity options. Therefore, they were more likely to respond with the 'sort of good' or 'pretty good' options.

Also, there are some limitations related to the translation of the PMSC which could have been partly avoided by including a larger pilot group before starting the data collection. It is possible that expanding the response options to also include 'not that good', 'sort of good', 'pretty good' and 'really good' would be more distinctive. There have been suggestions that the booklet should be replaced with video clips. A video may give a more precise description of the skill; that said, a video might too strongly provide just one type of an idea of how to execute the skill appropriately, while the cartoon picture leaves more room for the child's own imagination and to identify with his/her personal way of performing the skills with the picture.

In the three PMC profiles (publication IV), the first challenge was due to our data sample including young children with very high PMC levels, thus resulting in no normal distribution of PMC scores. The major limitation of publication IV, in line with previous studies using a profile approach to PMC (De Meester, Stodden et al. 2016; Duncan et al. 2018; Pesce et al. 2018), is that its results cannot be generalised to other samples. Consequently, another sample may under- or over-represent particular profiles if the participants are categorised into the profiles based on their current overall MC levels. Future studies should employ multi-professional collaboration to more precisely understand PMC development. The existing literature suggests that most data are fundamentally cross-sectional; therefore, PMC seems to decrease among many children as a function of age (Babic et al. 2014; Carcamo-Oyarzun, Estevan, & Herrmann 2020; True et al. 2017). However, highly skilled children may maintain high PMC levels over time. Therefore, future research on PMC profiles is necessary to overcome the current methodological limitations. Thus, under- and overestimations of competence – in addition to realistic estimations of competence – will remain important focuses in this work area despite challenges. These challenges are also present in the current thesis and its publications.

In relation to the Skilled Kids parental questionnaire, some important notes are considered here. The questionnaire would have benefitted from a larger pilot study. Additionally, even though the parental questionnaire was created from another internationally used questionnaires (Cleland et al. 2011; Rodrigues et al. 2005; Telford et al. 2004), and the validity and reliability were sufficient, some of the test-retest reliability levels were slightly low, with high CIs. Moreover, the gender option was replaced with 'respondent' and 'partner' as there was a desire to give everyone the opportunity to answer regardless of the gender of the adult. Yet, the gender options were only two: 'female' or 'male'. Within these years after the data collection, the discussion on 'gender' and 'sex' has been evolving tremendously, and therefore, in the current thesis' publications use different words to describe the gender of the participants.

Finally, the questionnaire was available only in Finnish, excluding some of the non-native Finnish speakers from the participant group or possibly leading to missing data. In practice, 95% of the study participants were native Finnish speakers (publication II). Consequently, the data sample may be considered too homogeneous. Despite this, the rate of Finnish-speaking people is considered in the country as a whole to be similarly high (93.2%) but reflects a wide range between different areas of the population (Tilastokeskus [Statististics Finland] 2017). The most common foreign language, aside from the official languages of Finland (Finnish and Swedish), is Russian (24%) (Tilastokeskus [Statististics Finland] 2010). The province of Uusimaa in Southern Finland has the most non-native Finnish speaking citizens as 8% of the population has a mother tongue other than Finnish (Tilastokeskus [Statististics Finland] 2010). This may also hinder a generalisation of the results of the current thesis, especially in the Uusimaa province and the eastern part of Finland.

YHTEENVETO (SUMMARY IN FINNISH)

Taitavia tenavia ympäri Suomen: Päiväkotilasten motoriset taidot ja koettu motorinen pätevyys sekä niihin yhteydessä olevia sosioekologisia tekijöitä

Motoriset taidot ja koettu motorinen pätevyys päiväkoti-ikäisillä lapsilla
Motorisilla taidoilla tarkoitetaan niitä hieno- ja karkeamotorisia perustaitoja, joihin myöhemmin kehittyvät taidot ja liikkuminen perustuvat. Ne voidaan jakaa liikkumistaitoihin, jotka tarkoittavat taitoja, joilla edetään paikasta toiseen, pallonkäsittelytaitoihin, joiden avulla käsitellään välineitä, esineitä ja toista ihmistä sekä tasapainotaitoja ja koordinatiivisia taitoja (Gabbard 2016; Gallahue & Donnelly 2003; Gallahue ym. 2012; Malina ym. 2004). Varhaislapsuudessa fyysinen aktiivisuus on tärkeä motoristen taitojen harjaannuttaja, sillä lapsen täytyy saada kokeilla, yrityksen ja erehdyksen kautta liikkumista. Vain siten motoriset taidot voivat kehittyä ikäistensä tasolle. Myöhemmin fyysisen aktiivisuuden ja motoristen taitojen suhde kehittyy vuorovaikutteisemmaksi, sillä hyvät motoriset taidot mahdollistavat fyysisen aktiivisuuden ja toisaalta monipuolinen fyysinen aktiivisuus kartuttaa motorisia taitoja.

Aikaisempien tutkimusten mukaan motoriset taidot ja fyysinen aktiivisuus tukevat terveempää kehonkoostumusta (Jaakkola ym. 2015; Robinson ym. 2015; Slotte ym. 2015; Stodden ym. 2008) sekä kognitiivisia taitoja, kuten akateemisia taitoja (Haapala 2015; Jaakkola ym. 2015; Rasberry ym. 2011). Motorisilla taidoilla on yhteyttä myös lapsen yksilölliseen kasvuun sekä sosiaaliseen ja emotionaaliseen hyvinvointiin (Reunamo ym. 2014), sillä paremmat motoriset taidot mahdollistavat lapsen osallistumisen ikätasoisiin peleihin ja leikkeihin muiden lasten kanssa. Nämä positiiviset sosiaaliset kokemukset ovat myös tärkeitä koetun motorisen pätevyyden kehittymisessä.

Motoriset taidot ja fyysinen aktiivisuus ovat hyvin läheisesti vuorovaikutuksessa, mutta myös kokemus omasta motorisesta pätevyydestä on yhteydessä siihen, lähteekö lapsi leikkimään muiden kanssa vai ei. Koetulla motorisella pätevyydellä tarkoitetaankin sitä, minkälaisiksi lapsi itse kokee omat motoriset taitonsa. Tutkimuksen teoreettisen viitekehyksen mukaan (Robinson ym. 2015; Stodden ym. 2008), jos lapsella on hyvät motoriset taidot, hän on myös todennäköisemmin fyysisesti aktiivinen ja toisaalta hän kokee onnistumisen kokemuksia liikkuessaan eli hän paitsi kokee myönteisiä tunteita, hän myös jaksaa harjoitella ja kokee omat taitonsa riittäviksi. Tämä positiivinen sitoutumisen kierre liikkumista kohtaan kehittää vuorovaikutteisesti kaikkia osa-alueita. Toisaalta taas, jos lapsi kokee olevansa motorisissa taidoissa muita kehityksessä jäljessä, hän saattaa todennäköisemmin jättää menemättä mukaan leikkeihin ja peleihin. Tämä edelleen vahvistaa hänen käsitystään siitä, että omat taidot eivät ole ikätasoisesti kehittyneet. Lapsen taitojen taso, kokemus omista taidoista sekä fyysinen aktiivisuus johtavat siihen, että lapsi luovuttaa helpommin tai ei lähde ollenkaan mukaan leikkeihin.

Aikaisempien tutkimusten mukaan koetun motorisen pätevyyden on tutkittu olevan yhteydessä ikään (Crane ym. 2017; Jozsa ym. 2014; Lopes ym. 2018;

True ym. 2017), sukupuoleen (Afthentopoulou ym. 2018; Estevan, Molina-García, Bowe, ym. 2018; LeGear ym. 2012; Lopes ym. 2018; Pesce ym. 2018; Slykerman ym. 2016), kehon painoon tai kehon painoindeksiin (Jones ym. 2010; Toftegaard-Stoeckel ym. 2010; Spessato, Gabbard, Robinson, ym. 2013), harrastuksiin osallistumiseen (Pesce ym. 2018) tai motivaatioon harrastamista kohtaan (Bardid, De Meester, ym. 2016). Lisäksi, koetun motorisen pätevyyden ja varsinaisen motorisen taidon yhteys on usein tutkittua tietoa (Barnett ym. 2008; Farmer ym. 2017; Liong ym. 2015; Lopes, Barnett, & Rodrigues 2016; Lopes ym. 2018). Tämä yhteys on heikompi varhaislapsuudessa, sillä nuoremmilla lapsilla on usein korkea koettu pätevyys ja heikommat motoriset taidot, jolloin yhteys ei ole realistinen (De Meester ym. 2018; Hall ym. 2019; Lopes, Barnett, & Rodrigues 2016; Lopes ym. 2018; Spessato ym. 2013; True ym. 2017). Iän karttuessa koetun motorisen pätevyyden taso laskee, mutta tarkkuus suhteessa varsinaiseen taidon tasoon paranee, jolloin kokemus ja varsinainen taitotaso ovat lähempänä toisiaan.

Toisaalta etenkin varhaislapsuudessa vanhemmat, leikkitoverit ja ympäristö mahdollistavat, kannustavat tai estävät lapsen mahdollisuuksia liikkumiseen ja taitojen kehitykseen (Gabbard 2009). Sen vuoksi on mahdotonta tutkia motorisiin taitoihin ja koettuun motoriseen pätevyyteen liittyviä sosioekologisia tekijöitä (Bronfenbrenner 1994, 1974) pelkästään kapealla näkökulmalla. Vanhempien ja ympäristön vaikutus lapsen liikkumisen tukemiseen on tärkeää ottaa myös huomioon. Sosioekologisen mallin tarkoitus on ottaa huomioon niitä tekijöitä, jotka vaikuttavat lapsen kehitykseen, mutta joita harvemmin tutkitaan suhteessa motorisiin taitoihin tai koettuun motoriseen pätevyyteen. Sosioekologiset tekijät voidaan jaotella lapseen itseensä liittyviin tekijöihin, kuten ikään, sukupuoleen, kehon koostumukseen ja temperamenttiin. Perhetason tekijöiksi luetaan vanhempien koulutustaso sekä vanhemman oma fyysinen aktiivisuus. Ympäristötekijöihin kuuluvat päivittäinen elinympäristö (asuinpaikan asukastiheys ja maantieteellinen sijainti), sekä lapsen käytössä olevien kodin elektronisten laitteiden määrä ja lapsen pääsy lähiliikuntapaikoille.

Tutkimuksen tavoitteet ja tutkimuskysymykset

Tämän neljästä tieteellisestä osajulkaisusta ja niiden yhteenvedosta koostuvan väitöskirjatutkimuksen tavoitteena oli ensisijaisesti tuottaa tietoa suomalaisten päiväkotilasten motorisista taidoista sekä koetusta motorisesta pätevyydestä. Erityisesti tutkittiin lapsen iän, sukupuolen sekä fyysisen ympäristön välisiä eroja motorisissa taidoissa ja koetussa motorisessa pätevyydessä. Toissijaisena tarkoituksena tutkimuksessa oli selvittää, mitkä sosioekologiset tekijät ovat yhteydessä motorisiin taitoihin ja koettuun motoriseen pätevyyteen. Myös ulkona vietetyn ajan ja liikuntaharrastamisen määrän yhteyttä motorisiin taitoihin ja koettuun motoriseen pätevyyteen tutkittiin. Lisäksi katsottiin, kuinka suuri osa lapsista yli- tai aliarvioi omat motoriset taitonsa, ja mitkä ovat näiden profiilien yhteydet sosioekologisiin tekijöihin. Tutkimuksen tarkoituksena oli tuottaa tietoa päiväkotilasten motorisista taidoista ja koetusta motorisesta pätevyydestä kansallisesti laajalla otoksella. Se mahdollistaa alueellisten eroavaisuuksien tutkimisen ja selvittämisen ajatellen sitä, minkälainen ympäristö tukee lasten motorisen kehityksen tarpeita. Lisäksi ikään, sukupuoleen ja koettuun motoriseen pätevyyteen liittyvien ilmiöiden ymmärtämisen toivotaan tuottavan varhaiskasvattajille sekä vanhemmille tietoa ja toisaalta pedagogisia välineitä lapsen motorisen kehityksen edistämiseen sekä terveen koetun motorisen pätevyyden luomiseen.

Täsmennetyt tutkimuskysymykset olivat:

1. Minkälaiset ovat lasten motoriset taidot ja koettu motorinen pätevyys eri puolella Suomea (osajulkaisut I, II, III). Tarkemmin sanottuna, tutkia
   - ikä- ja sukupuolieroja (osajulkaisut I, II, III)
   - fyysisen asuinympäristön, eli maantieteellisen sijainnin ja asukastiheyden, yhteyttä lasten motorisiin taitoihin, koettuun motoriseen pätevyyteen, ulkona vietettyyn aikaan sekä liikuntaharrastamiseen (osajulkaisu II)
2. Mitkä tekijät ovat yhteydessä lasten motorisiin taitoihin ja koettuun motoriseen pätevyyteen (osajulkaisut I, II, III, IV). Tarkemmin sanottuna, tutkia
   - mitkä sosioekologiset tekijät ovat yhteydessä motorisiin taitoihin ja koettuun motoriseen pätevyyteen (osajulkaisut I, III)
   - ovatko ulkona vietetty aika ja liikuntaharrastaminen yhteydessä motorisiin taitoihin ja koettuun motoriseen pätevyyteen (osajulkaisu II)
   - kuinka koetun motorisen pätevyyden kolme profiilia ovat yhteydessä sosioekologisiin tekijöihin (osajulkaisu IV)

Aineisto ja mittausmenetelmät

Väitöskirjan aineisto kerättiin vuosina 2015-2016 eri puolilta Suomea satunnaistetulla ryväsotannalla, joka mukaili WHO-Koululaistutkimuksen kyselyn satunnaistamisen mallia (World Health Organization 2020). Satunnaistamisessa huomioitiin päiväkodin maantieteellinen sijainti sekä alueen asukastiheys. Yhteensä 37 päiväkotia osallistui tutkimukseen. Maantieteellisesti 17 päiväkotia sijaitsi Etelä-Suomessa, 13 Keski-Suomessa ja seitsemän Pohjois-Suomessa. Asukastiheyden perusteella kuusi päiväkotia sijaitsi pääkaupunkiseudulla, 17 kaupungeissa, seitsemän taajamissa sekä seitsemän maaseudulla. Tutkimukseen osallistui kokonaisuudessaan yhteensä 945 lasta (ka 5,42 vuotta, poikia 473, tyttöjä 472) perheineen, mutta aineiston koko vaihteli käytetystä mittarista ja puuttuvasta aineistosta riippuen. Motoriset taidot mitattiin kahdella eri mittarilla, Test of Gross Motor Development –kolmas versio (TGMD-3; Ulrich 2019) ja Körperkoordinationstest für Kinder (KTK; Kiphard & Schilling 2007). Nämä kaksi mittaria täydensivät toisiaan; TGMD-3 on laadullinen motoristen taitojen mittari yli 3-vuotiaille lapsille. Sen 13 eri osiota on jaettu kahteen kategoriaan: liikkumistaitoihin ja pallonkäsittelytaitoihin. Liikkumistaitoihin lukeutuvat juoksu, laukka eteenpäin, yhdellä jalalla hyppääminen, vuorohyppely, vauhditon pituushyppy, sekä laukkaaminen sivuttain. Pallonkäsittelytaitoihin kuuluvat pallon lyönti kahdella kädellä ja mailalla (’pesäpallolyönti’), lyönti yhdellä kädellä (’tennislyönti’), pomputus, potkaisu, kiinniotto ja heitto ala- ja yläkautta. KTK –mittari puolestaan mittasi lasten koordinatiivisia ja tasapainotaitoja. Testiosiot koostuvat neljästä eri mittausosioista, joiden tulos lasketaan yhteispisteisiin. Mittausosiot olivat tasapainoilu takaperin eri levyisillä puomeilla, esteen yli kinkkaus molemmilla jaloilla, sivuttaishyppely ja sivuttaissiirtyminen. Testin tekivät ne lapset (n = 444), jotka olivat täyttäneet 5-vuotta ennen mittauksia (osajulkaisu I). Ensimmäisessä (I) ja toisessa (II) osajulkaisussa käytettiin aineistoa, jossa oli mukana 945 lasta mitattuna TGMD-3:lla. Sekä TGMD-3 että KTK-mittarit on todettu luotettaviksi testimenetelmiksi mittamaan lasten motorisia taitoja liikkumis- ja pallonkäsittelytaidoissa (Cools ym. 2009; Rintala ym. 2017; Ulrich 2019) tai koordinatiivisia ja tasapainotaitoja (Bardid, Huyben, ym. 2016; Iivonen ym. 2015; Kiphard & Schilling 2007).

Koettu motorinen pätevyys mitattiin yli 5-vuotiaille lapsille soveltuvalla the Pictorial Scale of Perceived Movement Skill Competence (PMSC; Barnett, Ridgers, Zask, ym. 2015) for young children –testillä. Mittari kysyy lasten koettua motorista pätevyyttä samoissa 13 eri taidoissa, joita mitataan TGMD-3:n motoriikkatestissä. Osajulkaisuissa III ja IV sekä yhteenveto-osassa lapsia oli 472. PMSC-mittari on todettu luotettavaksi koetun motorisen pätevyyden mittariksi kansainvälisesti (Diao ym. 2018; Johnson ym. 2016; Venetsanou ym. 2018). Sosioekologisia tekijöitä kysyttiin lapsen vanhemmilta Taitavat tenavat –kyselylomakkeella, joka mukaili jo olemassa olevia päiväkotilasten vanhemmille suunnattuja kyselylomakkeita (Cleland ym. 2011; Rodrigues ym. 2005; Telford ym. 2004), mutta se muokattiin suomalaiseen kulttuuriin sopivaksi. Ennen käyttöä, kyselylomake esitestattiin ja sen luotettavuus tarkistettiin. Varsinaisessa tutkimusaineistossa 936 vanhempaa vastasi kyselylomakkeeseen. Lapsen temperamenttia kysyttiin vanhemmilta Colorado Childhood Temperament Inventory (CCTI) –kyselylomakkeella (Rowe & Plomin 1977). Lapsen paino ja pituus mitattiin. Niiden perusteella laskettiin ikävakioitu kehon painoindeksi.

Tutkimusaineisto analysoitiin IBM SPSS Statistics 24.0 (IBM Corp., Armonk, NY, USA) –ohjelmalla. Tilastollisissa analyyseissä käytettiin kuvaavia tietoja, kuten keskiarvoja, -hajontoja sekä minimi- ja maksimiarvoja. Lisäksi käytettiin yksisuuntaista ANOVAa, t-testiä (motoriset taidot), Mann-Whitney U –testiä (koettu motorinen pätevyys), sekamallianalyysiä, lineaarista regressioanalyysia, ikävakioitua osittaiskorrelaatiota sekä multinominaalista logistista regressioanalyysiä. Tulosten tilastollisen merkitsevyyden raja-arvona käytettiin $p < 0.05$.

Jyväskylän yliopiston eettinen toimikunta antoi Taitavat tenavat –tutkimushankkeelle eettisen puollon 31 lokakuuta 2015. Lisäksi useita paikallisia eettisiä tutkimuslupapyyntöjä tehtiin erikseen, jos tutkimuspaikkakunta sitä vaati. Tutkimukseen osallistuminen oli kaikille paikkakunnille, päiväkotiyksiköille sekä lapsille ja heidän vanhemmilleen vapaaehtoista. Tutkimushanketta rahoitti Opetus- ja kulttuuriministeriö. Tämä väitöskirja oli osa Taitavat tenavat -tutkimushanketta.

Tulokset

Tutkimukseen osallistuneiden lasten motoristen taitojen taso oli normaalijakautunut ja eroja syntyi lähinnä iän ja sukupuolen (osajulkaisut I ja II) sekä asukastiheyden perusteella (osajulkaisu II). Toisin sanoen vanhemmilla lapsilla oli paremmat motoriset taidot molemmissa motorisen taidon mittareissa (osajulkaisu I). Sukupuolieroja löydettiin ainoastaan TGMD-3 mittarilla, jossa pojat suoriutuivat paremmin pallonkäsittelytaidoissa ja kokonaispistemäärässä, kun taas tytöt olivat parempia liikkumistaidoissa (osajulkaisut I ja II). KTK-mittarilla ei havaittu sukupuolieroja (osajulkaisu I). Asukastiheyden perusteella TGMD-3 tuloksissa maaseudun lapset olivat parempia motorisissa taidoissaan (osajulkaisu II). KTK-tuloksissa ei syntynyt merkitseviä eroja asukastiheyden tai maantieteellisen sijainnin perusteella.

Asuinpaikalla tuntui olevan yhteys ulkona vietetyn ajan määrään sekä liikuntaharrastamiseen (osajulkaisu II). Maaseudun lasten huomattiin viettävän eniten aikaa ulkona päiväkotipäivän jälkeen. Pääkaupunkiseudun ja Etelä-Suomen lapset osallistuivat eniten ohjattuihin liikuntaharrastuksiin. Vahvin yhteys motorisiin taitoihin oli lapsen korkeammalla iällä ja liikuntaharrastamisella, sekä yksilöllisillä temperamentin piirteillä, kuten korkealla aktiivisuudella ja kyvyllä ylläpitää tarkkaavaisuutta (osajulkaisu I). Sekä motorinen taito että koettu motorinen pätevyys olivat yhteydessä liikuntaharrastamiseen. Siksi liikuntaharrastamisen voidaan todeta tukevan motoristen taitojen ja koetun motorisen pätevyyden kokemista. Ulkoilun määrässä yhteys ei ollut yhtä vahva, vaikka myös se oli osittain yhteydessä parempiin motorisiin taitoihin.

Koettu motorinen pätevyys oli tässä tutkimuksessa kaikilla lapsilla korkea (osajulkaisut III, IV). Iällä oli merkitsevä yhteys koettuun motoriseen pätevyyteen; koettu pätevyys laski iän lisääntyessä, vaikka samaan aikaan motoriset taidot paranivat. Tutkimuksessa siis havaittiin, että mitä vanhempi lapsi oli, sitä todennäköisemmin hänellä oli alhaisempi koettu motorinen pätevyys (osajulkaisu III). Sukupuolieroja löytyi, sillä tytöt kokivat olevansa poikia parempia liikkumistaidoissa ja pojat puolestaan parempia pallonkäsittelytaidoissa. Asuinpaikalla ei ollut merkitystä koetun motorisen pätevyyden kokemuksen tasoon. Koettuun motoriseen pätevyyteen vahvin yhteys oli lapsen nuoremmalla iällä, korkeammalla kehon painoindeksillä, osallistumisella liikuntaharrastuksiin sekä korkeammalla motorisen taidon tasolla (osajulkaisu III).

Tutkimuksen rajoitteet ja vahvuudet

Tutkimukseen liittyy rajoittavia tekijöitä, jotka tulisi ottaa huomioon, kun tuloksia ja niiden yleistettävyyttä arvioidaan. Kuten väitöskirjan kirjallisuuskatsauksessa todetaan (kts. luku 6.3), niin lasten motoristen taitojen, koetun motorisen pätevyyden ja fyysisen aktiivisuuden yhteydet voivat olla niin vaihtelevia, että niitä voi olla vaikea erottaa toisistaan. Etenkin varhaislapsuudessa fyysinen aktiivisuus tukee motoristen taitojen kehitystä, ja sen vuoksi tutkimukseen lisäarvoa olisi tuonut objektiivinen fyysisen aktiivisuuden mittausmenetelmä. Lisäksi sosioekologinen malli ja sen eri kerrokset ovat teennäisiä erottaa toisistaan, koska kerrokset ja malli perustuvat vahvasti olettamukseen siitä, että eri kerrokset vaikuttavat toinen toiseensa ja vahvistavat toinen toisiaan. Nämä teoreettisten viitekehysten ominaisuudet on hyvä ottaa huomioon tuloksia tarkastellessa.

Tutkimusmenetelmistä voidaan todeta, että niissä esiintyy tiettyjä erityispiirteitä, jotka saattavat vaikuttaa tulosten oikeellisuuteen. Ensinnäkin, tässä tutkimuksessa käytetyt motoristen taitojen mittarit tukevat toisiaan, sillä ne mittaavat motoristen taitojen eri piirteitä (Cools ym. 2009; Ré ym. 2018). Samaan aikaan, on hyvä huomata, että motorisen mittarin valinta saattaa ratkaisevalla tavalla tuottaa tietyntyyppisiä tuloksia. Esimerkiksi TGMD-3 mittaria on kritisoitu kulttuurisidonnaiseksi, joka korostaa lajitaitoja ja niiden kehittymistä. Lisäksi niissä ei ole tasapainotaitoja otettu huomioon (Cools ym. 2009). TGMD-3-mittarin perusteella näyttää olevan enemmän sukupuolieroja kuin KTK-mittaria käytettäessä. Tämä saattaa johtua siitä, että kokonaispistemäärä muodostuu seitsemästä pallonkäsittelytaidosta, joista on saatavilla yhteensä 54 pistettä ja liikkumistaidoissa on ainoastaan kuusi taitoa, joiden maksimipistemäärä on 46 pistettä. Yhteensä TGMD-3-mittarista voi saavuttaa 100 pistettä. Tämä lähtöasetelma saattaa suosia poikia, sillä poikien on todettu olevan taitavampia pallonkäsittelytaidoissa (Barnett, Lai, ym. 2016; Hardy ym. 2010; LeGear ym. 2012; Spessato, Gabbard, Valentini, ym. 2013) ja tytöt usein menestyvät paremmin liikkumistaidoissa (Barnett ym. 2008; Hardy ym. 2010; LeGear ym. 2012). On epäilty myös, että koska mittarissa korostuu lajisisällöt, ja koska sukupuolten välillä on eroja harrastamisen sisällöissä (Barnett ym. 2013; Westendorp ym. 2014; Spessato, Gabbard, Valentini, ym. 2013), se saattaa heijastua TGMD-3 –mittarin tuloksiin. Myös laadunarviointi ei ole koskaan täysin ongelmatonta eri mittaajien tai välineiden (video- vai livearviointi) välillä vaan siihen liittyy usein isompaa vaihtelevuutta kuin tulosperusteisissa mittareissa, kuten KTK:ssa. KTK:ta puolestaan on kritisoitu esimerkiksi siitä, ettei se ota huomioon laisinkaan pallonkäsittelytaitoja (Cools ym. 2009; Iivonen ym. 2015).

Koetun motorisen pätevyyden PMSC –mittariin liittyy myös muutamia kriittisiä huomioita. Kuvallinen mittari on sukupuolisidonnainen, jota voidaan pitää syrjivänä. Lisäksi kuvalliseen taidon ymmärtämiseen voi liittyä haasteita, sillä osa kuvista ei välttämättä kuvaa riittävän tarkasti kutakin taitoa. Ennen kaikkea tämä ongelma liittyy liikkumistaitojen tunnistamiseen (Barnett, Ridgers, Zask, ym. 2015; Moulton ym. 2018). Kuvan pitäisi auttaa käsitteen ymmärtämistä, ei sekoittaa sitä tai vaikeuttaa. Myös vastausvaihtoehdot voivat olla osalle lapsista kielellisesti haastavia ymmärtää, sillä kaikki vaihtoehdot sisältävät 'hyvä' sanan (kts. luku 4.6.3). Tämä voi olla haaste esimerkiksi lapsille, joille suomi ei ole (ainut) kotimainen kieli tai joilla esiintyy kielenkehityksen viivästymää. Lisäksi tutkimustilanteessa, jossa lapset ovat tuntemattoman tutkijan kanssa, voi syntyä persoonallisia eroja siinä, kuinka lapset suhtautuvat vieraaseen aikuiseen. Osalla lapsista, sekä motoristen että koetun motorisen pätevyyden mittauksissa, tällainen uusi tilanne saattoi vaikuttaa lapsen suoriutumiseen tai vastaamiseen. Joissain tapauksissa lapsi saattoi ujostella tai vääristellä vastauksiaan. Nämä asiat kirjattiin ylös ja otettiin huomioon väitöskirjassa.

Suhteessa Taitavat tenavat –kyselylomakkeeseen, korostan muutamia kriittisiä kohtia. Joidenkin osakysymysten toistettavuutta kuvaavat IC-arvot olivat korkeat, jolloin kahden vastauskerran välillä esiintyi paljon eriäväisyyttä. Keskiarvioissa ne eivät kuitenkaan vaikuttaneet kyselylomakkeen luotettavuuteen.

Kyselylomaketta ei ollut saatavilla kuin suomeksi, joten osa niistä, joilla ei ollut vahva suomenkielentaito, ei välttämättä pystynyt vastaamaan kyselylomakkeeseen. Tästä kertoo esimerkiksi se, että 95% vastaajista kertoi omaksi äidinkielekseen suomen (osajulkaisu II). Tämän vuoksi tutkimusaineistoa voidaan kritisoida hieman liian homogeeniseksi, vaikka yleisesti ottaen 93.2% Suomessa asuvista puhuu suomea (Tilastokeskus 2017). Yleistettävyyttä voi kuitenkin heikentää alueelliset erot paikkakuntien välillä kielellisissä erityispiirteissä. Lisäksi 86% vastaajista oli lasten äitejä, joka vaikuttaa näkemykseen asioista. Kyselylomakevastaamiseen liittyy usein myös se, että terveystietoiset vanhemmat saattavat tiedostamattaan vastata yläkanttiin, joka voi vääristää tuloksia ja niiden yhteyttä motorisiin taitoihin sekä koettuun motoriseen pätevyyteen. Osa vanhemmista jätti palauttamatta kyselylomakkeen, jonka vuoksi puuttuvia tietoja esiintyi ja esimerkiksi yli 100 lapsen motorisen taidon mittauksia ei voitu käyttää analyyseissa (noin 10% koko aineistosta), sillä lasten tarkkaa syntymäaikaa ei puutteellisten tietojen vuoksi voitu määrittää.

Väitöskirjan tulosten yleistettävyyteen liittyy tiettyjä rajoitteita. Tutkimukseen osallistuneet lasten vanhemmat olivat muuta Suomen aikuisväestöä korkeammin koulutettuja, joka asettanee suurimman kysymyksen yleistettävyydestä. Lisäksi he mitä luultavammin ovat myönteisesti liikuntatutkimukseen suhtautuvia yksilöitä, joka voi liittyä esim. lasten alhaisempaan painoindeksiin. Näiden oletettujen tekijöiden vuoksi osa yhteyksistä voi hämärtyä. Esimerkiksi tutkimuksessa havaittiin, että korkeampi kehon painoindeksi on yhteydessä korkeampaan koettuun motoriseen pätevyyteen, vaikka vain 3.4% lapsista kuului selkeästi ylipainoisten kategoriaan (osajulkaisu III). Tämä tulos on myös vastoin aikaisempia tutkimuksia, joissa ylipainon on osoitettu olevan koettua motorista pätevyyttä heikentävä tekijä (Jones ym. 2010; Toftegaard-Stoeckel ym. 2010; Spessato, Gabbard, Robinson, ym. 2013).

Tämän väitöskirjan osajulkaisujen ja yhteenvedon vahvuuksina voidaan pitää kattavaa kansallista aineistoa, joka mahdollistaa alueellisten erojen tarkastelun maantieteellisen sijainnin sekä asukastiheyden perusteella. Lisäksi motoristen taitojen mittareiden puutteita on pyritty tasapainottamaan käyttämällä kahta eri mittaria, jotka osittain paljastavatkin eri näkökulmia lasten motoristen taitojen kehityksestä (osajulkaisut I, III). Ensinnäkin huomattiin, että vain TGMD-3 mittari tuotti selviä sukupuolieroja motoristen taitojen tasossa ja toisaalta ainoastaan tällä mittarilla mitattuna löydettiin kansallisesti eroja eri paikkakuntien välillä (osajulkaisu II). Tämän vuoksi herää kysymys siitä, onko ennen kaikkea harrastamismahdollisuuksissa eroja paikkakuntien välillä, sillä tyttöjen ja poikien harrastusten lajisisällöt suurissa otoksissa vaihtelevat. Myös motoristen taitojen yksityiskohtainen huomioiminen paljastaa sen, että suhteessa sukupuolieroihin pojilla ja tytöillä näyttää olevan eri vahvuudet motorisessa osaamisessa. Ennen kaikkea on tärkeää korostaa sitä, että molemmilla sukupuolilla on omat vahvuudet; pojilla pallonkäsittelytaidot ja tytöillä liikkumistaidot sekä osittain tasapainotaidot. Lapsen motorisen kehityksen näkökulmasta olisi tärkeää yksilö- ja ryhmätasolla korostaa heikkouksien harjoittelua vahvuuksien kautta. Esimerkiksi poikien kanssa liikkumistaitoja voisi ryhmätasolla harjoitella esimerkiksi pallonkäsittely kautta. Toisaalta tyttöjen lajitaitojen harjoittamiseen voisi lisätä pallonkäsittelyä liikkumistaitojen kautta. Tämä voisi motivoida ryhmätasolla enemmän heikkouksien harjoittamiseen, vaikka suuria yksilö- ja ryhmäkohtaisiakin eroja aina esiintyy.

Tässä tutkimuksessa tutkittiin lähes 500 päiväkotilapsen koettua motorista pätevyyttä (osajulkaisut III ja IV). Se on suurin kansallinen otos tässä ikäryhmässä ja kansainvälisestikin voidaan puhua mittavasta aineistosta. Lisäarvoa tutkimukseen tuo se, että kokemuksen on saanut välittää lapsi itse, eikä välillisesti esimerkiksi vanhemman kautta. Myös sosioekologisen mallin käyttö väitöskirjan teoreettisena viitekehyksenä (osajulkaisut I, III, IV) toi laajan määrän muuttujia, joiden yhteyttä motorisiin taitoihin ja koettuun motoriseen pätevyyteen pystyttiin tutkimaan. Tämän tiedon pohjalta voidaan olettaa, että syntyi laajempi ymmärrys niistä tekijöistä, jotka ovat merkityksellisiä motoristen taitojen ja koetun motorisen pätevyyden kannalta suomalaisilla päiväkotilapsilla.

Pohdinta ja johtopäätökset

Väitöskirjatutkimus antoi uutta ja tarkempaa tietoa motoristen taitojen tasosta ja niihin yhteydessä olevista tekijöistä kansallisesti laajalla päiväkotilasten aineistolla. Motorisen kehityksen kannalta yksilölliset tekijät, kuten esimerkiksi lapsen ikä ja sukupuoli, selittävät eniten motorisia taitoja sekä koettua motorista pätevyyttä. Lisäksi motoriikan eri mittareiden havaittiin tuottavan osittain erilaisia tuloksia, joten motoriikan mittaamisessa testimenetelmän käyttö, ja tulosten tulkinta, pitää tehdä harkiten. Ohjattuihin liikuntaharrastuksiin osallistuminen oli yhteydessä parempiin motorisiin taitoihin. Siitä huolimatta maaseudun lapsilla oli parhaimmat motoriset taidot, joten on tärkeää tunnistaa myös ympäristön, vapaan leikin ja ulkona vietetyn ajan merkitys motoristen taitojen kehityksen tukemiseen. Alla on listattu yhteenveto väitöskirjatutkimuksen päälöydöksistä ja niiden käytännön sovelluskeinoista lasten liikunnanedistämistyössä:

1. Lasten motoriset taidot kehittyvät iän myötä, mutta koetussa motoriikassa iän vaikutus oli päinvastainen eli laskeva. Tasoltaan laskeva koettu motorinen pätevyys tarkoittaa sitä, että iän myötä lasten kokemus omista taidoistaan on realistisempi. Sen vuoksi tämä on tärkeä kehityksellinen vaihe lapsen elämässä. Vaihe opettaa lapselle omia rajojaan ja sitä kautta lapsen toiminta muuttuu turvallisemmaksi. Aikuisen rooli on tässä kehityksessä tärkeä. Varhaislapsuudessa aikuinen kannustavalla otteellaan innostaa lasta kokeilemaan liikkumista ja korostamalla onnistumisia, lapsen koetun pätevyyden arvio nousee. Se lisää intoa kokeilla, liikkua, ja harjoitella motorisia taitoja. Tämä positiivinen kierre kumuloituu korkeampana fyysisenä aktiivisuutena, parempina motorisina taitoina, korkeampana koettuna motorisena pätevyytenä sekä voi ennaltaehkäistä pitkällä aikavälillä

ylipainolta. Iän myötä nämä yhteydet vahvistuvat ja aikuisen rooli muuttuu. Aikuisen rohkaiseva, mutta ohjaava positiivinen palaute, ohjaa lasta tiedostamaan taitonsa ja toimimaan niiden sallimissa rajoissa.

2. Tyttöjen ja poikien välillä havaittiin sukupuolieroja motorisissa taidoissa (TGMD-3) sekä koetussa motorisessa pätevyydessä (PMSC). Motorisissa taidoissa ei esiintynyt eroja KTK –mittarilla mitattuna. Motorisissa taidoissa tytöt olivat poikia parempia liikkumistaidoissa ja he myös kokivat olevansa niissä parempia. Pojat olivat tyttöjä parempia pallonkäsittelytaidoissa sekä TGMD-3 –mittarin kokonaispistemäärässä. Pojat myös kokivat olevansa tyttöjä parempia pallonkäsittelytaidoissa. Nämä sukupuolierot ja sukupuolten erilaiset vahvuudet ovat tärkeä tiedostaa lasten kanssa toimiessa. Ennen kaikkea niiden merkitys korostuu pedagogisessa mielessä, kun rakennetaan sisältöjä harrastuksiin tai varhaiskasvatuksen liikuntatuokioihin.
3. Päiväkotilasten koettu motorinen pätevyys on yleisesti ottaen korkea. Korkealla koetulla motorisella pätevyydellä on tärkeä kehityksellinen tarkoitus ohjata lasta kokeilemaan taitoja lannistumatta yhä uudelleen ja uudelleen, vaikka hän ei heti onnistuisikaan. Sen vuoksi aikuisen kannustus ja rohkaisu on tärkeää varhaislapsuudessa ja toisaalta mitä vanhemmaksi lapsi kasvaa, sitä suurempi merkitys on kavereilla sekä aikuisen ohjaavalla palautteella.
4. Asukastiheyden perusteella TGMD:ssä maaseudun lapset olivat parempia motorisissa taidoissaan ja he viettivät eniten aikaa ulkona päiväkotipäivän jälkeen. Voi olla, että alle kouluikäisten lasten liikkumisen ja motoristen taitojen kehittymisen kannalta on huomioitavaa, että lapsi pääsee liikkumaan vapaasti lähiympäristössään, vaihtelevassa maastossa. Tämä tukee liikkumistaitoja sekä tasapainotaitoja, jos eteneminen tapahtuu esim. juosten ja laukaten. Toisaalta vaihteleva maasto harjaannuttaa tasapainotaitoja. Pallonkäsittelytaidot ja pelit, jotka niitä kehittävät, onnistuvat paikoissa, joissa on runsaasti tilaa ja vain vähän esteitä pelaamiselle.
5. Pääkaupunkiseudun ja eteläsuomalaiset lapset osallistuivat eniten ohjattuihin liikuntaharrastuksiin. Liikuntaharrastaminen oli yhteydessä korkeampaan motoriseen taitotasoon sekä korkeampaan koettuun motoriseen pätevyyteen. Harrastusmahdollisuudet ovat siis tärkeitä. Sen vuoksi niitä pitäisi olla tarjolla kaikille lapsille asuinpaikasta tai esimerkiksi tulotasosta riippumatta. Erilaisten ympäristöjen aluesuunnittelussa tulisi ottaa huomioon liikuntapaikkojen läheisyys, sekä harrastusmahdollisuuksien monipuolisuus sekä lähiympäristön runsas tila vapaaseen leikkiin ja pelailuun ulkona.
6. Lapsen motorisiin taitoihin oli vahvimmin yhteydessä korkeampi ikä, liikuntaharrastaminen sekä yksilölliset temperamenttipiirteet, kuten korkeampi aktiivisuustaso ja kyky ylläpitää tarkkaavaisuutta. Temperamentin

yhteys motorisiin taitoihin tulisi huomioida sekä yksilö- että ryhmätasolla tarjoten lapsille mahdollisuuksia olla aktiivisia sekä toisaalta keskittyä ilman keskeytyksiä. Hyviä keinoja tällaisten oppimisympäristöjen luontiin voivat olla esimerkiksi vaihtelevat ryhmäkoot sekä liikuntatuokion jaksottaminen aktiiviseen ja keskittyneempään jaksoon. Myös ryhmien luomisessa opettaja tai varhaiskasvattaja voi ottaa huomioon lasten temperamenttipiirteet esimerkiksi valitsemalla pienryhmiin temperamentiltaan samantyyppisiä tai osin erilaisia lapsia.

7. Koetulla motorisella pätevyydellä oli vahvin yhteys lapsen nuorempaan ikään, korkeampaan kehon painoindeksiin, runsaampaan liikuntaharrastamiseen sekä parempaan motoriseen taitotaitoon. Lapsen kokemus realisoituu iän myötä ja sitä tukevat parempi motoristen taitojen taso sekä liikuntaharrastaminen. Lisäksi esimerkiksi alkuvuodesta syntyminen tai biologinen kypsyys sekä runsaamman liikkumisen vuoksi kehittynyt lihasmassa voivat selittää sitä, miksi korkeampi kehon painoindeksi on yhteydessä positiiviseen motorisen pätevyyden kokemukseen.

Asiasanat: motoriset taidot, TGMD-3, KTK, koettu motorinen pätevyys, PMSC, päiväkotilapset, sosioekologinen malli

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APPENDICES

Appendix 1. Informed study participation email for childcare directors.

Hyvä XXX päiväkodin johtaja,

Suomen Opetus- ja Kulttuuriministeriön (OKM) rahoittaman ”Taitavat tenavat” -tutkimushankkeen tarkoituksena on kartoittaa 3-6-vuotiaiden päiväkotilasten motorisia perustaitoja ja niihin yhteydessä olevia tekijöitä. Hanke on osa Jyväskylän yliopiston Liikuntatieteellisen tiedekunnan tutkimustyötä, joka pyrkii edistämään päiväkoti-ikäisten lasten motorisia perustaitoja, liikunta-aktiivisuutta ja kokonaisvaltaista hyvinvointia. Taitavat tenavat –tutkimukseen kutsutaan noin 1000 lasta 20-30 eri päiväkodista, eri puolilta Suomea. Tutkimukseen kutsutaan mukaan satunnaisotannan perusteella, joka on tehty 2600 päiväkodin sijaintitietojen pohjalta. Projektin johtajana toimii lasten liikuntakasvatuksen dosentti Arja Sääkslahti Jyväskylän yliopistosta.

Taitavat tenavat -tutkimuksessa selvitetään lasten liikkumistaitoja (kuten juoksua, hyppimistä ja laukkaamista), käsittelytaitoja (esimerkiksi pallon heittämistä, lyömistä ja potkaisemista) sekä tasapainotaitoja (kuten yhdellä jalalla seisomista). Lapsen motoristen taitojen yhteyttä sisäisiin (kuten temperamentti) ja ulkoisiin tekijöihin (esimerkiksi päiväkodin piha) mitataan kyselylomakkeilla. Tutkimukseen kuuluvat kyselylomakkeet ovat erikseen lapsen huoltajille sekä kysely päiväkodin liikuntaolosuhteista suoraan päiväkodin johtajalle.

Lähestyn Teitä, sillä 2 600 päiväkodin satunnaisotannan perusteella teidän päiväkotinne valikoitui mahdolliseksi tutkimuspäiväkodiksi. Tutkimukseen osallistuminen on täysin vapaaehtoista. Siksi tämän ennakkokirjeen saatuanne, toivon, että mietitte mahdollista osallistumishalukkuuttanne. Tiedustelen mahdollista osallistumishalukkuuttanne soittamalla teille puhelimitse. Puhelun yhteydessä voitte kysellä aiheesta lisää ja sen perusteella päättää päiväkotinne halukkuudesta osallistua tutkimukseen. Kaikkien osallistujapäiväkotien kesken tullaan arpomaan liikuntavälinekassi.

Soitan Teille asiasta kahden seuraavan viikon kuluessa. Halutessanne voitte myös soittaa minulle alla olevaan puhelinnumeroon.

Tutkimus etenee seuraavasti:

- Päiväkotien valitseminen satunnaisotannalla ja yhteydenotot päiväkotien johtajiin. Jos satunnaisotannan perusteella valittu päiväkodin johtaja kieltäytyy tutkimuksesta, kutsutaan tilalle listalla seuraavana oleva päiväkoti.
- Halukkaille tutkimuspäiväkodeille lähetetään vanhemmille eteenpäin välitettäväksi informaatiokirje tutkimuksesta ja lupalappu lapsen mahdollisesta osallistumisesta tutkimukseen.
- Sovitaan mittausajankohta kevään 2016 ajalle (tammikuu – toukokuu).
- Mittausten tekeminen ja niiden perustella lasten liikuntataidoista päiväkotikohtainen palaute
- Liikuntavälinepaketin arvonta

Tutkimukseen osallistuminen on täysin vapaaehtoista niin päiväkodille, vanhemmille kuin lapsille. Tutkijat antavat mielellään lisätietoja mittauksista sekä tutkimuksen tarkoituksesta. Kaikki tutkimukseen liittyvä toiminta tehdään yhteistyössä päiväkodin henkilökunnan kanssa normaalia päivärytmiä ja toimintaa kunnioittavasti. Lisäksi tutkimusaineisto tullaan käsittelemään täysin luottamuksellisesti niin, ettei yksittäistä lasta tai päiväkotia voida tunnistaa.

Tutkimus on merkittävä, sillä se tarjoaa varhaiskasvattajille ja lasten huoltajille tietoa siitä, kuinka he voivat tulevaisuudessa muokata lapsen ympäristöä niin, että liikunnalliset taidot kehittyvät lasten leikkien lomassa. Tutkimus tuottaa uutta ja tärkeää tietoa lapsen osaamisen kokemuksista ja hänen temperamentin piirteittensä yhteydestä taitoon liikkua ja leikkiä fyysisesti aktiivisella tavalla. Tutkimuksen tulosten avulla me aikuiset opimme huomioimaan yksilöllistä erilaisuutta paremmin sekä opimme tukemaan jokaisen yksilöllistä kehityskulkua aikaisempaa paremmin.

Ystävällisesti,

Liikuntakasvatuksen laitoksen tohtorikoulutettava

Donna Niemistö, LitM
puh: 040 - 8053 023
sähköposti: donna.m.niemisto@student.jyu.fi

Appendix 2. Informed consent for parents.

SUOSTUMUS TUTKIMUKSEEN OSALLISTUMISEEN

Hyvät lapsen huoltajat,

Lapsenne päiväkoti osallistuu ”Taitavat tenavat”-nimiseen Suomen Opetus- ja Kulttuuriministeriön (OKM) rahoittamaan hankkeeseen, jossa kartoitetaan 3-6-vuotiaiden päiväkotilasten motorisia perustaitoja, ja niihin yhteydessä olevia tekijöitä eri puolilla Suomea. Hanke on osa Jyväskylän yliopiston Liikuntatieteellisen tiedekunnan tutkimustyötä, jonka tarkoituksena on edistää päiväkoti-ikäisten lasten motorisia perustaitoja, liikunta-aktiivisuutta ja kokonaisvaltaista hyvinvointia. Tutkimus selvittää, onko lapsen sisäisillä tai ulkoisilla tekijöillä yhteyttä hänen motorisiin taitoihinsa. Lapsen sisäisiä tekijöitä ovat hänen fyysinen kasvunsa, käsitys itsestä liikkujana sekä hänen temperamentin piirteensä. Ympäristötekijöitä ovat fyysiseen ympäristöön (kuten päiväkodin ja kodin leikkipaikat) sekä sosiaaliseen ympäristöön (vanhempien ja päiväkodin henkilökunnan tukeen ja kaverisuhteisiin) liittyviä asioita.

Tutkimuksessa lasta pyydetään tekemään erilaisia liikuntatehtäviä kuten kävelyä, juoksua, hyppäämistä, heittämistä, kiinniottamista sekä mailalla lyömistä. Lasten taitoja mitataan tunnetuilla motoriikan testistöillä, kuten TGMD-3 (mukailtu Ulrich 2000), KTK (Kiphard & Schilling 2007) tai APM testistö (Numminen 1995). Ennen taitojen mittaamista lasta pyydetään erilaisten kuvien avulla arvioimaan sitä, miten hän omasta mielestään suoriutuu erilaisista liikuntatehtävistä. Tässä arvioinnissa käytetään apuna kansainvälistä minäpystyvyysmittaria (Pictorial instrument for assessing fundamental movement skill perceived competence in young children, Barnett ym. 2013). Lapsen fyysinen kasvu tutkitaan mittaamalla lapsen pituus, paino ja vyötärönympärys.

Lapsenne päiväkoti on sitoutunut täyttämään taustatietolomakkeen päiväkodin arjesta ja siihen liittyvistä fyysiseen aktiivisuuteen yhteydessä olevista tekijöistä (kuten lasten leikkiympäristö, liikuntavälineet, päivän ulkoiluhetket ja vapaat leikkituokiot). Lisäksi tutkimukseen osallistuvien lasten huoltajia pyydetään ystävällisesti täyttämään kysely lapsensa liikuntatottumusten taustatekijöistä sekä temperamenttista (Colorado Childhood Temperament Inventory questionnaire, Rowe & Plomin 1977) sekä teidän aikuisten omasta liikunta-aktiivisuudestanne (IPAQ). Näihin kyselyihin vastaamiseen kuluu aikaa yhteensä noin 15 minuuttia. Vastaamalla ja palauttamalla lomakkeen lapsenne päiväkoti osallistuu lasten liikuntavälinepaketin arvontaan. Näin kaikilla lapsilla on mahdollisuus saada päiväkotiin lisää uusia liikuntavälineitä. Päiväkodissa vierailevat tutkijat kuvaavat päiväkodin pihan, ympäristön sekä raportoivat päiväkodin liikuntavälinemäärän.

Tutkimukseen osallistuminen on täysin vapaaehtoista. Halutessaan lapsi voi kieltäytyä tekemästä mitä tahansa pyydettyä tehtävää ilman seuraamuksia. Tutkimus tapahtuu päiväkodin omissa tiloissa sovittuna ajankohtana. Tutkijat tekevät liikuntamittaukset turvallisessa, niille varatussa tilassa. Vain tutkimukseen luvan saaneet lapset osallistuvat mittauksiin. Mittaustuokioista ei aiheudu vaaraa. Huoltajien toivotaan selvittävän tutkimukseen osallistuvalle lapselleen tutkimuksen tarkoituksen sekä kertovan, että tutkimus on lapselle vapaaehtoinen ja että hän voi keskeyttää sen niin halutessaan. Tutkijat sekä päiväkodin henkilökunta antavat mielellään lisätietoja tutkimuksesta, niihin liittyvistä mittauksista sekä tutkimuksen tarkoituksesta. Kaikki tutkimukseen liittyvä toiminta tehdään yhteistyössä päiväkodin henkilökunnan kanssa normaalia päivärytmiä ja toimintaa kunnioittavasti.

Tutkimusaineisto tullaan käsittelemään täysin luottamuksellisesti. Tulosten raportoinnissa kenenkään henkilöllisyys ei tule selville ja tietoja käytetään ainoastaan tutkimustarkoituksiin. Tutkimusaineisto tallennetaan Jyväskylän yliopiston tietoturvalliselle suojatulle palvelimelle, jossa aineistoa käsitellään niin, että lapset eivät ole tunnistettavissa lopullisesta tutkimusaineistosta. Manuaalinen aineisto säilytetään tutkijaryhmän hallussa Jyväskylän yliopiston liikuntakasvatuksen laitoksella lukituissa tiloissa. Jyväskylän yliopiston henkilökunta ja toiminta on vakuutettu. Tutkimuksissa lapset on vakuutettu tutkimuksen ajan ulkoisen syyn aiheuttamien tapaturmien, vahinkojen ja vammojen varalta. Mikäli tutkimushanke tulee saamaan lisärahoitusta, on mahdollista, että tutkimukseen järjestetään seurantamittauksia. Tällaista mahdollista seurantaa varten huoltajilta tullaan pyytämään uusi, erillinen suostumus. Nyt pyydettävä tutkimussuostumus kattaa siis vain tämän yhden kerran aineistonkeruun.

Tutkimus on merkittävä, sillä se tarjoaa varhaiskasvattajille ja lasten huoltajille tietoa siitä, kuinka he voivat tulevaisuudessa muokata lapsen ympäristöä niin, että lapset liikunnalliset taidot kehittyvät lasten leikkien lomassa. Tutkimus tuottaa uutta ja tärkeää tietoa lapsen osaamisen kokemuksista ja hänen temperamentin piirteidensä yhteydestä taitoon liikkua ja leikkiä fyysisesti aktiivisella tavalla. Tutkimuksen tulosten avulla me aikuiset opimme huomioimaan yksilöllistä erilaisuutta paremmin sekä opimme tukemaan jokaisen yksilöllistä kehityskulkua aikaisempaa paremmin.

Lisätietoja tutkimuksesta mielellään antavat
Liikuntakasvatuksen laitoksen tohtorikoulutettava Donna Niemistö, puh. 040-8053023, donna.m.niemisto@student.jyu.fi sekä tutkimusprojektin johtaja LitT, dosentti Arja Sääkslahti, arja.saakslahti@jyu.fi.

Pyydämme teitä ystävällisesti palauttamaan alaosan täytettynä päiväkotiin mahdollisimman pian.

Yhteistyöstä kiittäen,

Tohtorikoulutettava Donna Niemistö ja tutkimusryhmä

Leikkaa
………

Pyydämme palauttamaan ”suostumus tutkimukseen osallistumiseen” -liuskan täytettynä päiväkotiin mahdollisimman pian.

Lapsen nimi: ____

Rastita haluamasi vaihtoehto:

☐ Annan luvan lapsen osallistumiselle liikuntatutkimukseen

☐ En anna lapselle lupaa tutkimukseen osallistumiselle

Päiväys ja paikka: ____

Huoltajan allekirjoitus: ____

Appendix 3. The Skilled Kids parental questionnaire.

TAITAVAT TENAVAT

Taitavat tenavat –kyselylomake huoltajille

1.Lapsen etu- ja sukunimi: ____

2. Tyttö: ____ Poika: _______ 3.Syntymäaika: ______/_______/___________

4. Syntymäpaino: ___________ g 5. Millä raskausviikolla lapsi syntyi? _______

6. Tutkimukseen osallistuva lapsenne on syntymäjärjestykseltään perheen ____ lapsi
(merkitse numerolla, 1=esikoinen, 2= toisena syntynyt lapsi jne.)

7. Lapsen äidinkieli: _____ suomi ______ ruotsi ______ jokin muu, mikä?____________

8. Lapseni päiväkoti on nimeltään: ____

9. Minkä ikäisenä lapsi oppi kävelemään ilman tukea? ________________ kk ikäisenä

10. Vastaajan ikä: __________ 11. Sukupuoli: ____ mies _____ nainen

12. Vastaajan koulutus:
____ peruskoulu
____ ammattikoulu/lukio
____ ammattikorkeakoulu
____ yliopisto

13. Vastaaja harrastaa liikuntaa:
____ ei lainkaan
____ satunnaisesti muutaman kerran kuukaudessa
____ noin kerran viikossa
____ 2-3 kertaa viikossa
____ yli 4 kertaa viikossa

14. Minkälaista liikuntaa? ____
Kuinka paljon? ____________ minuuttia / kerta

15. Perheesi elämisen muoto:
_____ ydinperhe
_____ yksinhuoltaja
_____ uusperhe
_____ jokin muu, mikä? ____

16. Perheen koko: ______aikuista ______ lasta

Jos perheeseen ei kuulu puolisoa, voit siirtyä puolisoa koskevan kohdan yli.
17. Puolison ikä: ___________ 18. Sukupuoli: ____ mies _____ nainen

19. Puolison koulutus:
____ peruskoulu
____ ammattikoulu/lukio
____ ammattikorkeakoulu
____ yliopisto

20. Puoliso harrastaa liikuntaa:
____ ei lainkaan
____ satunnaisesti muutaman kerran kuukaudessa
____ noin kerran viikossa
____ 2-3 kertaa viikossa
____ yli 4 kertaa viikossa

21. Minkälaista liikuntaa? ____
Kuinka paljon? ____________ minuuttia / kerta

22. Merkitse rasti alla olevaan laatikkoon, joka vastaa kotitaloutenne vuosittaisia bruttotuloja.

0-13 999€	14 000- 19 999 €	20 000- 39 999 €	40 000- 69 999 €	70 000- 99 999 €	100 000- 119 000€	120 000- 139 000€	140 000- €

23. Minkälaisessa talossa asutte?
____ Kerrostalo ____ Rivitalo ____ Omakotitalo

24. Onko asuinpaikkanne piha-alueella lapsella laaja tila leikkimiseen tai vapaasti liikkumiseen? (taka- tai etupiha, puutarha tms.)
____ Kyllä ____ Ei

25. Kuinka usein lapsenne saa käyttää asuinpaikan ulkopuolella olevaa laajaa tilaa leikkimiseen tai vapaasti liikkumiseen? (taka- ja etupiha, puutarha tms.)
____ Lähes päivittäin
____ Silloin tällöin
____ Viikonloppuisin
____ Ei koskaan

26. Arvioikaa, kuinka usein lapsenne on käyttänyt omalla paikkakunnalla tai lähikunnissa sijaitsevia liikuntapaikkoja. Arviointiasteikko: 0 = kyseistä paikkaa ei ole olemassa, 1 = ei juuri koskaan, 2 = satunnaisesti, 3 = viikoittain, 4 = keskimäärin päivittäin.
Huom! ympyröi kustakin kohdasta jokin numeroista 0-4.

Liikuntapaikka	ei ole olemassa	ei juuri koskaan	satunnaisesti	viikottain	keskimäärin päivittäin
Pallokenttä	0	1	2	3	4
Yleisurheilukenttä	0	1	2	3	4
Uimahalli	0	1	2	3	4
Urheiluhalli /Sali	0	1	2	3	4
Jäähalli	0	1	2	3	4
Luistinrata	0	1	2	3	4
Pururata	0	1	2	3	4
Virkistys- ja luontoalue	0	1	2	3	4
Leikkipuisto	0	1	2	3	4
Uimaranta	0	1	2	3	4
Muita, mitä (paikka ja arvio 0-4)					

27. Koetko, että asuntonne sisällä on riittävästi tilaa lapsenne vapaaseen leikkiin tai liikkumiseen?
______ Kyllä ______ Ei

28. Saako lapsenne käyttää sisällä olevaa tilaa vapaaseen leikkiin tai liikkumiseen?
_______ Kyllä ______ Ei

29. Onko lapsellanne oma huone?
_____ Kyllä ______ Ei

30. Onko lapsellanne omassa käytössään tai huoneessaan jokin tai useampi seuraavista:
_____ Ei mitään
_____ Televisio
_____ Pelikonsoli
_____ Tietokone
_____ Älypuhelin / tabletti / Ipad tms. älylaite
_____ Jokin muu, mikä? ____

31. Kuinka paljon lapsenne keskimäärin ulkoilee arkisin päiväkotipäivän jälkeen?
____ ei lainkaan
____ alle 30 minuuttia päivässä
____ noin 30-60 minuuttia päivässä
____ yli 60 minuuttia päivässä

32. Kuinka paljon lapsenne ulkoilee keskimäärin viikonloppuisin?
____ ei lainkaan
____ alle 30 minuuttia päivässä
____ noin 30-60 minuuttia päivässä
____ 1-2 tuntia päivässä
____ yli 2 tuntia päivässä

33. Kun vertaat lastanne muihin samanikäisiin lapsiin, ulkoileeko hän mielestäsi
____ vähemmän
____ saman verran
____ enemmän kuin muut lapset

34. Kun vertaat lapsenne liikuntataitoja muihin samanikäisiin lapsiin, onko hän mielestäsi
____ vähemmän taitava kuin muut
____ yhtä taitava kuin muut keskimäärin
____ liikunnallisesti taitavampi kuin muut lapset

35. Onko lapsellanne todettu vamma, sairaus tai ominaisuus, joka tarvitsee erityistä tukea?
____ ei
____ kyllä
Jos kyllä, niin mikä:____ ____

36. Harrastaako lapsenne ohjattua liikuntaa jossakin ryhmässä tai liikuntaseurassa?
_____ ei
_____ kyllä, minkälaista liikuntaa? ____
Kuinka usein? _____________ kertaa / viikossa
Kuinka paljon? ____________ minuuttia / kerta

37. Koetko, että lapsenne nauttii fyysisestä aktiivisuudesta?
_____ ei koskaan
_____ harvoin
_____ en osaa sanoa
_____ yleensä
_____ lähes aina

38. Kuinka paljon lapsenne nukkuu keskimäärin vuorokauden aikana **arkipäivisin** (päivä- ja yöunet)?
_____ alle 8 tuntia
_____ 8-9 tuntia
_____ 9-10 tuntia
_____ 10-11 tuntia
_____ yli 11 tuntia

39. Kuinka paljon lapsenne nukkuu keskimäärin vuorokauden aikana **viikonloppuisin** (päivä- ja yöunet)?
_____ alle 8 tuntia
_____ 8-9 tuntia
_____ 9-10 tuntia
_____ 10-11tuntia
_____ yli 11tuntia

40. Mieti lapsesi tyypillistä päivää ja tilannetta, jossa lapsesi istuu, makaa tai muuten viettää aikaansa paikallaan (esim. autossa, hiekkalaatikolla, rattaissa, tv:n äärellä, palapeliä tehdessään). Kuinka pitkän aikaa tällainen yhtäjaksoinen ja keskeytyksetön paikoillaan oleminen kestää pisimmillään?
_____ noin 15 minuuttia tai vähemmän
_____ noin 30 minuuttia
_____ noin 60 minuuttia
_____ noin 90 minuuttia tai enemmän

41. Mieti lapsenne tyypillistä päivää. **Kuinka usein** näitä pitkiä yhtäjaksoisia paikallaan olemisen jaksoja istuen, maaten tms. esiintyy päivässä?
_____ 1 kerta
_____ 2-3 kertaa
_____ 4-5 kertaa
_____ yli 6 kertaa

42. Kuinka paljon lapsenne viettää aikaa **arkipäivisin** mediaviihteen parissa yhteensä (televisio, tietokone, pelikonsoli, tabletti, älypuhelin jne.)?
____ei lainkaan
____ alle 30 minuuttia päivässä
____ noin 30-60 minuuttia päivässä
____ 1-2 tuntia päivässä
____ 2-3 tuntia päivässä
____ yli 3 tuntia päivässä

43. Kuinka paljon lapsenne viettää aikaa **viikonloppuisin** mediaviihteen parissa yhteensä (televisio, tietokone, pelikonsoli, tabletti, älypuhelin jne.)?
____ei lainkaan
____ alle 30 minuuttia päivässä
____ noin 30-60 minuuttia päivässä
____ 1-2 tuntia päivässä
____ 2-3 tuntia päivässä
____ yli 3 tuntia päivässä

44. Arvioi, kuinka usein osoitat suoraa tukea tutkimukseen osallistuvan lapsenne liikunnalliselle aktiivisuudelle. Suoralla tuella tarkoitetaan tässä esimerkiksi seuraavia asioita: liikuntaharrastuksiin kyyditseminen, liikunnalliseen toimintaan osallistumisesta koituvien kulujen maksaminen sekä liikuntavälineiden tai -vaatteiden ostaminen.
_____ ei koskaan
_____ harvemmin kuin kerran viikossa
_____ 1-2 kertaa viikossa
_____ 3-4 kertaa viikossa
_____ 5-6 kertaa viikossa
_____ päivittäin

45. Jos sinulla on puoliso, arvioi kuinka usein hän osoittaa suoraa tukea tutkimukseen osallistuvan lapsenne liikunnalliselle aktiivisuudelle. Suoralla tuella tarkoitetaan tässä esimerkiksi seuraavia asioita: liikuntaharrastuksiin kyyditseminen, liikunnalliseen toimintaan osallistumisesta koituvien kulujen maksaminen sekä liikuntavälineiden tai -vaatteiden ostaminen.
_____ ei koskaan
_____ harvemmin kuin kerran viikossa
_____ 1-2 kertaa viikossa
_____ 3-4 kertaa viikossa
_____ 5-6 kertaa viikossa
_____ päivittäin

46. Arvioi, kuinka usein osoitat kehuja tai kiitosta tutkimukseen osallistuvalle lapselle tämän liikunnallisen aktiivisuuden tai liikuntataitojen johdosta.
_____ ei koskaan
_____ harvemmin kuin kerran viikossa
_____ 1-2 kertaa viikossa
_____ 3-4 kertaa viikossa
_____ 5-6 kertaa viikossa
_____ päivittäin

47. Jos sinulla on puoliso, arvioi kuinka usein hän osoittaa kehuja tai kiitosta tutkimukseen osallistuvalle lapselle tämän liikunnallisen aktiivisuuden tai liikuntataitojen johdosta.
_____ ei koskaan
_____ harvemmin kuin kerran viikossa
_____ 1-2 kertaa viikossa
_____ 3-4 kertaa viikossa
_____ 5-6 kertaa viikossa
_____ päivittäin

48. Arvioi, kuinka usein perheenne harrastaa yhdessä liikkumista (esim. pyöräilyä, kävelyä, ulkona pelailua, retkeilyä, sisäliikuntaa, pelailua tai leikkimistä). Perheenä harrastamisella tarkoitetaan tässä sellaista toimintaa, johon osallistuu vähintään yksi aikuinen perheenjäsen ja jonka rooli ei rajoitu pelkkään valvomiseen vaan sisältää aktiivisen osallistumisen toimintaan.
_____ ei koskaan
_____ harvemmin kuin kerran viikossa
_____ 1-2 kertaa viikossa
_____ 3-4 kertaa viikossa
_____ 5-6 kertaa viikossa
_____ päivittäin

Lomake palautetaan mahdollisimman pian. *Kiitos vastauksistanne!*

Appendix 4. Child's temperament via parental rating instrument Colorado Childhood Temperament Inventory (CCTI) –questionnaire.

Colorado Childhood Temperament – kyselylomake

Ole ystävällinen ja ympyröi vaihtoehdoista se numero, joka mielestäsi kuvaa lastasi parhaiten.

	Ei kuvaa lastani lainkaan				Kuvaa lastani oikein hyvin
1. Lapsi ystävystyy helposti	1	2	3	4	5
2. Lapsi hermostuu helposti	1	2	3	4	5
3. Lapsi on vieraille ihmisille hyvin ystävällinen	1	2	3	4	5
4. Lapsi on melko tunteellinen	1	2	3	4	5
5. Lapsi on hyvin sosiaalinen	1	2	3	4	5
6. Lapsella kestää kauan sopeutua uusiin tuntemattomiin ihmisiin	1	2	3	4	5
7. Lapsi reakoi voimakkaasti hermostuessaan	1	2	3	4	5
8. Lapsi itkee helposti	1	2	3	4	5
9. Lapsi on melko ujo	1	2	3	4	5
10. Lapsi on usein ärtyisä ja itkuinen	1	2	3	4	5
11. Lapsi on hyvin energinen	1	2	3	4	5
12. Lapsi leikkii yhdellä lelulla pitkän aikaa	1	2	3	4	5
13. Lapsi on menossa koko ajan	1	2	3	4	5
14. Lasta miellyttävät enemmän rauhalliset kuin vauhdikkaat pelit ja leikit	1	2	3	4	5
15. Lapsi harjoittelee tehtävää niin kauan, että lopulta onnistuu siinä	1	2	3	4	5
16. Heti herättyään lapsi lähtee liikkeelle ja aloittaa touhuamisen	1	2	3	4	5

17. Lapsi siirtyy lelusta toiseen hyvin nopeasti	1	2	3	4	5
18. Lapsi liikkuu paikasta toiseen hyvin hitaasti	1	2	3	4	5
19. Lapsi luovuttaa vastoinkäymisissä helposti	1	2	3	4	5
20. Lapsi luovuttaa helposti leikkiessään vaikealla lelulla	1	2	3	4	5
21. Lapsi maistoi harvoin uutta ruokaa ilman vastustusta	1	2	3	4	5
22. Kun lapsi alkaa itkeä, hänet on helppo saada lopettamaan	1	2	3	4	5
23. Lapsi välttelee jatkuvasti useita ruokalajeja	1	2	3	4	5
24. Kun lapsi hermostuu yllättävässä tilanteessa, hän rauhoittuu nopeasti	1	2	3	4	5
25. Lapsi reakoi voimakkaasti irvistellen uusille ruuille	1	2	3	4	5
26. Kun lapsi on päättänyt, että hän ei pidä jostain, mikään ei saa häntä muuttamaan mieltään	1	2	3	4	5
27. Lapsi lopetti kiukuttelun heti, kun joku puhui hänelle tai hänet otettiin syliin	1	2	3	4	5
28. Lapsella on voimakkaita mieltymyksiä ja inhoja ruokaa kohtaan	1	2	3	4	5
29. Lapsi lopettaa itkemisen heti, kun hänelle puhutaan	1	2	3	4	5
30. Lapsi kestää turhautumista hyvin	1	2	3	4	5

Appendix 5. Feedback form for childcare centres after the participation.

PÄIVÄKOTIKOHTAINEN PALAUTE
TAITAVAT TENAVAT –TUTKIMUKSEEN OSALLISTUMISESTA

Päiväkoti:

Ajankohta:

Testaajat:

Tutkimukseen osallistuneet lapset:

Testit: Testauksessa XX.XX.2015/2016 arvioitiin kaikkien 3-6 –vuotiaiden tutkimukseen osallistuvien lasten liikkumistaitoja, kuten juoksua, laukkaa eteenpäin, kinkkausta, vuorohyppelyä, vauhditonta pituushyppyä ja sivulaukkaa molempiin suuntiin. Pallon käsittelytaidoista arvioitiin kahden käden mailasivulyönti, yhden käden kämmenlyönti, pallon pomputus paikoillaan sormenpäillä, kahden käden kiinniotto heitosta, potku vauhdista, yliolan heitto kohti seinää sekä aliolan heitto. Yhteensä arvioitiin 13 motorista perustaitoa.

XX.XX.2015/2016 testattiin 5-6-vuotiaiden lasten tasapainotaitoja neljällä eri osiolla. Ne koostuivat takaperin tasapainoilusta puomien päällä, yhdellä jalalla hyppelystä, 15 sekunnin sivuttaishyppelystä ja sivuttaisesta siirtymisestä kahta puulevyä siirtämällä 20 sekunnin ajan.

Lisäksi lapset vastasivat minäpystyvyystestin 13 kysymykseen yksilöllisesti sopivana ajankohtana. Lapsilta mitattiin myös heidän fyysinen kasvunsa (pituus, paino ja vyötärönympärysmitta).

Lasten huoltajat ja päiväkotihenkilökunta vastasivat heille suunnattuihin kyselylomakkeisiin.

Ryhmäkohtaisia huomioita lasten liikkumisesta:

Lapsikohtaisia huomioita motoriikkataidoista:

Päiväkodin ympäristön liikkumismahdollisuudet:

Tutkimuksen etenemisestä tulevaisuudessa: Tutkimus on merkittävä, sillä se tarjoaa varhaiskasvattajille ja lasten huoltajille tietoa siitä, kuinka he voivat tulevaisuudessa muokata lapsen ympäristöä niin, että liikunnalliset taidot kehittyvät lasten leikkien lomassa kotona ja päiväkodeissa. Tutkimus tuottaa uutta ja tärkeää tietoa lapsen osaamisen kokemuksista ja hänen temperamentin piirteittensä yhteydestä taitoon liikkua ja leikkiä fyysisesti aktiivisella tavalla.

Kevään 2016 aikana kaikkien osallistujapäiväkotien kesken tullaan arpomaan liikuntavälinekassi.

Ystävällisesti teitä kiittäen koko tutkimushenkilökunnan puolesta,

Liikuntakasvatuksen laitoksen tohtorikoulutettava

Donna Niemistö, LitM
puh: 040 - 8053 023
sähköposti: donna.m.niemisto@student.jyu.fi

TAITAVAT TENAVAT –ideoita ryhmäkohtaiseen harjoitteluun

Keltaisia osioita voi painottaa lasten kanssa leikeissä ja harjoittelussa.

Liikkumistaidot	**Kriteeri**
1. Juoksu	Vastakkainen käsi ja jalka heilahtavat
	Juoksun aikana molemmat jalat ovat ilmassa
	Juoksuasennossa kädet ja jalat liikkuvat eteen ja taakse (eivät kierry sivulle), jalkaterä tulee maahan päkiä edellä
	Juoksun aikana takaa eteen heilahtava jalka heilahtaa läheltä pakaraa
2. Laukka eteenpäin	Kädet ovat kyynärpäistä koukussa ja ne heilahtavat suoraan eteenpäin
	Takimmainen jalka ei ohita etummaista jalkaa laukan aikana
	Molemmat jalat ovat pienen hetken ilmassa eli irti maasta
	Lapsi tekee neljä peräkkäistä laukkaa rytmissä
3. Kinkkaus	Vapaa jalka myötäilee ja vauhdittaa hyppyä
	Vapaana olevan jalan jalkaterä pysyy ponnistavan jalan takana (ei siis ohita jalkaa)
	Kädet ovat kyynärpäät koukussa ja antavat hyppyyn vauhtia heilahtamalla suoraan eteenpäin
	Lapsi tekee neljä peräkkäistä kinkkausta rytmissä
4. Vuorohyppely	Lapsi osaa vuorohyppelyn askelluksen ja rytmin (askel-hypyn)
	Hyppelyn aikana vastakkainen käsi ja jalka heilahtavat, kädet kyynärpäistä hieman koukistuneina
	Lapsi tekee neljä peräkkäistä vuorohyppelyä rytmissä
5. Vauhditon pituushyppy	Lapsi aloittaa ponnistuksen koukistamalla polvensa ja hän vie samalla kädet taakse
	Hypyn ilmalennon aikana molemmat kädet ojentuvat ja nousevat pään yläpuolelle
	Lapsi ponnistaa ja tulee hypystä alas tasajalkaa (eli molemmilla jaloilla yhtä aikaa)
	Alastulossa kädet tulevat eteen alas ja jäävät siihen
6. Sivulaukka	Lapsen asento säilyy kylki edellä koko suorituksen ajan
	Lapsi ottaa askeleen ja vapaan jalan laukan niin, että hetkellisesti molemmat jalat ovat ilmassa
	Lapsi tekee neljä peräkkäistä sivulaukkaa rytmissä
	Lapsi tekee neljä peräkkäistä sivulaukkaa rytmissä heikompi kylki edellä

Pallon käsittelytaidot	Kriteeri
1. Kahden käden mailasivulyönti (pesislyönti)	Lapsi ottaa mailasta kahdella kädellä kiinni, vahvempi käsi ylempänä
	Ennen lyöntiä lapsi asettuu lyöntisuuntaan nähden vastakkainen lantio ja olkapää eteenpäin
	Lyönnin kiertoliike on edestakainen ja pysähtyy (hän ei jatka pyörähtämistä lyönnin jälkeen)
	Lyönnin aikana paino siirtyy taaemmalta jalalta etummaiselle jalalle
	Pallo lähtee lyönnistä suoraan eteenpäin
2. Yhden käden kämmenlyönti (Tennislyönti)	Maila heilahtaa taakse samaan aikaan, kun pallo pompahtaa maasta
	Lyönnin aikana paino siirtyy selvästi taaemmalta jalalta etummaiselle jalalle
	Lapsi lyö pallon kohti seinää
	Osuman jälkeen mailakäden liikerata jatkuu kohti vastakkaista olkapäätä
3. Pallon pompotus	Palloon kosketus tulee noin vyötärön korkeudelta
	Käsi koskettaa palloa sormilla (ei pomputusta kämmenpohjalla)
	Lapsi tekee 4 peräkkäistä pomputusta samalla paikalla, eikä pallo karkaa kauemmaksi
4. Kahden käden kiinniotto	Valmistautuessaan lapsen kädet ovat edessä koukistettuina
	Lapsi tulee palloa käsillään vastaan
	Lapsi tarttuu palloon vain käsillään (eli käsivarret tai muu ruumiinosa ei osu palloon)
5. Potku	Lapsi potkaisee palloa juoksun päätteeksi ilman, että hän pysähtyy ennen potkua
	Potkua edeltävä askel on muita askeleita pitempi
	Potkun hetkellä tukijalka on pallon vieressä sivulla
	Lapsi osuu palloon jalan sisäsyrjällä
6. Yläkautta heitto	Heittoliikkeen alussa lapsi vie käden taakse alas
	Heiton päätteeksi vartalo kiertyy pallon perään kohti heittosuuntaa
	Paino siirtyy heiton aikana taaimmaiselta jalalta etummaiselle jalalle
	Heittävän käden saattoliike jatkuu heiton jälkeen vastakkaista lonkkaa kohti
7. Alakautta heitto	Heitto alkaa heittävän käden viemisellä alas selän taakse
	Heiton aikana paino siirtyy taaimmaiselta jalalta etummaiselle jalalle
	Pallo lentää seinään ilman pomppua maahan
	Heittokäden saattoliike jatkuu pallon perään ja nousee vähintään rinnan tasolle

Appendix 6. The TGMD-3 sheet form.

Päiväkoti: ______________________ Testaaja:__________________ Testauspäivä: _______

	Lapsen nimi:		
Liikkumistaidot	**Kriteeri**	**1**	**2**
1. Juoksu	Vastakkaiset kädet		
	Jalat ilmassa		
	Kapea asento ei ”lättäjalalla”		
	Läheltä pakaraa		
2. Laukka eteenpäin	Kädet koukussa heiluu eteen		
	Takajalka ei ohita etummaista		
	Jalat ilmassa hetken		
	4 peräkkäistä		
3. Konkkaus	Vapaan jalan vauhdittava liike		
	Vapaajalkaterä ei ohita hyppäävää		
	Kädet koukussa vauhdittavat		
	4 peräkkäistä		
4. Vuorohyppely	Askel-hyppy		
	Vastakkaiset kädet koukistettuina		
	4 peräkkäistä rytmikästä		
5. Tasaponnistus eteen	Polvet koukkuun + kädet taakse		
	Kädet pään yläpuolelle		
	Ponnistus + alastulo tasajalkaa		
	Kädet jäävät eteen-alas		
6. Sivulaukka	Sivuasento säilyy (pisteytä “parempi suunta”)		
	Askel ja vapaan jalan laukka, hetkellisesti molemmat ilmassa (pisteytä ”parempi” suunta)		
	4 peräkkäistä (”parempaan” suuntaan)		
	4 peräkkäistä ”huonompaan” suuntaan		
	Liikkumistaitojen tulos:		

1. Kahden käden mailasivulyönti	”Parempi” käsi ylempänä		
	Vastakkainen lantio/olka eteenpäin		
	Edestakaisin / pysähtyvä kiertoliike		
	Selkeä painonsiirto (askel) ei-tukijalalla		
	Lyö pallon suoraan eteenpäin		
2. Yhden käden kämmenlyönti	Mailan takaheilahdus kun pallo pomppaa		
	Selkeä painonsiirto (askel) ei-tukijalalla		
	Lyö pallon kohti seinää		
	Mailalla saatto kohti vastakk. olkaa		
3. Pompotus	Kosketus palloon n. vyötärön kork.		
	Sormenpäillä		
	4 peräkkäin jalat pysyen paikoillaan		
4. Kiinniotto	Kädet edessä koukistettuina		
	Käsillä liike palloa vastaan		
	Tarttuminen vain käsillä		
5. Potku	Nopea jatkuva (juoksu) lähestyminen		
	Pidentynyt askel juuri ennen kontaktia		
	Tukijalka lähellä palloa		
	Osuma sisäsyrjällä/-terällä		
6. Yliolan heitto	Käsivarsi taakse-alas		
	Vartalon kierto kunnes ei-heittävä sivu osoittaa seinään		
	Selkeä painonsiirto (askel) ei-heittävän puolen jalalla kohti seinää		
	Heittokäden liike jatkuu kohti vastakkaista lonkkaa		
7. Aliolan heitto	Heittävän käden liike alas selän taakse		
	Astuu eteenpäin ei-heittävän puolen jalalla		
	Osuma seinään ilman pompahdusta		
	Käsillä saatto vähint. rinnan tasolle		
Pallon käsittelytaitojen tulos			
KMLT tulos			

Appendix 7. The KTK sheet form.

Lapsen nimi ____________________ ID:_____________ Paikka ja aika: ____________

1. Takaperin tasapainoilu
”Kävele takaperin puomilla niin pitkälle kuin pääset. Aloitetaan leveimmästä puomista”. Jokaisesta askeleesta piste, maksimi 8 pistettä / yritys. Huom! Ensimmäinen askel lasketaan siitä, kun toinenkin jalka asettuu puomille. Kokonaispistemäärä max 72.

Harjoittelu: kutakin palkkia voi harjoitella kävelemään kerran etu- ja takaperin.

Puomin leveys	1. yritys	2. yritys	3. yritys	Summa
6,0 cm (max 8pist./yritys)				
4,5 cm (max 8pist./yritys)				
3,0 cm (max 8pist./yritys)				

Summat YHT: _______

2. Yhdellä jalalla hyppely
”Ala hyppiä yhdellä jalalla tästä, hyppää vauhdilla yhdellä jalalla superlonien yli ja jatka vielä sen jälkeen vähintään 2 hyppyä samalla jalalla. Koko aikana et saa koskea toisella jalalla maahan, se katsotaan virheeksi.”
3 yritystä kummallakin jalalla / korkeus. Ylitys ensimmäisellä yrityksellä = 3 pist., toisella yrityksellä = 2 pist., viimeisellä yrityksellä = 1 pist. Jos pääsee yli vain vahvemmalla jalalla, niin jatketaan tällä jalalla pelkästään seuraavaan korkeuteen.

Harjoittelu: Kummallakin jalalla voi harjoitella 2 kertaa harjoituskorkeudelta. Suositus aloituskorkeudeksi: 5-6-vuotiaat 0cm (3 metriä yhdellä jalalla hyppelyä); 7-vuotiaat ja vanhemmat 10cm tai korkeampi.

Korkeus (cm)	0	5	10	15	20	25	30	35	40	45	50	55	60	Summa
Oikea jalka														
Vasen jalka														

Summat YHT: __________

3. Sivuttain hyppely
Molempien jalkojen on koskettava alustaa puuriman toisella puolella. Horjahtaminen ei keskeytä suoritusta, vaan lasta kehotetaan jatkamaan suoritusta. Harjoittelu: 5 hyppyä sivuttain alustalla.

	1. yritys	2. yritys	Summa
Hyppyaika 15 sekuntia			

Summa: __________

4. Sivuttain siirtyminen
1 piste: puulevy on siirretty puolelta toiselle, 2. Piste: lapsi on siirtynyt puulevylle, 3 piste: puulevy on siirretty puolelta toiselle jne. Harjoittelu: 5 kertaa sivuttain siirtyminen

	1. yritys	2. yritys	Summa
Siirtymisaika 20 sekuntia			

Summa: __________

4 TEHTÄVÄN KOKONAISSUMMAT YHTEENSÄ: __________

Appendix 8. The PMSC sheet form.

Pictorial Scale of Perceived Movement Skill Competence for Young Children

Lapsen syntymäaika: _____________ Testauspäivä: _________ Sukupuoli: P / T Ikä: _______ Testaajan nimi: _________ Muistiinpanot/ Kommentit: ___________________________________					
Taito	**Oletko kokeillut taitoa ennen?**	Ei kovin hyvä =1, Jonkin verran hyvä = 2, Aika hyvä = 3, Tosi hyvä = 4 HUOM! – Käänteinen järjestys joka toisessa kohdassa			
Juoksu	**K / E**	**4**	**3**	**2**	**1**
Laukka eteenpäin	**K / E**	**1**	**2**	**3**	**4**
Kinkkaus	**K / E**	**4**	**3**	**2**	**1**
Vuorohyppely	**K / E**	**1**	**2**	**3**	**4**
Tasaponnistus eteen	**K / E**	**4**	**3**	**2**	**1**
Sivulaukka	**K / E**	**1**	**2**	**3**	**4**
Kahden käden mailasivulyönti	**K / E**	**4**	**3**	**2**	**1**
Yhden käden kämmenlyönti	**K / E**	**1**	**2**	**3**	**4**
Pallon pomputus	**K / E**	**4**	**3**	**2**	**1**
Kahden käden kiinniotto	**K / E**	**1**	**2**	**3**	**4**
Potku	**K / E**	**4**	**3**	**2**	**1**
Aliolan heitto	**K / E**	**1**	**2**	**3**	**4**
Yliolan heitto	**K / E**	**4**	**3**	**2**	**1**

PMSC-PISTEET YHTEENSÄ: ________/ 52

Appendix 9. The translation of the PMSC into Finnish.

The protocol	English	Finnish
Locomotor skills		
Run		
Tries	Have you tried running before?	Oletko sinä juossut?
Not that good picture	This boy/girl isn't very good at running	Tämä poika/tyttö ei ole kovin hyvä juoksemaan
Quite good picture	This boy/girl is pretty good at running	Tämä poika/tyttö on aika hyvä juoksemaan
Question	Which boy/girl are you like when you run?	Kumpaa poikaa/tyttöä sinä muistutat, kun juokset?
Answer options	Really good (4 points) Pretty good (3 points) Sort of good (2 points) Not that good (1 point)	Tosi hyvä (4 pistettä) Aika hyvä (3 pistettä) Jonkin verran hyvä (2 pistettä) Ei niin hyvä (1 piste)
Gallop		
	Have you tried galloping before?	Oletko sinä laukannut eteenpäin?
	This boy/girl isn't very good at galloping	Tämä poika/tyttö ei ole kovin hyvä laukkaamaan
	This boy/girl is pretty good at galloping	Tämä poika/tyttö on aika hyvä laukkaamaan
	Which boy/girl are you like when you gallop?	Kumpaa poikaa/tyttöä sinä muistutat, kun laukkaat?
Hop		
	Have you tried hopping before?	Oletko sinä hyppinyt yhdellä jalalla?
	This boy/girl isn't very good at hopping	Tämä poika/tyttö ei ole kovin hyvä hyppimään yhdellä jalalla
	This boy/girl is pretty good at hopping	Tämä poika/tyttö on aika hyvä hyppimään yhdellä jalalla
	Which boy/girl are you like when you hop?	Kumpaa poikaa/tyttöä sinä muistutat, kun hypit yhdellä jalalla?
Skip		
	Have you tried skipping before?	Oletko sinä vuorohyppellyt?
	This boy/girl isn't very good at skipping	Tämä poika/tyttö ei ole kovin hyvä vuorohyppelemään
	This boy/girl is pretty good at skipping	Tämä poika/tyttö on aika hyvä vuorohyppelemään
	Which boy/girl are you like when you skip?	Kumpaa poikaa/tyttöä sinä muistutat, kun vuorohyppelet?
Jumping forward (horizontal jump)		
	Have you tried jumping forwards before?	Oletko sinä hypännyt pituushyppyä?
	This boy/girl isn't very good at jumping forwards	Tämä poika/tyttö ei ole kovin hyvä hyppäämään pituushyppyä
	This boy/girl is pretty good at jumping forwards	Tämä poika/tyttö on aika hyvä hyppäämään pituushyppyä
	Which boy/girl are you like when you jumping forward?	Kumpaa poikaa/tyttöä sinä muistutat, kun hyppäät pituushyppyä?

continues

Table continues

Step and slide (slide)		
	Have you tried side galloping before?	Oletko sinä laukannut sivuttain?
	This boy/girl isn't very good at side galloping	Tämä poika/tyttö ei ole kovin hyvä laukkaamaan sivuttain
	This boy/girl is pretty good at side galloping	Tämä poika/tyttö on aika hyvä laukkaamaan sivuttain
	Which boy/girl are you like when you side gallop?	Kumpaa poikaa/tyttöä sinä muistutat, kun laukkaat sivuttain?
Ball skills		
Hitting a ball (Two-hand strike of a stationary ball)		
	Have you tried hitting a ball before?	Oletko sinä lyönyt mailalla palloa?
	This boy/girl isn't very good at hitting a ball	Tämä poika/tyttö ei ole kovin hyvä lyömään mailalla palloa
	This boy/girl is pretty good at hitting a ball	Tämä poika/tyttö on aika hyvä lyömään mailalla palloa
	Which boy/girl are you like when you hit a ball?	Kumpaa poikaa/tyttöä sinä muistutat, kun lyöt mailalla palloa?
Hitting a ball with one hand on the bat (one-hand forehand strike)		
	Have you tried hitting a ball with one hand on the bat before?	Oletko sinä lyönyt palloa yhdellä kädellä ja mailalla?
	This boy/girl isn't very good at hitting a ball with one hand on the bat	Tämä poika/tyttö ei ole kovin hyvä lyömään palloa yhdellä kädellä ja mailalla
	This boy/girl is pretty good at hitting a ball with one hand on the bat	Tämä poika/tyttö on aika hyvä lyömään palloa yhdellä kädellä ja mailalla
	Which boy/girl are you like when you hit a ball with one hand on the bat?	Kumpaa poikaa/tyttöä sinä muistutat, kun lyöt palloa yhdellä kädellä ja mailalla?
Bouncing a ball (one-hand stationary dribble)		
	Have you tried bouncing a ball before?	Oletko sinä pomputtanut palloa?
	This boy/girl isn't very good at bouncing a ball	Tämä poika/tyttö ei ole kovin hyvä pomputtamaan palloa
	This boy/girl is pretty good at bouncing a ball	Tämä poika/tyttö on aika hyvä pomputtamaan palloa
	Which boy/girl are you like when you bounce a ball?	Kumpaa poikaa/tyttöä sinä muistutat, kun pomputat palloa?
(Two-hand) catch		
	Have you tried catching before?	Oletko sinä ottanut palloa kiinni kahdella kädellä?
	This boy/girl isn't very good at catching	Tämä poika/tyttö ei ole kovin hyvä ottamaan palloa kiinni kahdella kädellä
	This boy/girl is pretty good at catching	Tämä poika/tyttö on aika hyvä ottamaan palloa kiinni kahdella kädellä
	Which boy/girl are you like when you catch?	Kumpaa poikaa/tyttöä sinä muistutat, kun otat palloa kiinni?

continues

Table continues

Kicking (a stationary ball)		
	Have you tried kicking before?	Oletko sinä potkaissut palloa?
	This boy/girl isn't very good at kicking	Tämä poika ei ole kovin hyvä potkaisemaan palloa
	This boy/girl is pretty good at kicking	Tämä poika on aika hyvä potkaisemaan palloa
	Which boy/girl are you like when you kick?	Kumpaa poikaa/tyttöä sinä muistutat, kun potkaiset palloa?
Throwing a ball overhand (overhand throw)		
	Have you tried throwing a ball overhand before?	Oletko sinä heittänyt palloa yläkautta?
	This boy/girl isn't very good at throwing a ball overhand	Tämä poika ei ole kovin hyvä heittämään palloa yläkautta
	This boy/girl is pretty good at throwing a ball overhand	Tämä poika on aika hyvä heittämään palloa yläkautta
	Which boy/girl are you like when you throw a ball overhand?	Kumpaa poikaa/tyttöä sinä muistutat, kun heität palloa yläkautta?
Throwing a ball underhand (underhand throw)		
	Have you tried throwing a ball underhand before?	Oletko sinä heittänyt palloa alakautta?
	This boy/girl isn't very good at throwing a ball underhand	Tämä poika/tyttö ei ole kovin hyvä heittämään palloa alakautta
	This boy/girl is pretty good at throwing a ball underhand	Tämä poika/tyttö on aika hyvä heittämään palloa alakautta
	Which boy/girl are you like when you throw a ball underhand?	Kumpaa poikaa/tyttöä sinä muistutat, kun heität palloa alakautta?

Appendix 10. The derivation of the variable questions in the study.

Variable	Derivate from 1. What questionnaire?	Derivate from 2. With what question?	In the Skilled Kids – questionnaire
Biological factors			
Age	Children's Leisure Activities Study (CLASS) Affordances in the Home Environment for Motor Development Self-Report (AHEMD-SR)	Q14. What is his/her date of birth (day / month / year)? _______/_______/_______ Page 1, Birth Date: ____/____/____	Q3. Date of birth: _____/_____ /_____
Gender	Children's Leisure Activities Study (CLASS) Affordances in the Home Environment for Motor Development Self-Report (AHEMD-SR)	Q15. What is his/her sex? ☐1 Male ☐2 Female Page 1, Child Characterization: Male □ Female □	Q2. Girl:______ Boy:_______
Weight	Measured (Seca 877)		
Height	Measured (Charder HM 200P)		
BMI SDS	Measured and calculated national SDS		
Temperament	Colorado Childhood Temperament Inventory (CCTI)	For further information, see appendices 4 (questions in Finnish) and 11 (translation).	
Behavioural factors			
Motor competence	the Test of Gross Motor Development – third edition (TGMD-3) and the Körperkoordinationstest für Kinder (KTK)		

continues

Table continues

Perceived motor competence	the Pictorial Scale of Perceived Movement Skill Competence (PMSC)	For translation, see appendix 9.	
Sedentary time	Children's Leisure Activities Study (CLASS) Affordances in the Home Environment for Motor Development Self-Report (AHEMD-SR)	Q38. "Which of the following LEISURE activities does your child USUALLY do during a typical WEEK? (since the start of the school year, do NOT include school holidays)" → all answer options (n=15) relate to sitting or physically inactive behaviors. Specific answers are given with "total hours/minutes Monday-Friday" and "total hours/minutes Saturday & Sunday". "On a typical day, how would you describe the amount of awake time your child spends in each of the situations below? Q33. Carried in adult arms, attached to caregiver's body or in some carrying device. Q34. In a seating device (high chair, stroller, car seat, sofa, or any other type of seating devices) Q35. In a Playpen or some other similar equipment. Q36. On the bed or crib (while awake)" Answer options: No time □ Very little time □ Some time □ A long time □	Q40. "Think about your child's typical day and situations when (s)he is sitting or lying down or is sedentary in some other way (e.g. in a car, in a sandbox or in a trolley, in front of the TV or while playing with a puzzle). For how long, at the most, does such a sedentary activity approximately last continuously and without breaks?" 1 = >15 min, 2 = 30 min, 3 = 60 min and 4 = ≥90 min Q41. "How often is your child engaged in long and continuous sedentary activities in a day?" 1 = once, 2 = twice or thrice, 3 = four to five times and 4 = ≥six times

continues

Table continues

Time spent outdoors	Children's Leisure Activities Study (CLASS)	Q39. "In total how many hours/minutes does your child usually spend outside during a typical week after school? (MONDAY to FRIDAY) During the warmer months (Terms 1 and 4) __________hours and _________minutes/week (Monday to Friday) During the cooler months (Terms 2 and 3) __________hours and _________minutes/week (Monday to Friday) Q40. In total how many hours/minutes does your child usually spend outside on a typical weekend? (Saturday AND Sunday) During the warmer months (Terms 1 and 4) __________hours and _________minutes/weekend (Saturday AND Sunday) During the cooler months (Terms 2 and 3) __________hours and _________minutes/weekend (Saturday AND Sunday)"	Q31-32. "How much time, on average, does your child spend outdoors after a preschool day/on weekends?" The scale for weekdays: 0 = not at all, 1 = under 30 min/day, 2 = approximately 30–60 min/day, 3 = over 60 min/day) The scale for weekends: 0 = not at all, 1 = under 30 min/day, 2 = approximately 30–60 min/day, 3 = 1–2 h/day, 4 = over 2 h/day)
Participation in organised sport	Children's Leisure Activities Study (CLASS)	Q37. "Which of the following PHYSICAL activities does your child USUALLY do during a typical WEEK? (since the start of the school year, do NOT include school holidays)" → Answer options (n=32) are all related to physical activities. Information of each activity is asked with: "how many times Monday-Friday" and "how many times Saturday & Sunday"	Q36. "Does your child participate in organised PA or sports in a group or a sports club?" If the answer was "yes", further questions regarding such activities were asked, as follows: "How many times a week?" and "For how many minutes at a time?"

continues

Table continues

Family factors

Respondent's gender	Children's Leisure Activities Study (CLASS)	Q2. What is your sex? □1 Male □2 Female	Q11. Respondent's gender: ______Male ______Female
Parent's mean education level	Children's Leisure Activities Study (CLASS) Affordances in the Home Environment for Motor Development Self-Report (AHEMD-SR)	Q7, 29. "What is your (/your partners) highest level of schooling?" □1 Never attended school □2 Primary school □3 Some high school □4 Completed high school □5 Technical or trade school certificate/apprenticeship □6 University or tertiary qualification Q5-6. "What's the child's father's/mother's education?" □ Elementary School □ Middle School □ High School □ College □ Master □ PhD	Q12, 19. Education of the respondent / and partner 1=comprehensive school 2=high school/vocational school 3=polytechnic 4=university
Respondent's physical activity	Children's Leisure Activities Study (CLASS)	Q19. "In a typical week, how many times do you USUALLY do vigorous physical activity, which makes you breathe harder or puff and pant? (e.g. tennis, jogging, cycling) __________times in a typical week Please estimate the total time that you USUALLY spend doing vigorous physical activity in a typical week." __________hours and _________minutes	Q13. Respondent's exercises 0=not at all 1=randomly few times a month 2=approximately once a week 3 =2-3 times a week 4=over four times a week

continues

Table continues

Parental support for PAP	Family Physical Activity Environment (FPAE) questionnaire Children's Leisure Activities Study (CLASS), Q51-55	Direct support for PA: "Evaluate how often father/mother provides support for your child's participation in physical activity, such as taking him/her to PA hobby or training, providing money for participation, buying sports clothing/equipment." Reinforcement for PA: "Evaluate how often father/mother praises your child for participating in PA, such as saying positive things to him/her for participating in physical activity. Responses were scored: 0= don't know/ doesn't apply /never, 0.5= 1 time per week, 1.5= 1–2 times per week, 3.5= 3–4 times per week, 5.5= 5–6 times per week, 7= daily. Family participation in PA: ''How often the father, the mother, and other siblings (''think about the one who participates the most with your child'') each actively participate in physical activity with the child (e.g. go cycling or walking together, have a hit of tennis together; not just supervising the child while he/she is being active). Responses were scored: 0= don't know/doesn't apply, never/rarely, 0.5= 1–2 times/month, 1= 1 time/week, 3.5= several times/week, 7= daily. Q51. "How often do each of the following people participate in physical activities? (e.g. organised sport, walking for exercise, cycling or swimming)"	Q44-45. Direct support for PA: "Evaluate how often you (/your partner) provide support for your child's participation in PA, such as taking him or her to a PA hobby or training, providing money for participation and buying sports clothing/equipment." Q46-47. Reinforcement for PA: "Evaluate how often you (/your partner) praise your child for participating in PA, such as saying positive things to him or her for being physically active or physically skilful." Q48. Family participation in PA: "Evaluate how often you engage in PA, such as cycling, walking, playing outdoors or indoors, hiking and playing games, together as a family so that at least one parent is actively involved." The answer options were quantified as follows: 0= never, 0.5= less than once per week, 1.5= 1- 2 times per week, 3.5= 3- 4 times per week, 5.5= 5- 6 times per week, 7= daily.

continues

Table continues		Q52. “How often do the following people actively participate in physical activity with your child? (e.g. actually go cycling or walking together, or have a hit of tennis together. Not just supervising your child while he/she is being active)” Q53. “How often do you do the following activities together as a family with at least one adult family member?” Q54. “How often do the following people provide support for your child’s participation in physical activity? (e.g. take him/her to training, provide money for participation, buy sports clothing/equipment)” Q55. “How often do each of the following people praise your child for participating in physical activity? (e.g. say positive things to him/her, seem happy that he/she does it)”	
Environmental factors			
Electronic devices in use	Children's Leisure Activities Study (CLASS)	Q44. “How often does your child use the following at home?” Answer options from 1 “don’t have” to 7 “daily”. - Free to air TV - Pay TV - Video/DVD - Playstation/Nintendo/Gameboy - Computer Q45. “Does your child have a TV in his/her bedroom?” Q46. “How many TV’s do you have in your house?” Q58. “How often do you restrict the amount of time your child spends in the following?”	Q30. “Does your child have access to any or some of the following: 1) TV, 2) game console, 3) computer, 4) smartphone, tablet, Ipad or other smart device, 5) something else, what?” The number of accessible electronic devices was used in the analyses.

continues

Table continues		→ Answer options from 1 "don't know" to 5 "very often" - Watching TV - Playing Playstation/Nintendo - Going to friends' houses - Using the computer - Playing outside	
Access to sport facilities	Children's Leisure Activities Study (CLASS)	Q37. "Which of the following PHYSICAL activities does your child USUALLY do during a typical week?" → Answer options are 32 physical activities (such as e.g. aerobics, dance and basketball). More specified answer is given by responding to "Does your child usually do this activity?", "How many times in total Monday-Friday?" and "How many times in total Saturday & Sunday?" Q42. Please tell us about your yard. We have: □1 No yard at all □2 No private yard □3 A small yard (e.g. unit) □4 A medium yard (e.g. standard block of land) □5 A large yard (e.g. ¼ acre or more) Q 43. Which of the following do you have within or outside of your home/yard/garden? (please tick all that apply) Outside: □1 Front fence □2 Swimming pool/spa (e.g. patio, decked area, garage) □3 Trampoline □4 Cubby house □5 Basketball ring □6 Covered area outdoors □7 Paved area outdoors □8 Sandpits/swings/play equipment □9 Other (please state) 1)____________________________ 2)____________________________	Q26. "Evaluate how often your child has used sport or outdoor facilities situated in your own locality or municipality nearby." (e.g. playing field, playground, swimming hall, sports indoor hall). Q24. Additionally, the respondents were asked to estimate: "Is there a large area for the child's free-play on your home yard (front- or backyard, garden etc.)?" and furthermore, *Table continues…* Q25. "How often is your child allowed to play in the yard?" Answer options: scale from 0 to 4 0 = no access to a facility; 1 = nearly never; 2 = randomly; 3 = weekly; 4 = approximately daily. *continues*

Table continues		Inside: □10 Indoor play areas (e.g. rumpus room, family room) □11 Study/computer area	
Geographical location	Children's Leisure Activities Study (CLASS) Health Behaviour in School-aged Children (HBSC)	Q11. “What is the postcode of the suburb that you currently live in?” Protocol of the international Health Behaviour in School-aged Children (HBSC) –research	Based on the childcare centres postcode
Residential density	Children's Leisure Activities Study (CLASS) Health Behaviour in School-aged Children (HBSC)	Q11. “What is the postcode of the suburb that you currently live in?” Protocol of the international Health Behaviour in School-aged Children (HBSC) –research	Based on the childcare centres postcode

Q=question, BMI SDS= Body mass index standard deviation scores, min= minutes, n=number, PA=physical activity, e.g.=for example, PAP=physical activity parenting.

Appendix 11. Parental rating instrument Colorado Childhood Temperament Inventory (CCTI) –questionnaire: Questions in English and in Finnish.

Question number	English	Finnish	Scale
1	Child makes friend easily	Lapsi ystävystyy helposti	Sociability
2	Child gets upset easily	Lapsi hermostuu helposti	Emotionality
3	Child is very friendly with strangers	Lapsi on vieraille ihmisille hyvin ystävällinen	Sociability
4	Child tends to be somewhat emotional	Lapsi on melko tunteellinen	Emotionality
5	Child is very sociable	Lapsi on hyvin sosiaalinen	Sociability
6	Child takes a long time to warm up to strangers	Lapsella kestää kauan sopeutua uusiin tuntemattomiin ihmisiin	Sociability
7	Child reacts intensely when upset	Lapsi reagoi voimakkaasti hermostuessaan	Emotionality
8	Child cries easily	Lapsi itkee helposti	Emotionality
9	Child tends to be shy	Lapsi on melko ujo	Sociability
10	Child often fusses and cries	Lapsi on usein ärtyisä ja itkuinen	Emotionality
11	Child is very energetic	Lapsi on hyvin energinen	Activity
12	Plays with a single toy for long periods of time	Lapsi leikkii yhdellä lelulla pitkän aikaa	Attention span persistence
13	Child is always on the go	Lapsi on menossa koko ajan	Activity
14	Child prefers quiet, inactive games to more active ones	Lasta miellyttävät enemmän rauhalliset kuin vauhdikkaat pelit ja leikit	Activity
15	Child persists at a task until successful	Lapsi harjoittelee tehtävää niin kauan, että lopulta onnistuu siinä	Attention span persistence
16	Child is off and running as soon as (s)he wakes up in the morning	Heti herättyään lapsi lähtee liikkeelle ja aloittaa touhuamisen	Activity
17	Child goes from toy to toy quickly	Lapsi siirtyy lelusta toiseen hyvin nopeasti	Attention span persistence
18	When child moves about, (s)he usually moves slowly	Lapsi liikkuu paikasta toiseen hyvin hitaasti	Activity
19	Child gives up easily when difficulties are encountered	Lapsi luovuttaa vastoinkäymisissä helposti	Attention span persistence
20	With a difficult toy, child gives up quite easily	Lapsi luovuttaa helposti leikkiessään vaikealla lelulla	Attention span persistence
21	Rarely took a new food without fussing	Lapsi maistoi harvoin uutta ruokaa ilman vastustusta	Reaction to food

continues

Table continues

22	Whenever child starts crying, (s)he can be easily distracted	Kun lapsi alkaa itkeä, hänet on helppo saada lopettamaan	Soothability
23	Child consistently dislikes many kinds of food	Lapsi välttelee jatkuvasti useita ruokalajeja	Reaction to food
24	When upset by an unexpected situation, child quickly calms down	Kun lapsi hermostuu yllättävässä tilanteessa, hän rauhoittuu nopeasti	Soothability
25	Child makes faces at new food	Lapsi reagoi voimakkaasti irvistellen uusille ruuille	Reaction to food
26	Once the child decides he doesn't like something, there is no getting him to like it	Kun lapsi on päättänyt, että hän ei pidä jostain, mikään ei saa häntä muuttamaan mieltään	Reaction to food
27	Child stopped fussing whenever someone talked to him/her or picked him/her up	Lapsi lopetti kiukuttelun heti, kun joku puhui hänelle tai hänet otettiin syliin	Soothability
28	Child has strong likes and dislikes in food	Lapsella on voimakkaita mieltymyksiä ja inhoja ruokaa kohtaan	Reaction to food
29	If talked to, child stops crying	Lapsi lopettaa itkemisen heti, kun hänelle puhutaan	Soothability
30	Child tolerates frustration well	Lapsi kestää turhautumista hyvin	Soothability

ORIGINAL PAPERS

I

INDIVIDUAL, FAMILY, AND ENVIRONMENTAL CORRELATES OF MOTOR COMPETENCE IN YOUNG CHILDREN: REGRESSION MODEL ANALYSIS OF DATA OBTAINED FROM TWO MOTOR TESTS

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Article

Individual, Family, and Environmental Correlates of Motor Competence in Young Children: Regression Model Analysis of Data Obtained from Two Motor Tests

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Abstract: Physical activity and motor competence (MC) have been considered to be closely related and prevent childhood obesity. The aim of the study was two-fold: to examine MC measured with two different tools in relation to individual, family, and environmental correlates and to investigate gender differences in MC. The Test of Gross Motor Development-Third Edition (TGMD-3) was administered to three- to seven-year-old children (n = 945), while the Körperkoordinationstest für Kinder (KTK) was also used for five- to seven-year-old children (n = 444). The parent questionnaire (n = 936) included questions about individual (e.g., participation in organized sports), family (e.g., parents' education level), and environmental (e.g., access to sports facilities) correlates. The children's temperament was assessed using the Colorado Childhood Temperament Inventory (CCTI) questionnaire. Data were analyzed using one-way analysis of variance and linear mixed-effects regression models. The regression models explained 57% and 38% of the variance in TGMD-3 and KTK, respectively. Individual correlates, including older age, more frequent participation in sports, and specific temperament traits of activity and attention span-persistence, were the strongest predictors for better MC. Small gender differences were found in both assessment tools, albeit in a different manner. In conclusion, socioecological correlates of MC in young children are multidimensional, and individual correlates appear to be the most important predictors of MC. Importantly, the correlates can differ according to the MC assessment tools.

Keywords: socioecological model; locomotor skills; ball skills; balance skills; coordination; TGMD-3; KTK; temperament

1. Introduction

Motor competence (MC) and physical activity (PA) have been found to be closely and bidirectionally related in several theoretical models [1–3] and studies [4]. Consequently, it is claimed that if a child is not physically active, he/she may have a greater tendency to have lower MC, or vice versa, and be at risk of gaining unhealthy body weight [5]. Children's weight status negatively influences their future level of gross motor coordination, and vice versa [6]. According to a recent systematic review [7], PA begins to decline from early childhood. This review pointed out that during the life course, inactivity is more persistent; therefore, intervening during early years is extremely important. In fact, the age under seven years can be defined as a rapid period for the development of fundamental movement skills, known as MC [8,9].

During infancy, a child's development is evaluated almost exclusively by motor development [10]. New motor behaviors emerge from a mix of interacting factors [11]. Some of these motor behaviors are less recognized to be directly linked to motor behavior (e.g., facial expressions and speech), while others are known to be important milestones for a child's overall development (e.g., walking) [11]. MC develops together with biological maturation [12]. However, the thought that as most children are naturally curious and love to play and explore, these skills are learned easily [13], and without practice is often misleading.

Motor development involves the acquisition and refinement of basic patterns via repetition [14], and these basic movement patterns form the foundation of more specialized and complex skills that a child will achieve later in life [3,8,14]. The mastery of MC is a prerequisite for daily life functioning and participation in physical or sports-specific activities later in life [13,15]. Moreover, it contributes to a balanced caloric intake, and contrarily, overweight children often have lower MC [16,17]. Therefore, PA plays a major role in providing these opportunities for repetition in children.

The basic patterns of MC are divided into locomotor (LM) skills (e.g., running, jumping, and galloping), stability movement skills (e.g., turning, balancing, and bending), and finally, manipulative movement skills (e.g., throwing, catching, and kicking) [8], henceforth called ball skills (BS). Each of these skills plays a specific role in a child's development. In particular, LM skills are important for enabling (independent) movement, leading to increased opportunities to engage in social and cognitive interactions [18] in the environment [11]. BS are crucial for hand–foot coordination [11] and its development, and stability helps children maintain balance on variable and unsteady surfaces. All these skills are associated with MC development, which has other great benefits for a child's general health and wellbeing. MC is positively associated with cognitive functions, such as executive functions [19], attention and working memory, information processing speed [20–23], as well as language development [24], reading [25], and psychological functions [10]. These associations have been explained through similar maturation schedules of the brain structures controlling motor and cognitive functions for which children's active interaction with their environment is crucial [26].

As motor development is a multidimensional process [11,27], it differs according to the motor skill category, e.g., [27,28]. In this study, two MC assessment tools were used to provide broader knowledge about the range of correlates of MC in young children. According to the socioecological model [29], a child's behavior stems from reciprocal interactions among individual, family, environmental, and community levels. According to Barnett et al. [27], correlates that are directly associated with the individual level seem to be the most important ones for MC. However, other factors related to a child's life and surroundings may enhance or limit the possibilities of PA and MC development [29,30]. For example, a child's PA or MC has been found to be positively associated with his/her father's [31] or mother's PA behavior [32]. Additionally, Laukkanen et al. [33] recently found that children with an agreeable temperament (individual correlate, biological characteristic) had more parental support for PA (family correlate). In contrast, children with a less agreeable temperament had less opportunities to participate in PA with their parents and received less frequent parental support for PA. Such a lack of family support may be related to the interaction style stemming from the child's more or less demanding temperament. It is not yet well researched, but such individual correlates can be associated with lower PA levels and therefore with lower MC levels.

The choice of two assessment tools makes it possible to examine the gender differences found in some studies [12,34,35] based on divergent skill categories, wherein most studies found that boys had a better gross motor index than girls [12,35]. However, it is suggested that the gender differences in early childhood are not based on biological factors [15], but are more likely related to family, environmental, and sociocultural contexts [35–38]. Therefore, we consider it important to assess MC using two assessment tools covering divergent aspects of MC and to include correlates belonging to all three levels (individual, family, and environmental) in the analysis. Sallis et al. [30] stated that to be able to make substantial behavioral changes, interventions must target changes at each level of the socioecological model.

Although PA, MC, and body mass index (BMI) are closely related [39], the younger the child, the more dependent his/her (motor) development and daily activities are on his/her family environment. In this equation, individual correlates along with family and environmental correlates play a role in the actual and long-term PA levels of children, influencing children's motor development. As the majority of the studies [12,34–36] focus on individual correlates of MC, we wanted to broaden the research into a socioecological perspective, such as family and environmental correlates, to gain more knowledge about MC development. Thus, the aims of this study were to examine correlates associated with MC in three- to seven-year-old Finnish children using two internationally well-known MC assessment tools and to examine whether there were gender differences in MC.

2. Materials and Methods

The Ethics Committee of the University of Jyväskylä, Finland, granted approval for the study on 31 October 2015 (Skilled Kids, 31.10.2015). The parents of the participating children provided their written consent. The children were informed about all the study procedures and their right to opt out of the study at any time, without consequences.

2.1. Study Protocol and Participants

The aim of the Skilled Kids study was to have a nationally representative sample of 1000 children aged 3 to 7 years from Finnish childcare centers. The sample was recruited on the basis of the Finnish National Registry of Early Educators, which included 2600 childcare centers. Based on this registry, cluster random sampling was performed, i.e., childcare centers were randomly chosen from the metropolitan area and southern, central, and northern Finland based on postal codes. The number of childcare centers involved in one region was weighted with the population density of the area. The recruitment took place in the autumn of 2015. Thirty-seven childcare centers participated in total: six from the metropolitan area, eleven from southern Finland, thirteen from central Finland, and seven from northern Finland. Ten childcare centers (27%) declined to participate due to a lack of space, interest, time, or a low number of children. The aim of the Skilled Kids study and the recruitment process have been described in detail in previous studies [33,40,41]. For the recruited childcare centers, the respective directors first approved the participation, and the staff was informed about the study. In total, 1239 children (78.5%) received consent for study participation. The measurements were conducted in childcare center settings between November 2015 and September 2016 by two researchers (D.N. and A.S.), along with two research assistants.

The study sample consisted of 945 children (mean age 5.42 years, boys = 473 (50.1%)); however, the number of participants differed for different MC assessment tools. The detailed descriptive data of the study sample are provided in Table 1.

Table 1. Descriptive statistics of the study sample (n = 945).

	Age in Years (mean).					Total Sample		
Individual Correlates	**3 (n = 116)**	**4 (n = 227)**	**5 (n = 244)**	**6 (n = 295)**	**7 (n = 63)**	**N**	**Mean (SD)**	**Gender Differences (p-Value)**
Biological correlates								
Age (years)	3.54	4.48	5.48	6.46	7.13	945	5.42 (1.12)	0.36
- Girls	3.54	4.47	5.49	6.49	7.13	472	5.38 (1.13)	
- Boys	3.54	4.49	5.48	6.43	7.14	473	5.45 (1.11)	
Height (cm)	100.51	106.77	114.16	120.86	124.72	943	113.52 (9.73)	**0.01**
- Girls	100.47	106.41	113.14	120.35	124.05	472	112.64 (10.06)	
- Boys	100.55	107.23	115.10	121.30	125.46	471	114.40 (9.32)	
Weight (kg)	16.56	18.47	21.25	23.98	26.16	943	21.19 (4.47)	0.291
- Girls	16.36	18.39	21.35	23.91	26.32	472	21.04 (4.73)	
- Boys	16.76	18.57	21.15	24.04	25.97	471	21.34 (4.19)	
BMI SDS	0.26	0.19	0.18	0.16	0.26	943	0.19 (1.05)	0.61
- Girls	0.15	0.20	0.26	0.15	0.38	472	0.21 (1.13)	
- Boys	0.36	0.17	0.10	0.17	0.13	471	0.17 (0.98)	

Table 1. Descriptive statistics of the study sample (n = 945).

	Age in Years (mean).					**Total Sample**		
Individual Correlates	**3 (n = 116)**	**4 (n = 227)**	**5 (n = 244)**	**6 (n = 295)**	**7 (n = 63)**	**N**	**Mean (SD)**	**Gender Differences (p-Value)**
Temperament								
Sociality (scale from 5 to 25 points)	17.22	18.17	18.53	18.38	19.20	929	18.28 (3.70)	0.82
- Girls	17.27	18.17	18.44	18.43	18.85	466	18.25 (3.63)	
- Boys	17.17	18.17	18.61	18.34	19.61	463	18.31 (3.77)	
Emotionality (scale from 5 to 25 points)	15.44	15.00	14.70	14.52	14.52	923	14.80 (3.11)	0.48
- Girls	15.45	14.70	14.85	14.36	14.6	461	14.72 (3.07)	
- Boys	15.43	15.40	14.55	14.67	14.39	462	14.87 (3.17)	
Activity (scale from 5 to 25 points)	18.90	19.09	18.48	18.66	18.08	914	18.71 (3.01)	**<0.001**
- Girls	18.75	18.54	17.63	18.11	17.48	460	18.14 (2.91)	
- Boys	19.05	19.82	19.30	19.12	18.79	454	19.28 (3.00)	
Attention span-persistence (scale from 5 to 25 points)	15.54	16.09	16.61	16.74	17.65	907	16.46 (3.01)	**0.01**
- Girls	15.53	16.43	16.85	17.21	17.48	455	16.73 (2.93)	
- Boys	15.54	15.65	16.37	16.35	17.85	452	16.20 (3.07)	
Reaction to food (scale from 5 to 25 points)	13.36	13.10	13.42	12.91	13.42	906	13.18 (4.44)	0.57
- Girls	13.00	13.17	13.37	13.20	13.94	452	13.26 (4.27)	
- Boys	13.70	13.01	13.48	12.68	12.76	454	13.09 (4.61)	
Soothability (scale from 5 to 25 points)	15.63	16.29	16.16	16.59	16.43	910	16.28 (3.26)	0.30
- Girls	15.47	16.48	16.12	16.85	16.75	457	16.39 (3.05)	
- Boys	15.79	16.04	16.21	16.37	16.07	453	16.17 (3.47)	
Behavioral correlates								
Sedentary time (min/day)	74.32	81.73	83.94	87.76	101.37	923	84.62 (47.31)	0.10
- Girls	72.17	76.69	81.52	89.72	88.13	459	82.01 (45.95)	
- Boys	76.32	88.03	86.16	86.03	115.50	464	87.20 (48.53)	
Time spent outdoors (scale from 1 to 7)	4.96	4.85	5.05	5.29	5.30	938	4.97 (1.19)	**0.001**
- Girls	5.00	4.80	4.87	5.16	5.24	469	5.22 (1.14)	
- Boys	4.97	4.97	5.22	5.45	5.37	469		
- Less than 1h/day (%)	13.2	8.0	13.2	8.6	6.3	94	10.0	
- Approximately 1 h/day (%)	51.8	66.4	51.0	43.8	50.8	493	52.6	
- 1-2 h/day (%)	35.1	25.7	35.8	47.6	42.9	351	37.4	
Participation in organized sports (min/week)	17.35	29.96	52.08	69.92	76.41	902	49.51 (65.28)	0.60
- Girls	23.02	31.66	56.54	64.55	59.58	448	48.34 (59.85)	
- Boys	12.26	27.86	47.94	74.64	95.00	454	50.65 (70.27)	
TGMD-3 locomotor skills (0 to 46 points)	16.33	24.97	28.84	31.66	32.87	945	27.52 (8.07)	**<0.001**
- Girls	17.65	26.44	30.53	33.39	33.24	472	28.89 (7.78)	
- Boys	15.05	23.07	27.29	30.15	32.47	473	26.16 (8.13)	
TGMD-3 ball skills (0 to 54 points)	14.47	19.89	25.84	29.99	34.24	945	24.87 (9.06)	**<0.001**
- Girls	13.12	18.43	23.14	27.40	30.94	472	22.43 (7.91)	
- Boys	15.76	21.77	28.32	32.23	37.87	473	27.29 (9.49)	
TGMD-3 gross motor index (0 to 100 points)	30.79	44.85	54.68	61.64	67.11	945	52.39 (15.16)	**0.030**
- Girls	30.77	44.87	53.67	60.80	64.18	472	51.32 (14.11)	
- Boys	30.81	44.84	55.61	62.38	70.33	473	53.46 (16.08)	
KTK (0 to 193 points)	-	-	85.20	112.25	128.14	416	103.21 (34.26)	0.19
- Girls	-	-	87.39	117.28	118.90	198	105.54 (33.51)	
- Boys	-	-	82.99	107.84	136.17	218	101.09 (34.86)	
Family correlates								
Parents' education level (scale from 1 to 4)	2.78	2.73	2.79	2.66	2.75	935	100.0	0.99
- Girls	2.86	2.72	2.84	2.57	2.79			
- Boys	2.70	2.73	2.74	2.74	2.70			
- Elementary school (%)	4.4	4.4	1.7	2.1	1.6	26	2.8	
- Secondary/ vocational school (%)	28.1	29.6	30.7	36.8	33.3	301	32.2	
- Polytechnic (%)	35.1	38.5	36.9	38.1	38.1	351	37.5	
- University (%)	32.5	27.5	30.7	23.0	27.0	257	27.5	
Respondent's physical activity (min/week)	59.19	56.76	58.06	58.42	57.20	845	57.93 (22.63)	0.88
- Girls	59.00	57.34	54.28	61.31	56.13	420	57.81 (21.12)	
- Boys	**59.38**	**56.01**	**61.55**	**55.99**	**58.42**	**425**	**58.06 (24.05)**	

Table 1. Descriptive statistics of the study sample (n = 945).

	Age in Years (mean).					Total Sample		
Individual Correlates	**3 (n = 116)**	**4 (n = 227)**	**5 (n = 244)**	**6 (n = 295)**	**7 (n = 63)**	**N**	**Mean (SD)**	**Gender Differences (p-Value)**
Environmental correlates								
Electronic devices in use (n)	0.29	0.41	0.55	0.71	0.89	923	0.56 (0.92)	**0.04**
- Girls	0.31	0.35	0.49	0.63	0.78	463	0.49 (0.84)	
- Boys	0.26	0.47	0.60	0.79	1.00	460	0.62 (0.99)	
Access to sports facilities (scale from 0 to 44 points)	20.49	21.14	21.79	22.36	23.21	939	21.75 (4.17)	**0.04**
- Girls	20.91	21.01	21.37	21.74	23.39	467	21.47 (4.19)	
- Boys	20.10	21.31	22.18	22.90	23.00	472	22.03 (4.14)	
- Rarely (%)	27.1	21.4	16.4	10.4	5.5	141	16.4	
- Occasionally (%)	48.6	42.4	38.6	34.7	36.4	339	39.4	
- Weekly/daily (%)	24.3	36.2	45.0	54.9	58.2	380	44.2	

Statistically significant values are shown in bold. SD = standard deviation; BMI SDS = body mass index standard deviation scores; TGMD-3 = Test of Gross Motor Development-Third Edition; KTK = Körperkoordinationstest für Kinder.

2.2. Motor Competence

MC was measured using two different assessment tools. Children aged 3 to 7 years were assessed using the Test of Gross Motor Development-Third Edition (TGMD-3) [42,43]. Moreover, children aged 5 to 7 years (n = 444, mean age 6.2 years, boys = 234 (52.7%)) completed an additional MC test, the Körperkoordinationstest für Kinder (KTK) [44].

First, all children aged 3 to 7 years completed the TGMD-3 measurements [42,43]. This process-oriented measurement evaluates the quality of the skills and has two skill categories concentrating on locomotion (LM) and on ball skills (BS). LM skills include a summary of six skills evaluated by the following points: run (0–8 points), gallop (0–8 points), hop (0–8 points), skip (0–6 points), horizontal jump (0–8 points), and slide (0–8 points), resulting in a maximum of 46 points. BS include a summary of seven skills: two-hand strike of a stationary ball (0–10 points), one-hand forehand strike (0–8 points), one-hand stationary dribble (0–6 points), two-hand catch (0–6 points), kicking a stationary ball (0–8 points), overhand throw (0–8 points), and underhand throw (0–8 points), resulting in a maximum of 54 points. An educated observer, who analyzed the skills according to the fulfilment of the given criteria (three to five criteria for one skill), evaluated each skill (0 points if the given criteria were not fulfilled and 1 point if they were fulfilled). Children performed each skill twice, and the recorded score was the sum of the received points of these two performances (maximum of 2). The TGMD-3 gross motor index was the sum of LM skills and BS, with a theoretical maximum of 100 points. The gross motor index itself is the most reliable test score [42].

The TGMD-3 protocol was carefully followed according to the manual described previously [33,40]. TGMD-3 has been demonstrated to have a good to excellent intra-rater and inter-rater reliability [43], and it is valid and reliable both internationally [13,45] and in the Finnish context [33,40]. Within this study sample, the inter-rater reliability of the TGMD-3 gross motor index was 0.88 (95% confidence interval (CI) = 0.85–0.92), tested among 167 children [40].

To have complementary information about gross motor coordination and body control of children aged 5 to 7 years, they participated also in the KTK assessment. In this product-oriented assessment tool, evaluation is based on the total score of the four items included in the test battery, and as the test is result-based, the theoretical total maximum points cannot be specified. The test items include balance, with a walk of eight steps backwards on balance beams (width 6.0 cm, 4.5 cm, and 3.0 cm; maximum score of 72 points), hopping on one leg over an obstacle (maximum score of 78 points), jumping laterally from side to side on a jumping base for 15 s (the sum of the number of correct jumps in two trials), and shifting platforms as quickly as possible for 20 s (the sum of the number of points in 20 s in two trials). Each skill was performed and observed carefully following the manual instructions by experienced observers. Finally, the sum of these latter scores yielded the total sum score for the KTK test. The raw score was used in the present analysis, as recommended [46,47]. The KTK assessment tool is considered to be highly reliable internationally, most likely because it is result-based, with the test-retest reliability coefficient of the total score being 0.97 and the subtests ranging between 0.80 and 0.96 [44].

2.3. Individual Correlates

2.3.1. Biological Correlates

Each child's exact age was calculated on the basis of the date of birth related to the date of assessments, with 1 month accuracy. In the tables, however, the age is reported in years following common convention. The children's weight (Seca 877) and height (Charder HM 200P) were directly measured, with the accuracy of a decimal. BMI was calculated as weight/height^2 (kg/m^2) and converted to BMI standard deviation scores (BMI SDS) using the most recent national BMI references [48].

The child's temperament was assessed using a parental rating instrument, the Colorado Childhood Temperament Inventory (CCTI). This questionnaire is suitable for children aged up to 7 years [49]. It involves six dimensions of personality: sociability, emotionality, activity, attention span-persistence, reaction to food, and soothability. Each scale was constructed using five more specific statements. One statement representing each scale is presented here: sociability, "Child makes friends easily"; emotionality, "Child gets up easily"; activity, "Child is very energetic"; attention span-persistence, "Child plays with a single toy for long periods of time"; reaction to food, "Child rarely took a new food without fussing", and soothability, "Whenever the child starts crying, (s)he can be easily distracted". As a response, each parent had to rate every statement from 1 ("not at all like the child") to 5 ("a lot like the child"). In total, there were 30 statements, five in every scale; therefore, the maximum points for each scale were 25 (5 × 5). The validity of CCTI is reported to be good, and its reliability is moderately high [49]. Scale scores were used in the analyses.

2.3.2. Behavioral Correlates

The sedentary time, time spent outdoors, and participation in organized sports were assessed through a parental questionnaire. The test-retest reliability of all the items was investigated with 30 responses (obtained over 21 days); these are marked in parentheses with an intra-class correlation coefficient (ICC) and a 95% confidence interval (CI) after each item. The sedentary time (ICC = 0.45; 95% CI −0.09–0.80) was assessed through the following questions: "Think about your child's typical day and situations when (s)he is sitting or lying down or is sedentary in some other way (e.g., in a car, in a sandbox or in a trolley, in front of the TV or while playing with a puzzle). For how long, at the most, does such a sedentary activity approximately last continuously and without breaks?" (1 = >15 min, 2 = 30 min, 3 = 60 min and 4 = ≥90 min) and "How often is your child engaged in long and continuous sedentary activities in a day?" (1 = once, 2 = twice or thrice, 3 = four to five times and 4 = ≥six times). The amount of sedentary time (min) in a day was calculated using the aforementioned information (min/time × times/day). The time spent outdoors (ICC = 0.62; 95% CI = −0.12–1.0) was obtained by asking "How much time, on average, does your child spend outdoors after a preschool day/on weekends?" The scale for weekdays ranged from 0 to 3 (0 = not at all, 1 = under 30 min/day, 2 = approximately 30–60 min/day, and 3 = over 60 min/day), while the scale for weekends ranged from 0 to 4 (0 = not at all, 1 = under 30 min/day, 2 = approximately 30–60 min/day, 3 = 1–2 h/day, and 4 = over 2 h/day). The total score from both scales was used to represent the time spent outdoors, with 7 being the maximum score. Participation in organized sports (ICC = 0.81; 95% CI = 0.60–0.91) was assessed by asking the following: "Does your child participate in organized PA or sports in a group or a sports club?" If the answer was "yes", further questions regarding such activities were asked, as follows: "How many times a week?" and "For how many minutes at a time?" The total time (min) spent on organized sports per week was calculated and used in the analyses.

2.4. Family Correlates

Due to divergent family backgrounds, we used the concepts of respondent and partner instead of mother or father. Later, female respondents were called mothers and male respondents were called fathers. The parents' mean education level was the mean value of the respondent's (ICC = 0.96; 95% CI = 0.92–0.98) and partner's (ICC = 0.94; 95% CI = 0.87–0.97) education level (1 = comprehensive school, 2 = high school/vocational school, 3 = polytechnic, and 4 = university). Each respondent's PA (ICC = 0.72; 95% CI = 0.50–0.86) was divided on a scale from 0 to 4 (0 = not at all, 1 = randomly few times a month, 2 = approximately once a week, 3 = twice or thrice a week, and 4 = over four times a week).

2.5. Environmental Correlates

The number of electronic devices (varying from ICC = 0.80; 95% CI = 0.62–0.90 to ICC = 1.00) was assessed through the following question: "Does your child have access to any or some of the following: (a) TV, (b) game console, (c) computer, (d) smartphone, tablet, iPad or any other smart device or (e) something else (if yes, then what)?" Finally, the child's access to sports facilities (varying from ICC = 0.52; 95% CI = 0.21–0.74 to ICC = 0.87; 95% CI = 0.75–0.94) was asked, e.g., "Evaluate how often your child has used sport or outdoor facilities situated in your own locality or nearby municipality". The questionnaire included 10 divergent and organized sports facilities (e.g., playing field, playground, swimming hall, and indoor sports hall) and an open space for the facilities that were being used, but were not listed. The use of each facility was scored on a scale from 0 to 4 (0 = no access to a facility, 1 = nearly never, 2 = randomly, 3 = weekly, and 4 = approximately daily). Additionally, the respondents were asked the following: "Is there a large area for the child's free play in your home yard (front- or backyard, garden, etc.)?" (no = 0 point and yes = 1 point) and "How often is your child allowed to play in the yard?" The frequency was scored from never to nearly daily (0 = never, 1 = during weekends, 2 = every now, and then and 3 = nearly daily). The total access to sports facilities and to the home yard was calculated by adding all the respondents' scores, with the maximum points being 44.

2.6. Statistical Analysis

IBM SPSS Version 24.0 (IBM Corp., Armonk, NY, USA) was used for the analyses, and the level of significance was set at $p < 0.05$. Descriptive statistics (mean and standard deviation (SD)) were calculated for all variables (Table 1). Gender differences were calculated using a *t*-test (Table 1). A linear regression model with the enter method was used to analyze the associations between the individual, family, and environmental correlates and the two MC assessment tools (TGMD-3 and KTK). However, as childcare centers may be associated with MC [50], the goodness of fit was tested with and without a childcare cluster. In all the models, the goodness of fit was significantly better when linear mixed-effects models with a childcare cluster were used (for all models, $p < 0.001$). Therefore, in the final analyses, linear mixed-effects models were used. In Model 1 for TGMD-3 and KTK, all the individual, family, and environmental correlates predicting TGMD-3 (Table 2) or KTK (Table 3) were entered. The least significant correlates were removed from Model 1 one at a time. Then, Model 1 was re-run with all the remaining correlates until there were only significant correlates left in the final model, Model 2. The order of removal from Model 1 is represented in Table 2 (TGMD-3) and Table 3 (KTK). This so-called backward method made it possible to consider the interdependency (mutual covariance) of predictors at each step of modelling. In Models 1 and 2, the number of items varied because of missing data in the remaining variables.

3. Results

3.1. Descriptive Results

All children were aged three to seven years (mean age 5.42 years, SD 1.12). The study sample had an equal distribution of girls (n = 472, 49.9%, mean age 5.4 years) and boys (n = 473, 50.1%, mean age 5.5 years). Of the parents (n = 936; mean age 35.8 years, SD = 5.4) who answered the parental questionnaire, most were mothers (n = 816, 87.2%). Two-thirds of the parents who responded to the questionnaire had polytechnic- or university-level education (n = 569, 60.7%). More detailed information about the study sample is provided in Table 1.

Regarding the gender differences, boys had lower LM skills, better BS, and a better TGMD-3 gross motor index than girls (Table 1). Boys also spent more time outdoors, used more electronic devices, and more frequently accessed sports facilities according to their parents. Some differences in temperament were noted between boys and girls. The parents described boys as being more active and girls as having higher attention span-persistence. The level of MC in the children increased with age in both assessment tools (Figure 1).

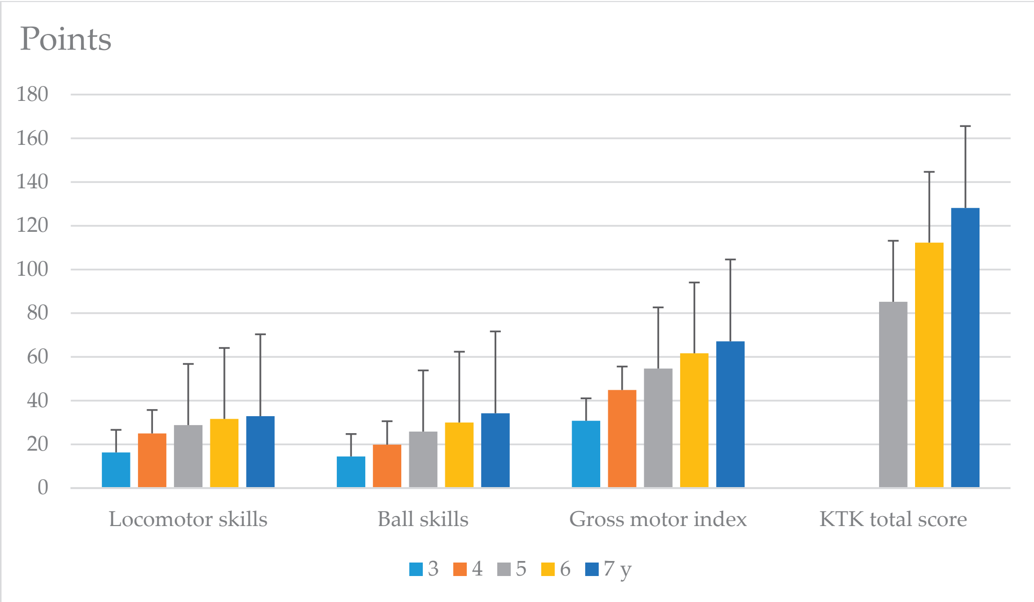

Figure 1. The level of motor competence (MC) measured using the Test of Gross Motor Development-Third Edition (TGMD-3) and Körperkoordinationstest für Kinder (KTK) assessment tools in the study sample (*n* = 945); values are reported as the mean and standard deviation (SD) scores for different ages (in y = years).

3.2. Correlates of Test of Gross Motor Development-Third Edition

In Model 2, having TGMD-3 as a dependent variable, children's age (older), temperament traits, such as activity (higher) and attention span-persistence (higher), participation in organized sports (higher), and access to sports facilities (higher) explained 57% of the variance in the TGMD-3 gross motor index among children (Table 2).

3.3. Correlates of Körperkoordinationstest für Kinder

In Model 2 having KTK as a dependent variable, children's age (older), gender (female), temperament traits such as emotionality (lower), activity (higher), and attention span-persistence (higher), participation in organized sports (higher), and parents' mean education level (higher) explained 38% of the variance in the KTK total score among the children (Table 3).

Of all the variables, a child's age was most strongly associated with MC in both models; therefore, the older the child, the better MC they had. Furthermore, in both assessment tools, the participation in organized sports had a positive association with MC, in addition to having a more active temperament and having higher attention span-persistence as a dimension of personality.

Table 2. Individual, family and environmental correlates associated with children's TGMD-3 total score.

Variables	TGMD-3 Total Score				
	Model 1 (n = 716)			Model 2 (n = 856)	
Individual Correlates	**Standardized *B* (95% CI)**	***p***	*** RE**	**Standardized *B* (95% CI)**	***p***
Biological correlates					
- Age (months)	0.05 (0.60; 0.70)	<0.001		0.06 (0.61; 0.71)	<0.001
- Gender (1 = girls, 2 = boys)	0.02 (−0.02; 0.07)	0.32	6	0.03 (−0.01; 0.07)	0.19
- BMI SDS	−0.01 (−0.06; 0.04)	0.69	6		
Temperament (scale from 5 to 25 points in every subcategory mentioned below)					
- Sociability	0.04 (−0.02; 0.09)	0.20	7		
- Emotionality	0.01 (−0.05; 0.06)	0.81	4		
- Activity	0.11 (0.05; 0.16)	<0.01		0.11 (0.06; 0.15)	<0.001
- Attention span-persistence	0.04 (−0.01; 0.09)	0.12		0.05 (0.01; 0.10)	0.02
- Reaction to food	−0.04 (−0.09; 0.00)	0.07	9		
- Soothability	0 (−0.05; 0.06)	0.90	1		
Behavioral correlates					
- Sedentary time (min/day)	0.04 (−0.01; 0.09)	0.12	8		
- Time spent outdoors (scale from 1 to 7)	0.04 (−0.02; 0.10)	0.18	10		
- Participation in organized sports (min/week)	0.13 (0.07; 0.18)	<0.001		0.16 (0.12; 0.21)	<0.001
Family correlates					
- Parents' education level (scale from 1 to 4)	0.01 (−0.04; 0.06)	0.72	3		
- Respondent's physical activity (min/week)	0.01 (−0.04; 0.07)	0.65	5		
Environmental correlates					
- Electronic devices in use (n)	0 (−0.05; 0.05)	0.90	2		
- Access to sports facilities (scale from 0 to 44 points)	0.06 (−0.00; 0.11)	0.05		0.06 (0.01; 0.10)	0.03

Statistically significant values are shown in bold. 95% CI = confidence interval. * RE = removal order in which the explanatory variable was deleted from Model 1. In Model 2, only statistically significant correlates explaining the TGMD-3 gross motor index were left. In Models 1 and 2, the number of items varied because of missing data in the remaining variables. TGMD-3 = Test of Gross Motor Development-Third Edition; BMI SDS= body mass index standard deviation scores.

Table 3. Individual, family and environmental correlates associated with children's KTK total score.

Variables	KTK Total Score				
	Model 1 (*n* = 330)			**Model 2 (*n* = 392)**	
Individual Correlates	**Standardized *B* (95% CI)**	***p***	*** RE**	**Standardized *B* (95% CI)**	***p***
Biological correlates					
- Age (months)	0.51 (0.42; 0.59)	<0.001		0.50 (0.41; 0.58)	<0.001
- Gender (1 = girls, 2 = boys)	−0.08 (−0.16; 0.01)	0.07		−0.13 (−0.20; −0.05)	0.002
- BMI SDS	−0.01 (−0.12; 0.05)	0.42	8		
Temperament (scale from 5 to 25 points in every subcategory mentioned below)					
- Sociability	−0.08 (−0.17; 0.01)	0.09	9		
- Emotionality	−0.12 (−0.21; −0.03)	0.01		−0.12 (−0.20; −0.04)	0.003
- Activity	0.24 (0.16; 0.33)	<0.001		0.23 (0.15; 0.31)	<0.001
- Attention span-persistence	0.18 (0.10; 0.27)	<0.001		0.16 (0.08; 0.24)	<0.001
- Reaction to food	0.03 (−0.06; 0.11)	0.49	5		
- Soothability	0.04 (−0.06; 0.13)	0.43	7		
Behavioral correlates					
- Sedentary time (min/day)	0 (−0.09; 0.09)	0.96	1		
- Time spent outdoors (scale from 1 to 7)	0.01 (−0.08; 0.11)	0.81	3		
- Participation in organized sports (min/week)	0.13 (−0.03; 0.22)	0.01		0.12 (0.04; 0.21)	0.03
Family correlates					
- Parents' education level (scale from 1 to 4)	0.08 (−0.01; 0.17)	0.08		0.09 (0.01; 0.17)	0.03
- Respondent's physical activity (min/week)	0.01 (−0.08; 0.09)	0.88	2		
Environmental correlates					
- Electronic devices in use (n)	−0.06 (−0.15; 0.02)	0.15	4		
- Access to sports facilities (scale from 0 to 44 points)	0.04 (−0.07; 0.14)	0.49	6		

Statistically significant values are shown in bold. *RE = Removal order in which the explanatory variable was deleted from model 1. In model 2, only statistically significant factors explaining the KTK result were left. In models 1 and 2, the number of items varied because of missing data in the remaining variables. KTK = Körperkoordinationstest für Kinder; BMI SDS = body mass index standard deviation scores.

4. Discussion

Based on the socioecological model, we investigated the associations of individual, family, and environmental correlates with MC in young children using the TGMD-3 gross motor index and KTK total score. We also examined whether there were any gender differences in the dependent variables.

Our study had several important findings. First, some individual (age, participation in organized sports, and temperament traits such as activity, attention span-persistence, and emotionality), family (parents' education level), and environmental correlates (access to sports facilities) were associated with the children's MC, supporting the socioecological model. Second, a model including six individual, family, and environmental correlates explained 57% of the variability in the TGMD-3 gross motor index, while seven correlates explained 38% of the variability in the KTK total score. Third, some gender differences were found; however, the findings of TGMD-3 and KTK were different.

In our study, higher variance in MC was explained with TGMD-3 than with KTK. This result may reflect the fact that these assessment tools measure different aspects of MC [13,51]. On the one hand, research suggests that TGMD-3 is a sports-centric test that uses quality evaluations of LM skills and BS, but lacks balance skills [13]. On the other hand, research suggests that KTK is a non-sports specific assessment tool [13,46] focusing on result-based evaluation of balance and motor skills, but lacks BS. Hence, although these two assessment tools complement each other, an assessment tool should ideally include a whole range of fundamental movement skills, i.e., balance skills, LM skills, and BS.

Other differences emerged in the assessment tools as some correlates, such as gender, emotionality of the child, parents' education level, and access to sports facilities, were related in either, but not both assessment tools. These differences in the associated correlates may stem from the fact that the choice of the assessment tool provided varying outcomes as the tools measure different aspects of MC. Interestingly, the correlates that were significant in both TGMD-3 and KTK models (age, participation in organized sports, and temperament traits such as activity and attention span-persistence) were individual correlates, underlining the finding of Barnett et al. [27] that individual correlates seem to be the most important ones for MC development.

4.1. Individual Correlates of Motor Competence

We found that older children tended to have better MC levels in both MC assessment tools. In line with previous studies, it was evident that age was a strong predictor of MC levels in children, affirming the role of age in MC [1,2,12,15,36,52]. This increase in MC in children aged three to seven years can be explained by the rapid biological development during these early years [53], wherein the high plasticity of the nervous system contributes to the major improvement in coordination [11,14]. However, children do not develop MC solely through maturational processes as coordinative movements need to be learned, practiced, and reinforced [54]. Therefore, regardless of age or gender, children should be encouraged to move and to develop age-appropriate MC [11,55].

This study provided novel information about the importance of temperament traits for motor development. More specifically, traits such as activity and attention span-persistence were found to be positively associated with MC using both motor assessment tools. This was a rather novel result, as the association between MC and temperament during early childhood is not yet widely understood. Temperament is rather stable [49,56] over time; thus, children who tend to have an active type of temperament, as well as children who show persistency when faced with challenges can be motivated and persistent in learning and rehearsing motor tasks. Interestingly, a recent study by Laukkanen et al. [33] demonstrated that children with an agreeable temperament (referring to a factor created from the total scores for sociability, activity, and attention span-persistence) tended to have more parental support for PA. Accordingly, there is evidence that the lack of fit between a child's temperamental characteristics and parents' responses [56] can influence the overall development of the child. Since the parent–child relationship is bidirectional, also the child's behavior influences parenting [57]. In essence, it can be questioned if some children benefit from temperament traits such as activity and attention span-persistence not only in terms of motor development, but also in terms of the amount of parental support received for PA.

Additionally, children who were more emotionally regulated had a better KTK total score. This may also mean that during early childhood, as is consistently found in exercise psychology (e.g., emotion), regulating one's effort control and distractibility during motor performance [56] may help maintain focus. Thus, temperament can be associated with motor development both directly and indirectly. The future research would benefit from a multidisciplinary collaboration between different professionals to better understand the role of a child's temperament and parents' behavior in the development of MC.

Participation in organized sports was associated with better scores in both assessment tools, underlining the fact that during early childhood, motor development benefits from sports-related hobbies [38,41,58] related to LM skills [27,41], BS [41], and coordination [55]. Although participation in organized sports is mainly positively related to MC development, there may be differences between different environments [41] and countries [59]. Therefore, one should not forget the importance of outdoor play and everyday life choices [59] that help to accumulate more daily PA [60].

4.2. Family and Environmental Correlates of Motor Competence

A child's access to sports facilities and parents' educational level were associated with better TGMD-3 and KTK total scores. Access to sports facilities had a greater association; however, these associations were smaller than the aforementioned findings with other individual correlates. Some other studies have likewise demonstrated that family- and environmental-level correlates are not as closely associated with MC as individual correlates [27] or their significance to motor development is not easily demonstrated using the current assessment tools. However, there is evidence that having skill-related equipment or sports facilities near one's home is positively associated with MC [31]. Thus, having a supportive environment in terms of toys and equipment may help develop MC or children with better MC may be provided more equipment [27] and opportunities to access sports facilities. Although the amount of toys and equipment was not assessed in the present study, we support the idea of Cools et al. [31] that providing access to sports facilities creates an environment conducive to MC development. Lastly, the higher the parents' education level, the better was the KTK total score. This is in line with previous research findings [31], even though Finland as a country may have less diversity in parental education [61] than some other countries. However, this association should be critically evaluated because there was a bias towards highly educated parents in the present sample.

4.3. Gender Differences

In TGMD-3, boys had superior BS scores and a better gross motor index, while girls had better LM skills, as analyzed using a *t*-test. This finding is consistent with those of most previous studies comparing gender differences between girls and boys in BS [12,34,35,61] and LM skills [34,61,62], although a previous systematic review has stated no gender differences in LM skills [12] as well. Regarding TGMD-3, the findings of several studies are in concurrence with our findings that boys have a better gross motor index than girls [12,35]. In contrast, some studies have proclaimed that the gender differences may disappear on unifying LM skills and BS into a gross motor index [34,61]. Furthermore, our results indicate that because boys had higher BS scores than girls, boys may benefit from such unification as BS (54 points) can offer more points than LM skills (46 points) in the TGMD-3 gross motor index (100 points). As TGMD-3 is considered to be a sports-specific test, the hobbies and their content may reflect the development of MC. In fact, hobbies may differ between genders [19,27,35]. These aforementioned issues may explain the differences in MC measured using TGMD-3.

Previous studies have also shown that gender differences may become more evident if children do not participate in organized sports [58] or have lower MC [59]. Laukkanen et al. [59] found smaller gender differences in nationalities that have higher MC regardless of gender. Therefore, several studies have questioned whether the differences in MC may cease to exist in children aged under eight years if girls are provided with equivalent opportunities to practice sports [16,58]. Many researchers agree that gender differences during early childhood are not based on biological factors [15], but the differences seem more related to family, environmental, and sociocultural contexts [35–38], wherein girls tend to behave differently than boys [63,64].

When looking at the effect of gender in the regression models, there were no gender differences in TGMD-3, while there was a gender difference in KTK in Model 2. The result showed that being a girl was a positive predictor of a higher KTK total score. Previous studies [38,53] on balance and body coordination skills during early childhood revealed similar gender differences in some balance skills. However, the effect sizes were so small that gender could not be specified as an important correlate in children's balance skills. Our research suggested that although gender (being a girl) was a positive predictor of the KTK total score in Model 2, the effect size was rather small; thus, greater gender differences occurred in TGMD-3 than in KTK.

4.4. Strengths and Weaknesses of the Study

The strengths of this study included the use of two internationally well-known MC assessment tools offering more information about children's MC [51,65], which is highly recommended [47,51]. The use of two test batteries made the results more robust and stronger. In addition, the study assessed a range of individual, family, and environmental correlates of MC based on the socioecological model. Moreover, the study sample was large, randomly selected, and nationally representative. However, the fact that MC assessment tools measure different aspects of MC can also be seen as a study limitation. Furthermore, the sample had an overrepresentation of highly educated parents, which is a limitation in many studies examining behaviors and attitude towards PA. The cross-sectional nature of our study also did not allow making any inference about causality. Furthermore, in the parental questionnaire, some test-retest reliability levels were slightly low with high 95% CIs. In the current study, we assessed the time spent outdoors and participation in organized sports using a proxy measure, which due to the age of the children could be considered a feasible method to assess the type and setting of PA. However, in future research, it would be optimal to combine parent-reported PA measures with device-based measures of PA such as accelerometers. Finally, in order to better understand the role of a child's temperament in motor development and PA, observations of children's motivation and persistence in physical play could be useful. Early educators could provide important information on children's daily functioning.

5. Conclusions

The most important correlates associated with better MC were closely related to children's biological (age, temperament traits such as activity and attention span-persistence) or behavioral (participation in organized sports) correlates. The TGMD-3 gross motor index explained 57% of the variance in MC, while the KTK total score explained 38% of the variance. Some small gender differences emerged in both test batteries, however, in a different manner. Therefore, it is important to note that the choice of test battery is crucial when investigating MC and gender differences. In sum, the findings may have relevant implications for both practical field study and research, especially in relation to the role of motor development. We state that skills are mainly learned by doing, and as a function of age, various movement experiences can be gained for example by participating in organized sports. In addition, the individual correlates such as temperament traits implied that to support young children's MC development, and also to create efficient interventions to improve MC, it is useful to acknowledge the importance of individuality in learning. Thus, identifying individual (risk) factors, such as active, inattentive, or persistent temperament traits, may help in developing PA interventions that motivate also those children who might lag behind in age-appropriate motor skills. Moreover, the gender gap in motor learning needs to be explored in future research. On the other hand, early educators and parents should provide the same opportunities to be physically active and develop motor skills regardless of gender.

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Environmental Correlates of Motor Competence in Children—The Skilled Kids Study

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Abstract: Environment, physical activity (PA) and motor development are tightly interwoven during childhood. We examined the associations of environmental factors with motor competence (MC) in children. Children (*N* = 945, 50.1% boys, age = 3–7 years, mean = 5.4 years) from 37 childcare centres in the Southern (*n* = 17), Central (*n* = 13) and Northern Finland (*n* = 7) participated. The environmental factors comprised the geographical location (Southern, Central and Northern Finland) and residential density (metropolitan area, city, rural area and countryside) of the childcare centres' based on postal codes and the national population density registry. MC was measured using the Test of Gross Motor Development (TGMD)-3, as well as by quantifying time spent outdoors and participation in organised sports via parental questionnaire. It was found that children from the countryside had better MC and spent most time outdoors, while children from the metropolitan area most frequently engaged in organised sports. Gender comparisons revealed that girls outperformed boys in locomotor skills, while boys were better in object control skills, had higher TGMD-3 score and spent more time outdoors. Time spent outdoors and participation in organised sports were associated positively with MC, but not in children from the countryside. In conclusion, higher population density was associated with lower MC and less time spent outdoors. The findings suggest that versatile outdoor environments may support motor development through PA.

Keywords: children; motor competence; environment; geographical location; residential density; outdoor time; participation in sports

1. Introduction

Motor competence (MC) enables children to participate in various physical activities (PA) and physically active play [1,2]. Better MC has also been found to predict children's subsequent PA levels [3]. However, the evidence from previous studies suggests negative secular changes in MC over the past decades [4,5], and children struggle to achieve the recommended levels of daily PA [6]. Stodden et al. [1] proposed a bidirectional connection between MC and PA. Furthermore, MC influence children's motivation and engagement in PA [1,2]. Therefore, the declining MC in children may be due to their decreasing PA [5] or changes in their living environment [7,8].

According to Gibson [9], the theory of affordances refers to the functionally significant properties of the environment; he describes the variety of affordances an environment offers that animals (i.e., terrain, shelters and surfaces) can use for multiple purposes. Gibson [9] defines affordance as a combination of physical properties of the environment that fit one's actions and locomotor systems. The theory of affordance has also been applied to young children's motor learning contexts [10] as well as explaining PA in children, in terms of outdoor play [11], independent mobility [11,12] and the amount of affordances in the environment [13]. Previous research has shown that children find outdoor environments stimulating and motivating [12,14,15], for example, large yards that provide affordances to play and run [16]. Indeed, free running and playing are important for the development of locomotor (LM) skills, such as walking, running, climbing, galloping and jumping [17]. Furthermore, large spaces and areas of play are also crucial to practise object control (OC) skills [18].

Overall, MC development is stimulated through appropriate challenges to maintain balance, achieve objectives and move from the current place to another location. Campos et al. [19] suggested that improved LM skills provide more numerous and variable social and cognitive experiences and support the development of such experiences during infancy. After infancy, LM skills may be responsible for an enduring role in development by maintaining and updating existing skills. Such development is possible when children have social support and psychological freedom to move in an environment with interesting affordances [16]. During early childhood, handling different objects opens up new opportunities for visual, manual, and oral exploration [20]. This is significant because good hand/foot-eye coordination is essential to the development of OC skills [21,22]. Besides LM and OC skills, also climbing and balancing are essential for children's MC development [23,24]. All the aforementioned skills serve to develop children's MC, at both low and high PA intensities. However, as discussed above, to practise for example walking or running there is a need for divergent affordances in addition to climbing, throwing or balancing. This demonstrates that environment and its affordances can contribute to motor development and PA.

Motor development not only influences the PA level, but is also related to cognitive functions. Recently, MC has been associated with cognitive functions, such as executive functions [21], attention and working memory, and information processing speed [25–28] as well as language development [29] and reading [30]. These associations have been explained through the adaptations of brain structures and functions [31]. Therefore, to support cognitive functions, the environment has an important role providing affordances to practise motor skills. On the other hand, for motor learning the perfect timing for the child to learn skills is essential and thus recognised as a zone of proximal learning [32]. When a child has the prerequisites to learn a new skill but is not yet able to do it alone, the environment or other people (peers or adults) can support and scaffold this appropriate level.

As previously stated, a versatile outdoor environment can offer a proximal zone of development. A physically activating environment is demonstrated to be safe and to offer the possibilities for free play [33]. Secondly, adults can create a proximal zone to support MC learning through organised physical activities for children. Organised sports have been shown to increase children's PA [8], and frequent participation in organised sports has been found to improve MC [34]. Furthermore, early educators in the childcare centres can influence the role of curriculum, which is crucial to defining age appropriate contents, amount, quality and environments to support motor skill learning [34]. Children are motivated to be active and practise new MC when they feel themselves to be competent, have the autonomy to choose appropriate activities and are able to be with other children [35]. Therefore, from a proximal learning perspective, the timing of different motor challenges during children's development becomes meaningful. It follows that child falls out of zone if he already is competent or he does not yet have abilities to perform the task [32]. Thus, the more variation an environment provides, the more there is the potential to offer appropriate and timely challenges. For this reason, it is assumed that the physical environment plays an important role in children's MC development, which by extension supports their cognitive functions.

From a global perspective, countries have widely different living environments, which is likely to cause differences in MC via diversity in socio-cultural and geographical aspects [36]. While some cross-country comparisons of children's MC are available [4,5,37,38], the effects of environmental differences within a single country are less studied. Therefore, information about how environmental factors within one country are associated with MC in children is scarce, particularly with regard to time spent outdoors and participation in organised sports. The environmental factors referred to in this study are geographical location of the living place (Southern, Central and Northern Finland) and residential density (metropolitan area, cities, rural areas and countryside). We assume that the amount of daylight and the mean temperature present in each geographical location may have a mediating role to time spent outdoors, because previous studies suggested that children tend to be less physically active in cold seasons [39–41]. We were interested in learning if this phenomenon can be observed in relation to MC. It is also important to study residential density because the MC of young children seems to be declining [4] simultaneously with a global population trend towards living in bigger cities [42]. We hypothesised that less inhabited areas, contain more natural, unbuilt parks that include several different landforms provide venues for children to practise balance and coordination [16], and therefore children in rural areas and countryside may have better MC. By contrast, cities and denser areas contain parks and playing areas that include fixed equipment, such as slides, climbing bars, jungle gyms and tunnels that allow children to practise mainly balancing and strength-demanding skills [17,23]. However, we question if that is enough to develop MC. Finally, we hypothesised that children living in the rural areas and countryside spend more time outdoors and have fewer opportunities to participate in organised sports than children living in cities or metropolitan areas. In one Nordic country, we examined whether children's physical living environment i.e., geographical location and residential density, are associated with their MC, the amount of time spent outdoors and participation in organised sports.

2. Methods

2.1. Study Protocol and Study Participants

The Skilled Kids study protocol and cluster-random sampling have been previously described in detail [43,44]. Briefly, we aimed to recruit a geographically representative sample of 1000 children, aged 3–7 years, from Finnish childcare centres. The Finnish national registry of early educators includes 2600 childcare centres. Based on this register, childcare centres were chosen using cluster-random sampling from the Southern, Central and Northern Finland based on postal codes. Of the 47 childcare centres that we invited to participate in the study, 37 centres agreed to participate, with a total of 945 children, aged over 36 months (mean age = 5.4 years, 473 boys or 50.1%) and with complete data on the Test of Gross Motor Development—third edition (TGMD-3). Of the childcare centres, 17 were located in Southern, 13 in Central and 7 in Northern Finland (Table 1).

The Ethics Committee of the University of Jyväskylä, Finland, granted approval for the study on 31 October 2015 (Skilled Kids, 31.10.2015). The parents of the participating children provided their written consent. The children were informed about all study procedures and their right to opt out of participation at any time, without consequences.

2.2. Physical Environment: Geographical Location and Residential Density

Both geographical location and residential density were evaluated indirectly by using the set of postal codes of the childcare centres that the children were attending as the reference and the national population density registry for the categorisation. Finland was divided into three geographical locations: Northern, Central and Southern Finland. Additionally, as the residential density might affect the possibilities for the children's time spent outdoors and for organised sports, the rest of the country was classified according to residential density, comprising four categories: the metropolitan area, cities, rural areas and the countryside (Table 1).

Table 1. Geographical location, residential density and characteristic of living environment of study sample.

Physical Environment	Localities	Childcare Centres	Educational Level	Income Mean	Children (*n*)			Age in Years (SD)			% of the Study Sample		
Geographic location (°C [1]/h/day [2])	*n*	*n*	Range 1 to 4 (SD)	Range 1 to 8 (SD)	All	Girls	Boys	All	Girls	Boys	All	Girls	Boys
Southern (−6.6 to +17.7/6 to 19)	10	17	2.90 (0.83)	4.58 (1.56)	449	224	225	5.30 (1.09)	5.24 (1.07)	5.35 (1.11)	47.5	47.4	47.5
Central (−8.1 to +16.8/5 to 20)	10	13	2.63 (0.74)	4.00 (1.28)	335	163	172	5.59 (1.13)	5.57 (1.18)	5.62 (1.08)	35.4	34.5	36.4
Northern (−11.2 to +15.1/2.5 to 24)	4	7	2.48 (0.70)	4.30 (1.35)	161	85	76	5.40 (1.15)	5.41 (1.15)	5.38 (1.15)	17.1	18.1	16.1
Residential density (n/km^2)													
Metropolitan (876.4–2964)	2	6	3.17 (0.79)	4.91 (1.68)	189	94	95	5.17 (1.15)	5.09 (1.08)	5.25 (1.20)	20.0	19.9	20.0
Cities (24.65–762.9)	13	17	2.69 (0.77)	4.15 (1.45)	421	211	210	5.60 (1.11)	5.53 (1.18)	5.66 (1.04)	44.5	44.7	44.4
Rural areas (4.93–64.35)	5	7	2.56 (0.69)	4.31 (1.24)	183	98	85	5.48 (1.15)	5.49 (1.15)	5.47 (1.15)	19.4	20.8	18.0
Countryside (1.49–8.56)	4	7	2.53 (0.69)	4.13 (1.22)	152	69	83	5.15 (0.97)	5.18 (0.91)	5.12 (1.02)	16.1	14.6	17.5
In total sample	24	37	2.73 (0.80)	4.33 (1.46)	945	472	473	5.42 (1.12)	5.38 (1.13)	5.45 (1.11)	100	49.9	50.1

Educational level (1 = comprehensive school; 2 = high school/vocational school; 3 = polytechnic; 4 = university). Income mean (1 = 0 to 13,999 €/year, 2 = 14,000 to 19,999 €; 3 = 20,000 to 39,999 €; 4 = 40,000 to 69,999 €; 5 = 70,000 to 99,999 €; 6 = 100,000 to 119,000 €; 7 = 120,000 to 139,000 €; 8 = over 140,000 €). Values are reported as mean (standard deviation) scores or percentages (%). [1] Mean temperature in February (coldest month) and in July (warmest month). [2] The amount of daylight in 21st of December (least daylight; winter solstice) and 21st of June (most daylight; summer solstice).

2.3. Motor Competence

MC was measured with the TGMD-3 [45], which has two skill categories: LM skills and OC skills. LM skills constitute a summary of six skills evaluated by points, as follows: run (0–8 points), gallop (0–8 points), hop (0–8 points), skip (0–6 points), horizontal jump (0–8 points) and slide (0–8 points), for a maximum total of 46 points. OC skills include a summary of seven skills, as follows: two-hand strike of a stationary ball (0–10 points), one-hand forehand strike (0–8 points), one-hand stationary dribble (0–6 points), two-hand catch (0–6 points), kicking a stationary ball (0–8 points), overhand throw (0–8 points) and underhand throw (0–8 points), for a maximum total of 54 points. An educated observer, who analysed the skills according to the fulfilment of the given criteria (3 to 5 criteria for one skill), evaluated each skill (0 point if the given criteria were not fulfilled, 1 point if they were met). Each child performed each skill twice, and his/her evaluation score was the sum of the received points during these two performances. The TGMD-3 total score was the sum of LM and OC skills, with a theoretical maximum of 100 points.

The TGMD-3 protocol was carefully followed according to the manual and described previously [43,44]. The TGMD-3 has been demonstrated to have good to excellent intrarater and interrater reliability [45], and it has been found valid and reliable both internationally [46,47] and in this study's context [43,44]. With this sample, the interrater reliability for the TGMD-3 total skills was 0.88 (95% confidence interval [CI] = 0.85–0.92), tested among 167 children [44].

2.4. Time Spent Outdoors and Participation in Organised Sports

The time spent outdoors and participation in organised sports were assessed through a questionnaire administered to the parents. The data on the time spent outdoors were obtained by asking this question: "How much time, on average, does your child spend outdoors after a preschool (or childcare) day/on the weekends?" The scale for the weekdays ranged from 0 to 3 (0 = not at all, 1 = under 30 min/d, 2 = approximately 30–60 min/d and 3 = over 60 min/d), and the scale for the weekends ranged from 0 to 4 (0 = not at all, 1 = under 30 min/d, 2 = approximately 30–60 min/d, 3 = 1–2 h/d and 4 = over 2 h/d). The total score from both scales was used to represent the time spent outdoors. The question's test-retest reliability was investigated with 30 responses and found to be appropriate (ICC = 0.62; 95% CI = −0.12–1.0). The data on participation in organised sports were obtained by asking this question: "Does your child participate in organised PA or sports in a group or a sports club?" If the answer was "yes", further questions regarding such activities were asked, as follows: "How many times a week?" "For how many minutes at a time?" The total time (in minutes) spent on organised sports per week was calculated and used in the analyses. The test-retest reliability of the questions was analysed and found to be good (ICC = 0.81; 95% CI = 0.60–0.91).

2.5. Other Assessments

The children's height, weight, body mass index standard deviation scores (BMI-SDS) [48] and their parents' educational and income levels were assessed, as described in detail previously [43,44] (Table 2).

Table 2. The descriptive data of the study sample.

Child Factors	*N*	Mean (SD)	Min	Max	Mean (SD) Girls	Mean (SD) Boys	Gender Differences *p*-Value
Age (years)	945	5.42 (1.12)	3.08	7.75	5.38 (1.13)	5.45 (1.11)	0.36
BMI SDS (%)	943	0.19 (1.05)	−4.55	3.45	0.21 (1.13)	0.17 (0.98)	0.56
Significantly underweight	15	1.6			2.5	0.6	0.66
Underweight	22	2.3			2.2	2.5	0.12
Normal weight	687	72.9			77.1	68.6	<0.001
Overweight	178	18.9			14.4	23.4	<0.001
Obesity	41	4.3			3.8	4.9	0.001
Height (cm)	943	113.52 (9.73)	86.30	137.30	112.64 (10.05)	114.40 (9.33)	0.001
Weight (kg)	943	21.19 (4.47)	11.30	41.60	21.04 (4.73)	21.34 (4.19)	0.62
TGMD-3 locomotor skills (0–46 p.)	945	27.52 (8.07)	0	46	28.89 (7.78)	26.16 (8.13)	<0.001
TGMD-3 object control skills (0–54 p.)	945	24.87 (9.06)	3	50	22.43 (7.91)	27.29 (9.49)	<0.001

Table 2. *Cont.*

Child Factors	*N*	Mean (SD)	Min	Max	Mean (SD) Girls	Mean (SD) Boys	Gender Differences *p*-Value
TGMD-3 total score (0–100 p.)	945	52.39 (15.16)	4	88	51.32 (14.11)	53.46 (16.08)	0.030
Time spent outdoors (%)	938	100					0.001
Less than 1 h/day	94	10.0			12.8	7.2	
Approximately 1 h/day	493	52.6			52.2	52.9	
1 to 2 h/day	351	37.4			35.0	39.9	
Participation in organised sports (mins/week)	902	49.50 (65.28)	0	421.00	48.34 (59.84)	50.65 (70.27)	0.97

BMI, Body mass index; SDS, standard deviation scores. Motor competence was measured using the Test of Gross Motor Development (TGMD)-3. Time spent outdoors and participation in organised sports were asked via parental questionnaire. Values are reported as mean and standard deviation (SD) scores or percentages (%) and adjusted for age.

2.6. Statistical Analysis

IBM SPSS version 24.0 (IBM Corp., Armonk, NY, USA) was used for the analyses, and the level of significance was set at $p < 0.05$. Descriptive statistics (mean and standard deviation [SD]) were calculated for MC (LM, OC and TGMD-3 skills) and for time spent outdoors and participation in organised sports. Furthermore, because previous studies [49,50] and the present study (Table 2) showed differences in MC between boys and girls, further analyses were performed separately for girls and boys.

The correlations between MC (LM, OC skills and TGMD-3), time spent outdoors and participation in organised sports was analysed with partial correlation adjusting for age in months. To analyse the differences between gender, geographical locations (Southern, Central and Northern Finland) and residential density (metropolitan area, cities, rural areas and countryside) in MC (LM, OC skills and TGMD-3), the time spent outdoors and participation in organised sports, the linear mixed-effects model was used (Tables 3–6). The age and the random effect for childcare centres were adjusted for the model. LM, OC skills, TGMD-3 total score, time spent outdoors and participation in organised sports were used as separate outcome variables, using geographical location and residential density as categorical explanatory variables one at a time. The effect of childcare centre was decided to adjust for random effect as the previous study [51] with this dataset showed that childcare centres' were associated with MC in children, which corresponds with the findings of several other studies regarded to MC or PA [10,52].

Table 3. Geographic location: differences in girls.

Child Factors	Total Sample	Southern			Central			Northern		
	Overall *p*-Value	*n*	Mean (SD)	Adj. Age	*n*	Mean (SD)	Adj. Age	*n*	Mean (SD)	Adj. Age
LM skills (max.46p.)	0.93	224	28.40 (7.81)	28.99	163	29.47 (7.70)	28.71	85	29.05 (7.87)	28.93
OC skills (max. 54p.)	0.27	224	20.83 (7.75)	21.48	163	24.23 (7.78)	23.41	85	23.21 (7.80)	23.08
TGMD-3 total (max. 100p.)	0.58	224	49.23 (13.96)	50.48	163	53.71 (13.90)	52.12	85	52.26 (14.25)	52.00
Time spent outdoors (scale 1–7)	**0.06**	222	4.82 (1.15)	**4.83** [1]	162	5.14 (1.24)	**5.12** [1]	85	5.08 (1.15)	5.08
Participation in organised sports (mins/week)	**0.03**	208	54.68 (63.05)	**56.98** [1]	160	38.23 (52.63)	**35.28** [1]	80	52.10 (62.85)	51.82

Motor competence was measured using the Test of Gross Motor Development (TGMD)-3. Time spent outdoors and participation in organised sports were asked via parental questionnaire. The time spent outdoors was a sum from the time spent outdoors on weekdays and weekends. The scale for the weekdays ranged from 0 to 3 (0 = not at all, 1 = under 30 min/d, 2 = approximately 30–60 min/d and 3 = over 60 min/d), and the scale for the weekends ranged from 0 to 4 (0 = not at all, 1 = under 30 min/d, 2 = approximately 30–60 min/d, 3 = 1–2 h/d and 4 = over 2 h/d). Values are reported as mean and standard deviation (SD) scores. LM skills= locomotor skills, OC skills= object control skills. * Statistically significant difference (adjusted for age, random effect of childcare centre) between geographical locations groups at the level of $p < 0.05$. Statistically significant differences in bold. In time spent outdoors difference between Central and Southern: 1 $p = 0.03$ *. Participation in organised sports, difference between Southern and Central: 1 $p = 0.012$ *.

Table 4. Geographic location: differences in boys.

Child Factors	Total Sample	Southern			Central			Northern		
	Overall *p*-Value	*n*	Mean (SD)	Adj. Age	*n*	Mean (SD)	Adj. Age	*n*	Mean (SD)	Adj. Age
LM skills (max.46p.)	0.61	225	26.12 (7.96)	26.58	172	26.33 (8.17)	25.57	76	25.93 (8.64)	26.28
OC skills (max. 54p.)	0.46	225	26.27 (9.33)	26.83	172	29.02 (9.31)	28.10	76	26.42 (9.90)	26.84
TGMD-3 total (max. 100p.)	0.94	225	52.39 (15.61)	53.42	172	55.35 (16.10)	53.67	76	52.36 (17.18)	53.13
Time spent outdoors (scale 1–7)	**0.001**	223	4.82 (1.15)	**4.94** [1,2]	170	5.55 (1.10)	**5.53** [1]	76	5.36 (1.10)	**5.37** [2]
Participation in organised sports (mins/week)	0.26	219	55.87 (76.38)	58.11	163	46.43 (62.79)	42.32	72	44.34 (66.58)	46.85

Motor competence was measured using the Test of Gross Motor Development (TGMD)-3. Time spent outdoors and participation in organised sports were asked via parental questionnaire. The time spent outdoors was a sum from the time spent outdoors on weekdays and weekends. The scale for the weekdays ranged from 0 to 3 (0 = not at all, 1 = under 30 min/d, 2 = approximately 30–60 min/d and 3 = over 60 min/d), and the scale for the weekends ranged from 0 to 4 (0 = not at all, 1 = under 30 min/d, 2 = approximately 30–60 min/d, 3 = 1–2 h/d and 4 = over 2 h/d). Values are reported as mean and standard deviation (SD) scores. LM skills= locomotor skills, OC skills= object control skills. * Statistically significant difference (adjusted for age, random effect of childcare centre) between geographical locations groups at the level of $p < 0.05$. Statistically significant differences in bold. Time spent outdoors, difference between Central and Southern: **1** $p = 0.028$ * and Northern and Southern: 2 $p = 0.031$ *.

Table 5. Residential density: differences in girls.

Child Factors	Total Sample	Metropolitan			Cities			Rural Areas			Countryside		
	Overall *p*-Value	*n*	Mean (SD)	Adj. Age	*n*	Mean (SD)	Adj. Age	*n*	Mean (SD)	Adj. Age	*n*	Mean (SD)	Adj. Age
LM skills (max.46p.)	0.076	94	27.46 (8.35)	**28.67** [1,4]	211	29.24 (7.39)	**28.62** [2]	98	28.74 (7.75)	**28.30** [3,4]	69	29.94 (8.07)	**30.82** [1,2,3]
OC skills (max. 54p.)	**0.054**	94	19.70 (7.84)	**21.05** [1,4]	211	22.73 (7.71)	**22.05** [2]	98	22.86 (7.25)	**22.36** [3,4]	69	24.64 (8.65)	**25.60** [1,2,3]
TGMD-3 total (max. 100p.)	0.036	94	47.16 (14.63)	**49.72** [1,4]	211	51.98 (13.65)	**50.67** [2]	98	51.60 (13.36)	**50.66** [3,4]	69	54.58 (14.87)	**56.42** [1,2,3]
Time spent outdoors (scale 1–7)	0.032	93	4.77 (1.14)	**4.80** [1]	211	5.03 (1.23)	5.02	96	4.81 (1.15)	**4.80** [2]	69	5.30 (1.09)	**5.32** [1,2]
Participation in organised sports (mins/week)	0.118	88	61.08 (67.09)	**65.78** [1,2]	204	44.69 (60.61)	**42.67** [1]	89	43.16 (48.52)	**41.22** [2,3]	67	49.64 (59.94)	**52.18** [3]

Motor competence was measured using the Test of Gross Motor Development (TGMD)-3. Time spent outdoors and participation in organised sports were asked via parental questionnaire. The time spent outdoors was a sum from the time spent outdoors on weekdays and weekends. The scale for the weekdays ranged from 0 to 3 (0 = not at all, 1 = under 30 min/d, 2 = approximately 30–60 min/d and 3 = over 60 min/d), and the scale for the weekends ranged from 0 to 4 (0 = not at all, 1 = under 30 min/d, 2 = approximately 30–60 min/d, 3 = 1–2 h/d and 4 = over 2 h/d). Values are reported as mean and standard deviation (SD) scores. LM skills= locomotor skills, OC skills= object control skills. * Statistically significant difference between residential density areas (adjusted for age, random effect of childcare centre) at the level of $p < 0.05$. Statistically significant differences in bold. In LM skills difference between countryside and metropolitan area: [1] $p = 0.05$ *, countryside and cities: [2] $p = 0.025$ *, countryside and rural areas: [3] $p = 0.015$ * and metropolitan area and rural areas: [4] $p = 0.025$ *. In OC skills difference between countryside and metropolitan area: [1] $p = 0.013$ *, countryside and cities: [2] $p = 0.015$ *, countryside and rural areas: [3] $p = 0.002$ **, and rural areas and metropolitan area: [4] $p = 0.015$ *. In TGMD-3 total skills difference between countryside and metropolitan area: [1] $p = 0.011$ *, countryside and cities: [2] $p = 0.010$ **, countryside and rural areas: [3] $p = 0.024$ * and rural areas and metropolitan area: [4] $p = 0.010$ **. Time spent outdoors, difference between countryside and metropolitan: [1] $p = 0.011$ *, and countryside and rural areas: [2] $p = 0.010$ **. In participation in organised sports difference between metropolitan and cities: [1] $p = 0.030$ *, metropolitan area and rural areas: [2] $p = 0.032$ * and countryside and rural areas: [3] $p = 0.030$ *.

Table 6. Residential density: differences in boys.

Child Factors	Total Sample	Metropolitan			Cities			Rural Areas			Countryside		
	Overall p-Value	n	Mean (SD)	Adj. Age	n	Mean (SD)	Adj. Age	n	Mean (SD)	Adj. Age	n	Mean (SD)	Adj. Age
LM skills (max.46p.)	0.094	95	25.68 (8.13)	26.61	210	27.29 (7.82)	26.30	85	24.41 (8.21)	**24.32** [1]	83	25.67 (8.56)	**27.21** [1]
OC skills (max. 54p.)	0.179	95	24.39 (9.51)	**25.52** [1]	210	29.06 (9.12)	27.85	85	26.60 (9.85)	26.49	83	26.86 (9.20)	**28.74** [1]
TGMD-3 total (max. 100p.)	0.110	95	50.07 (16.33)	52.13	210	56.35 (15.40)	54.15	85	51.01 (16.62)	**50.51** [1]	83	52.53 (15.89)	**55.95** [1]
Time spent outdoors (scale 1–7)	0.020	94	4.80 (1.17)	**4.83** [1,2]	210	5.40 (1.09)	**5.37** [1]	83	5.16 (1.20)	**5.16** [3]	83	5.33 (1.07)	**5.38** [2,3]
Participation in organised sports (mins/week)	0.939	92	52.49 (66.90)	57.16	200	55.25 (75.62)	50.43	83	46.47 (69.83)	46.14	79	41.27 (59.82)	48.38

Motor competence was measured using the Test of Gross Motor Development (TGMD)-3. Time spent outdoors and participation in organised sports were asked via parental questionnaire. The time spent outdoors was a sum from the time spent outdoors on weekdays and weekends. The scale for the weekdays ranged from 0 to 3 (0 = not at all, 1 = under 30 min/d, 2 = approximately 30–60 min/d and 3 = over 60 min/d), and the scale for the weekends ranged from 0 to 4 (0 = not at all, 1 = under 30 min/d, 2 = approximately 30–60 min/d, 3 = 1–2 h/d and 4 = over 2 h/d). Values are reported as mean and standard deviation (SD) scores. LM skills= locomotor skills, OC skills= object control skills. * Statistically significant difference between residential density areas (adjusted for age, random effect of childcare centre) at the level of $p < 0.05$. Statistically significant differences in bold. In LM skills difference between countryside and rural areas: [1] $p = 0.014$ *. In OC skills difference between countryside and metropolitan area: [1] $p = 0.048$ *. In TGMD-3 total skills difference between countryside and rural areas: [1] $p = 0.030$ *. In time spent outdoors, difference between cities and metropolitan area: [1] $p = 0.006$ **, countryside and metropolitan area: [2] $p = 0.012$ * and countryside and rural areas: [3] $p = 0.006$ **.

3. Results

3.1. Descriptive Results

All 945 children's ages ranged from three to seven years (mean = 5.4 years, SD = 1.1). About half of the children were boys (n = 473 or 50.1%). The parents who answered to the questionnaire (n = 936; mean age = 35.8 years, SD = 5.4) were most likely mothers (n = 816 or 87.2%), and more than half of the parents had polytechnic- or university-level education (n = 569 or 60.7%). Nearly every child spoke Finnish as his/her mother tongue (n = 886 or 94.5%). The majority of the children lived in cities, the metropolitan area, or Central or Southern Finland (Table 1). The parents living in the metropolitan area had the highest annual income (n = 172) and the highest educational level (n = 187), while the parents living in cities (n = 386) and the countryside (n = 134) had the lowest annual income. The parents living in the countryside had the lowest educational level (n = 150) (Table 1). Using the total sample, we found that the TGMD-3 total score correlated with LM skills (r = 0.83; $p < 0.001$), OC skills (r = 0.0.84; $p < 0.001$), time spent outdoors (r = 0.12; $p < 0.001$) and participation in organised sports (r = 0.23; $p < 0.001$). LM skills correlated with OC skills (r = 0.38; $p < 0.001$), time spent outdoors (r = 0.07; $p = 0.029$) and with participation in organised sports (r = 0.14; $p < 0.001$). OC skills correlated with time spent outdoors (r = 0.13; $p < 0.001$) and finally, participation in organised sports (r = 0.23; $p < 0.001$).

3.2. Gender Differences

The descriptive data of the study sample are reported in Table 2. Boys had lower LM skills, better OC skills and a better TGMD-3 total score than girls (Table 2). Boys also spent more time outdoors.

3.3. Geographic Location

The girls from Central Finland spent more time outdoors than girls from the Southern part of the country, while girls from the Southern area participated more in organised sports than girls from Central Finland (Table 3). Additionally, time spent outdoors correlated positively with LM skills in Central Finland (r = 0.21; $p = 0.007$). Participation in organised sports correlated positively with LM skills in Central (r = 0.20; $p = 0.01$) and Northern Finland (r = 0.23; $p = 0.05$) and with better OC skills in Southern (r = 0.15; $p = 0.04$) and Northern Finland (r = 0.39; $p < 0.001$).

The boys from Central and Northern Finland spent more time outdoors than boys living in the Southern part of the country (Table 4). Moreover, time spent outdoors correlated positively with OC skills in Southern Finland (r = 0.14; $p = 0.04$). Participation in organised sports correlated positively with LM skills in Southern (r = 0.16; $p = 0.02$) and in Central Finland (r = 0.20; $p = 0.01$) while in Northern Finland the correlation with LM skills was negative (r = −0.33; $p = 0.005$). Participation in organised sports correlated positively with OC skills in Southern (r = 0.41; $p < 0.001$) and Central Finland (r = 0.20; $p = 0.01$).

3.4. Residential Density

Girls living in the countryside outperformed other girls in LM, OC skills and in TGMD-3 total scores. Additionally, girls from metropolitan area had better LM skills than girls from rural areas, while girls from rural areas had better OC skills and TGMD-3 total scores than girls from metropolitan area. Girls from the countryside spent more time outdoors than girls from metropolitan or rural areas. Girls from metropolitan area participated more in organised sports than girls from cities or rural areas. Finally, girls from the countryside participated more in organised sports than girls from rural areas (Table 5). Among girls, participation in organised sports correlated positively with LM skills (r = 0.25; $p = 0.02$) in metropolitan area and with LM (r = 0.15; $p = 0.03$) and OC (r = 0.21; $p = 0.03$) skills in cities.

Boys from the countryside outperformed the boys from the rural areas in LM skills. Boys from the countryside scored higher in OC skills than boys from the metropolitan area. The boys from the countryside had a higher TGMD-3 total score than the boys from the rural areas. The boys from metropolitan area spent less time outdoors compared with boys from the cities and the countryside. Additionally, boys living in rural areas spent less time outdoors than boys living in the countryside. (Table 6). Time spent outdoors correlated positively with LM skills in cities (r = 0.17; $p = 0.02$) and with OC skills in metropolitan area (r = 0.23; $p = 0.03$). Participation in organised sports correlated positively with OC skills in metropolitan area (r = 0.30; $p = 0.004$), in cities (r = 0.38; $p < 0.001$) and in rural areas (r = 0.26; $p = 0.02$).

4. Discussion

In this study, we investigated the associations between geographical location and the residential density of the living environment with MC, time spent outdoors and participation in organised sports in 3–7-year-old Finnish children. The main finding was that residential density was more strongly associated with MC, time spent outdoors and participation in organised sports than geographical location was. Specifically, girls from the countryside had better MC than their peers from metropolitan area, cities or rural areas. Girls living in metropolitan area engaged more in organised sports than the other girls. Boys from the countryside outperformed boys from rural areas in LM skills and TGMD-3 total scores and boys from metropolitan area in OC skills. Furthermore, in the whole sample of children, some gendered differences emerged. Finally, time spent outdoors and especially participation in organised sports, was associated with better MC. However, similar associations between better MC and time spent outdoors and participation in organised sports were not observed among children from the countryside, despite the fact that they had the highest MC. Thus, we suggest that children with lower MC skills tend to benefit more from time spent outdoors and participation in organised sports. As cognitive functions and MC are positively associated [25,26,29,30], this research is a valuable contribution to the literature regarding the associations among MC, PA and environmental factors.

4.1. Geographical Location

We found that children from Central Finland spent the most time outdoors, while children from Southern Finland spent the least time outdoors. Therefore, the mean temperature and the amount of daylight were not significant determinants of outdoor time, which was counter to our hypothesis. Furthermore, we observed that girls who spent more time outdoors had better LM skills in Central Finland, while boys who spent more time outdoors had better OC skills in Southern Finland. In addition, we found no differences in LM, OC skills or MC among children from different geographical locations. This result may reflect the national curriculum of early education [53], which covers the whole nation and supports equal educational actions and recommendations for PA [54] for all children among early education. Furthermore, Finnish children can move around quite freely and independently [11] due to the right of common access to the environment and its affordances. Therefore, it may be that Finnish children have equal opportunities to develop MC, and to participate in organised sports, regardless of geographical location. These findings together suggest that the equal and free access to multiple affordances and participation in organised sports in Finland may greatly benefit motor learning in children. This is in line with the theory of affordances, which holds that playing outdoors motivates and supports motor development [14]. Coté and his research group [55,56] have shown that the majority of professional athletes grew up in small cities, which offer more equal possibilities for free play and access to organised sports [57]. As a whole, our data suggests that early childhood years are important to development of MC; free play provides children possibilities to feel autonomy and freedom to play [35], while access to organised sports also contributes to the development of motor learning in children. Those factors, together with multiple environmental affordances [14], are strong motivators for PA and motor development.

Interestingly, the geographic characteristics of Northern Finland (a long dark period with low temperature) are not disadvantages in terms of the time children spent outdoors or their motor development. Some previous studies have shown an inverse association between the temperature and PA levels [39–41] but the findings with regard to younger children (less than 8-years) are inconsistent [40].

In Finnish context, Soini et al. [58] found that season only minimally influence children's PA levels, and that other factors (e.g., gender, educational support by parents and teachers) are more significant correlates of PA and motor development in children who are less than 4-years old.

Finally, we found that children from Central Finland tend to spend the most time outdoors. Central Finland has many small cities, lots of unbuilt spaces and nature elements (e.g., hills, lakes and forests) around people's everyday living environment. According to previous studies [7,8], varying surfaces and shapes, such as natural and built playground facilities, not only increase children's PA but also support their motor development. Therefore, it is suggested that versatile environments create proximal zones of development [32] for MC learning. Additionally, to motivate children to move, it is fundamental to hear what they want from their environment [15]. Children typically want their living environment to have active and natural spaces with natural elements, such as water, animals, stones, leaves, sand and sticks [15], all of which are present in Central Finland.

4.2. Residential Density

We found that the children from the countryside (with the lowest residential density) had better MC and spent larger amounts of time outdoors than their peers from metropolitan area (with the highest residential density), especially among girls. Girls living in the countryside outperformed other girls in LM, OC skills and in TGMD-3 total scores. Boys from the countryside outperformed boys from rural areas in LM skills and TGMD-3 scores and scored higher in OC skills than boys from the metropolitan area.

One reason that children from countryside succeed in MC may be access to large spaces and freedom to move, which increases the children's PA and their development of MC. Kyttä [11] stated that Finnish children have more freedom than their peers from Western Europe do and that less dense areas may provide better possibilities for independent mobility. This suggests that for Finnish children, the freedom of independent mobility increases the pleasure derived from PA. Additionally, the amount of time spent outdoors, which was higher in the countryside than in other regions, has been shown to be positively associated with children's PA levels [59], which could partly explain the better MC demonstrated by children from the countryside.

With regard to MC, Campos et al. [19] proclaimed that LM skills are fundamental for future MC learning; it may be that if PA levels remain low due to the lack of space or safety, LM skills do not develop as much, and OC skill learning can be delayed. Children from the countryside may have more space and time to repeat those motor skills that are critical for them during that developmental phase. Moreover, playing ball games requires large, empty places, which are usually lacking in a metropolitan area [18] resulting lower level of OC skills in children from metropolitan area.

As PA and motor development are associated with each other [1,2], the possibility to move freely in less densely populated areas in everyday life may be associated with better MC skills or more time spent outdoors, as demonstrated by our sample of children from the countryside. In fact, a previous study [60] showed that children's PA participation in everyday life was positively associated with publicly provided recreational infrastructure, such as access to recreational facilities and schools, and transport infrastructure, such as the presence of sidewalks and controlled intersections, access to destinations and public transportation. On the other hand, in densely populated areas, parents may exert more control or restriction of their children's time spent outdoors due to the lack of safety [60,61] although in general Finland is perceived as a relatively safe environment [61].

Children seem to prefer versatile environments near home [61] that provide large, safe spaces with natural elements that encourage the development of LM, OC skills and balance skills. In line with the theory of affordances [9], it seems that the more variation the environment and affordances provides, the more possibilities the child may have for divergent motor learning. Thus, the result is two-fold: the variety of living environments may be greater in less dense areas, which explains why children from the countryside display more advanced motor skills, and secondly, tend to spent more time outdoors.

Childcare centre. In the present study, even though Finnish children's equality in terms of geographical location was evident, there were differences between childcare centres in MC. A previous study [51] with this study sample showed that childcare centres that had large yards, with variation in shapes and the amount of surfaces, were positively associated with children's MC [51]. Thus, it is significant that childcare centres with large yards are more common in less densely populated areas, like in the countryside. Similarly, a study by Kyttä [13] showed that in Finland, areas with lower population density provided the largest number of actively available affordances, while areas with high population density had the lowest number of affordances, although her focus was not specifically on childcare centres. These findings are in accord with the theory of affordances, which proclaims that motor development benefits from environmental affordances [14] located in children's everyday living environment [61]. Because children spend multiple hours in childcare centres, we believe that the environment near these centres plays a notable role in motor development. Children from the countryside spent more time outdoors at home than children from metropolitan (girls and boys) or rural areas (girls) and they benefit from childcare centres larger yards, so they may have more opportunities to develop their motor skills both at the childcare centre and at home, which would explain their better MC.

Participation in organised sports. In the present study, the metropolitan children, especially the girls, participated the most in organised sports, as expected. Contrary to our hypotheses, children from the countryside were not disadvantaged by their lack of participation in organised sports. However, children with lower MC, participation in organised sports can be crucial for their MC learning, as MC does not develop optimally with increasing age and maturity but needs to be practised and reinforced continuously during childhood. Previous studies [17,32] suggested that skilled adults' guidance in organised sports could support children's MC learning. Additionally, Brian et al. [4] state that the development of OC skills is heightened by participation in specific contexts where children receive accurate instructions. Similarly, the present study revealed that a higher level of participation in organised sports was positively associated with MC in rural areas, cities and metropolitan area. However, no such finding was found with children from the countryside. Thus, we suggest that children, who were not from the countryside, who have lower MC overall, benefitted from participation in organised sports. Since the abovementioned associations were not found in children living in the countryside, it is important to examine further, which other contextual factors could play a mediating or moderating role in children's participation in organised sports.

4.3. Gender Differences

Girls outperformed boys in LM skills, but boys outperformed girls in OC skills and in the TGMD-3 total score. Additionally, boys spent more time outdoors. These findings are in line with those of previous studies [18,62], as boys are typically recognised as having better OC skills than girls. This result may reflect the content of gender differences in play, as girls participate more in organised sports involving LM skills, such as dance [63], while boys engage more in hobbies that include mastery of ball skills [21]. Some researchers suggest that environmental and socio-cultural factors may be the reason for gender differences in children's OC skills [18,64]. According to some researchers [65], boys are more social and significantly more likely to be involved in ball games, while girls are more likely to play in smaller groups, involving more conversation, sedentary play, jump-skipping and verbal games. These differences may reflect the gender differences in motor development as well.

4.4. Suggestions for Future Research from the Cognitive Development Perspective

Our findings indicate that the environment matters for children's motor development. Earlier research has shown close relationships among brain structures, functions and cognitive functions [31], such as executive functions [21], working memory and information processing [28,66]. Controlling balance and body movements in the natural environment and on different surfaces requires constant brain activity. Appropriate stimuli from parents, peers or the environment are required for normal cognitive development. Nevertheless, there is limited evidence about the effects of different types of PA and the time spent outdoors in different environments on cognitive skills or brain development, and more research on this topic is warranted. However, to optimally support motor development, age appropriate psychological motivation is also necessary. This match meets in the proximal zone of development [32]. In future studies, also from the cognitive development perspective, it would be important to investigate interactions and combined effects of MC, PA as well as time spent outdoors and participation in organised sports on cognitive development.

4.5. Strengths and Weaknesses of the Study

This study's strengths include a relatively large sample of children from varying geographical locations in Finland, and the valid and reproducible methods used to measure MC. We assessed the time spent outdoors and participation in organised sports using a questionnaire administered to parents because a questionnaire is the only feasible method to assess the type and the setting of PA among children. However, it would have been optimal to combine parent-reported measures of PA (time spent outdoors) with device-based measures of PA using accelerometers. Additionally, to gain a deeper understanding of the relationship between cognitive functions and MC, the study would have benefited greatly by measuring cognitive functions. Furthermore, we were unable to assess physical environments other than the childcare centres, and we could not rule out the possibility that local differences in built environments had a small effect on our results. Despite the efforts to include a fully representative sample of Finnish children attending childcare centres, the results revealed a bias towards more highly educated parents. Moreover, it can be assumed that this kind of study interests parents with positive attitudes about a physically active lifestyle. Therefore, our sample may not perfectly represent the Finnish population in different parts of the country.

5. Conclusions

The current study provided an example of how children's daily living environment and MC are closely related in the Finnish context. The main finding revealed that residential density is related to children's MC, engagement in outdoor play and organised sports. At its best, the daily environment provides children with versatile opportunities to motor learning. Indeed, it was found that Finnish children living in the countryside spent more time outdoors and had higher MC than their age peers in the metropolitan area. The conclusion is that time spent in a physical environment that provides the affordances needed for physical activity is closely related to the development of MC. Furthermore, such an environment enables also learning in a broader perspective; while moving, children perceive and observe their environment. If the environment is safe and engaging enough, children are likely to be fit both physically and cognitively. Therefore, future research can provide more understanding of the multifaceted benefits of physical environments to children's motor and cognitive learning in variable residential densities and geographical locations.

Author Contributions: For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used "conceptualization, D.N., T.F., M.C. and A.S.; methodology, D.N., T.F., M.C. and A.S.; software, D.N. and E.K..; validation, D.N.; formal analysis, D.N., E.A.H & E.K.; investigation, D.N., A.S.; resources, D.N. and A.S.; data curation, D.N. and E.K.; writing—original draft preparation, D.N., T.F., M.C., E.A.H., E.K and A.S.; writing—review and editing, D.N., T.F., M.C., A.S., E.A.H., E.K.; visualization, D.N. and E.A.H.; supervision, T.F., M.C., A.S.; project administration, A.S.; funding acquisition, A.S., T.F. and M.C. ".

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III

SOCIOECOLOGICAL CORRELATES OF PERCEIVED MOTOR COMPETENCE IN 5- TO 7-YEAR-OLD FINNISH CHILDREN

by

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Socioecological correlates of perceived motor competence in 5–7-year-old Finnish children

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Abstract

We investigated child, family and environmental factors associated with young children's perceptions of locomotor (LM) and object control (OC) skills. The participants comprised 472 children (6.22 ± 0.63) and their parents. The children were assessed for their perception of motor competence in LM and OC skills (using the pictorial scale of Perceived Movement Skill Competence for young children), and actual motor competence (Test of Gross Motor Development 3rd edition and Körperkoordinationstest Für Kinder). Anthropometrics were calculated using the children's body mass index standard deviation scores. A parent questionnaire included questions about child factors (sex, child's independent walking age, time spent sedentary and outdoors, participation in organised sport activities and access to electronic devices), family factors (parent educational level, physical activity frequency and sedentary behaviour) and environmental factors (access to sport facilities). Variance analysis sought to identify age-related differences, and a linear regression model examined correlates of children's perception of LM and OC skills. The children's movement skill perceptions were found to be generally high. Four factors explained 5.7% of the variance in perceptions of LM skills and 7.5% of the variance in perceptions of OC skills. Two factors, lower age and higher actual motor competence, explained most of the children's skill perceptions. Access to electronic devices (less) and BMI (higher) were associated with perceptions of LM skills. Participation in organised sport activities (higher) and parental education (lower) were associated with perceptions of OC skills. When promoting children's physical activity and motor competence, perceptions of motor competence are an important consideration.

Keywords: self-perception, locomotor skills, object control skills, TGMD-3, KTK, childcare centre, BMI

Introduction

As society has changed, families with young children have encountered challenges such as growing obesity rates,[1] physical inactivity[2] and decreased motor competence (MC)[3] in children. Stodden et al. (2008) suggest that there is an interconnection between physical activity (PA), MC and the perception of motor competence (PMC). According to the abovementioned model and a subsequent review, which synthesized the research supporting the model,[5] children's PA participation influences their development of MC, and in turn, their MC influences their PA motivation and engagement. Conversely, PMC is considered to consist of a child's perceptions, awareness and beliefs regarding performing motor tasks.[4,5] PMC evolves over time[6] and contributes to PA behaviour. It is suggested that children with high PMC are more engaged, motivated and persistent during PA,[7,8] whilst children with lower PMC may lose interest and do not persist with mastering tasks. This spiral of (dis)engagement in terms of PA, MC and PMC contributes to the prevention of inactivity and obesity in childhood and later on in an individual's life.[4,5] Therefore, focusing research attention on how children develop their PMC is necessary to lay a foundation for PA behaviour and the development of necessary motor skills.

An essential component in the development of PMC is cognitive maturity.[6] Due to cognitive immaturity, young children tend to overestimate their mastery of motor tasks,[9] which can lead to engagement and persistence in PA behaviour despite unsuccessful outcomes.[10] Thus, according to Harter's (1999) construct of self-concept, the younger that children are, the more positive and unrealistic may be their PMC. In line with Harter's (1999) theory, recent studies have demonstrated that young children have relatively high perceptions of their skills.[3,11] However, after age seven, children's cognitive capacity permits them to evaluate their mastery with greater accuracy.[6] Simultaneously, the growth of comparison, rivalry and selectiveness in sport activities and schools may be associated with a decline in PMC with age.[12] The lack of these aforementioned factors in the early years could explain young children's positive PMC. However, as many health habits, especially PA, are traceable to the early years,[13] it is essential that we understand more about the factors that influence the construction of a child's PMC, especially that factors which are associated with low PMC.

Understanding the correlates of PMC is, therefore, important in order to develop effective means to prevent future inactivity and to enhance motor development. However, the previous literature has predominantly studied child-related factors of PMC.[11,14] According to the socioecological model,[15] a child's behaviour stems from reciprocal interactions between micro, meso, exo and macro systems, thus, in child, family, environmental and community levels. According to Sallis and collegues (2000), to be able to make substantial behavioural changes, interventions must target changes at each level of this model. However, before an intervention, there should be basic knowledge about factors that are associated with PMC. For example, Barnett et al. (2016) demonstrated that child-related factors are most important correlates for MC. As growing evidence demonstrates that even in young children PMC and actual MC are associated,[3,18,19] and that PA, MC and PMC are linked in Stodden et al.'s (2008) spiral of engagement, we believe it is important to understand the correlates of PMC. In the present study the aim was to examine the PMC and its association with different levels of the socioecological model and to broaden the existing PMC research to understand not only children's child-related factors (e.g. sex and age) but also family (e.g. parents' mean educational level and PA behaviour) and environment (access to sport facilities) related factors.

We investigated 5–7-year-old children’s perception of locomotor (LM) and object control (OC) skills, and their associated correlates, based on the socioecological model. We hypothesised that there may be some important hitherto undiscovered socioecological aspects at the family and environmental levels that relate to the child’s ability to evaluate his/her competence.

Materials and Methods

The Ethics Committee of the University of Jyväskylä, Finland, granted ethical approval for the study. The parents of the participating children provided written consent. The children were informed about their right to opt out of participation at any time.

Random sampling and recruitment

The aim of the larger study, *Skilled Kids,*[20] was to explore Finnish children’s MC and PMC as well as their covariates. The study design was aimed at a geographically representative sample of 1000 children aged 3–7 years from Finnish childcare centres. The Finnish national registry of early educators included 2600 childcare centres. Based on this registry, cluster-random sampling was carried out, i.e. childcare centres were chosen randomly from the metropolitan area, Southern, Central and Northern Finland based on postal codes. The number of childcare centres involved in one region was weighted with the population density of the area. The recruitment took place in the autumn of

2015. Altogether, 37 childcare centres participated: six from the metropolitan area, eleven from Southern, thirteen from Central and seven from Northern Finland. A total of ten childcare centres (27%) declined to participate, citing reasons such as lack of space, interest, time or low pupil numbers. If a randomly chosen childcare centre declined to participate, the following one on the list was recruited from the same area. For the recruited childcare centres, the respective directors would first approve the participation, and their staff were then informed about the study. Second, the staff received informed written study forms and questionnaires (n = 1579) and forwarded them to parent(s). The parents were asked to fill in the consent forms and questionnaires. The questionnaires were returned to the researchers in prepaid envelopes. In total, 1239 children (78.5%) received consent for study participation. The measurements were conducted in childcare centre settings between November 2015 and September 2016 by two researchers (DN and AS), along with two research assistants.

Participants

In this study, all those children in the *Skilled Kids* –study[20] who were over 59 months old and who had filled out the PMSC were included in the analysis. The study participants comprised 472 Finnish children who were 5–7 years old: boys, 247 (52.3%, mean 6.22 years) and girls, 225 (47.7%, mean 6.23 years).

Perceptions of motor competence

PMC was measured with the pictorial scale of Perceived Movement Skill Competence (PMSC)[21] for young children. The modified version of this scale is aligned with the items in the third edition of the Test of Gross Motor Development (TGMD-3).[22] The scale contains 13 items subdivided into two subscales, LM skills (run, gallop, hop, skip, horizontal jump and slide) and OC skills (two-hand strike of a stationary ball, one-hand forehand strike, one-hand stationary dribble, two-hand catch, kick a stationary ball, overhand throw, underhand throw), using gender-specific booklets. Each item in the subscale was presented in the form of bipolar statements accompanied by a picture for each statement; for example, two images show a boy running. The child was asked whether he was like the competent child or like the child who was not very competent at running. After the child picked one of the pictures, he was further asked to specify his answer. If the child chose the more competent child, he would then choose between 'really good' (4 points) or 'pretty good' (3 points) at running. If the child chose the less competent child, he would then choose between 'sort of good' (2 points) or 'not that good' (1 point) at running. The maximum score of one item was four. The maximum sum score for LM skills was 24 points (6 X 4) and for perception of OC skills 28 points (7 X 4). The maximum total score was 52 points. The higher the child scored, the higher the PMC. The test was done one-on-one with each child in a quiet room. If the child did not understand the picture or the question, the researcher demonstrated the skill once. If child had never tried the skill before, he/she was asked to imagine how good he/she would be at the given task with the aforementioned answer options. The test took an average of 10 minutes per child, and it was done before the actual MC measurements.

This modified version of the PMSC has demonstrated good face validity and test–retest reliability in children of similar age in perceptions of both six LM skills (ICC .62)[23] and seven OC skills (ICC .86).[24] The total PMC (ICC .78) showed good internal consistency (alpha coefficient range = .73 - .87).[23] In this sample, PMSC's test–retest reliability was conducted with 53 children, and the results indicated good consistency in terms of perception of LM skills (ICC .75), OC skills (ICC .82) and total PMC (ICC .85) (95% CI =.75 -.91).

The children's skill-by-skill PMC is reported in Table 2. The scores for LM and OC subtests were converted into four categories. Due to a distribution peak in the maximum score in both subtests, we converted the scores so that only those children who had maximum scoring in perception of LM skills (24p.) or OC skills (28p.) were allocated to the 'really good' category. Subsequently, regarding the perception of LM skills, the category for 'not that good' consisted of scores from 6 (6 X 1) to 11p. (6 X 1.9), 'sort of good' scores from 12 (6 X 2) to 17p. (6 X 2.9) and 'pretty good' scores from 18 (6 X 3) and 23p. (6 X 3.9). In terms of OC skills, the categories followed the same logic, but were multiplied for seven skills (Table 2).

Anthropometric measures

Weight (Seca 877) and height (Charder HM 200P) were measured directly. The measurements were undertaken before the MC assessments, and the children wore light clothing without shoes or socks. Body mass index (BMI) was calculated as weight/height^2 (kg/m^2) and converted to BMI standard deviation scores (BMI SDS) using national BMI references.[25] The BMI SDS categories in Table 1 follow the norm and value categories provided by Saari et al. (2011): significantly underweight, underweight, normal weight, overweight, and obesity.

Actual motor competence

Actual MC was operationalised and measured as process and product assessments, respectively (the Test of Gross Motor Development – third edition (TGMD-3)[22] and Körperkoordinationstest Für Kinder (KTK)[26]).

The TGMD-3 was administered individually, coding the 3–5 skill criteria as either present (1) or absent (0). Each skill was performed and observed twice, as instructed in the manual. The skills were divided into LM (6 skills, max. 46 points) and OC (7 skills, max. 54 points) skills. The total sum score was LM skills added to OC skills (max. 100 points). The test consisted of the same 13 items as in the modified PMSC assessment tool. Intrarater and interrater reliability were shown to be good to excellent.[22] Before starting the data collection, two observers were trained to observe the children's performance, and both passed Ulrich's official TGDM-3 reliability test. To determine interrater reliability, the observers both coded the same performance for the 167 children. One observer coded the performance during the assessment, while the other observer performed the coding from a recorded video. Interrater reliability was calculated as the intraclass correlation coefficient based on a two-way random model of consistency for single measures. Interrater reliability between the observers for the TGMD-3 total skills was 0.88 (95% CI = 0.85–0.92).

The KTK test included four items: 1) walking backwards (WB) on balance beams at decreasing widths of 6.0 cm, 4.5 cm and 3.0 cm (maximum score of 72p.); 2) hopping for height (HH) on one foot at a time, with consecutive steps of 5 cm (max. score of 78p.); 3) jumping sideways (JS) from side to side on a jumping base for 15 seconds (the sum of the number of correct jumps in two trials) and 4) moving sideways (MS) with wooden plates without stepping out as quickly as possible for 20 seconds (the sum of the number of points in 20 seconds for two trials). Each skill was performed and observed, carefully following the manual instructions. The observers were well-trained and experienced. Finally, the sum of these latter scores yielded one total sum score for the KTK test. The KTK test's raw score was used in the current analysis. This test has been shown to be highly reliable with a test–retest reliability coefficient of the total score of 0.97 and the subtests ranging between 0.80 and 0.96.[26]

Child-related factors

The parental questionnaire included questions about the child's sex, date of birth, age of independent walking and estimations about the amount of time the child spent in sedentary activities, time spent outdoors and participation in organised sports activities. The questions from two internationally valid and reliable questionnaires were modified for the Finnish culture: the Children's Leisure Activities Study Survey (CLASS)[27] and Affordances in the Home Environment for Motor Development Self-Report (AHEMD-SR).[28] Parents were first asked: "How old was your child when he/she learned to walk independently (in months)?" Sedentary time was assessed through the following questions: "Think about your child's typical day and situations when he/she is sitting, lying down, or in some other way is sedentary (e.g. in car, sand box, trolley, in front of TV or while playing with a puzzle). For how long, at the most, does such a sedentary activity last continuously and without breaks approximately?" (1 = 15 min>, 2 = 30 min, 3 = 60 min, 4 ≥ 90 min) and "How often is your child engaged in long and continuous sedentary activities during a day?" (1 = 1 time, 2 = 2-3 times, 3 = 4-5 times, 4 ≥ 6 times). The amount of sedentary time (in minutes) during a day was calculated using the abovementioned information (min/time * times/day). Time spent outdoors was divided into weekdays and weekends and assessed through the question: "How much, on average, does your child spend time outdoors after a preschool day/on weekends?" The weekday scale ranged between 0 and 3 (0 = not at all; 1 = under 30 min/d; 2 = approx. 30–60 min/d; 3 = over 60 min/d) and the weekend scale between 0 and 4 (0 = not at all; 1 = under 30 min/d; 2 = approx. 30–60 min/d; 3 = 1-2 hrs/d; 4 = over 2 hrs/d). Outdoor time was based on the sum of the scales. Furthermore, participation in organised sport activities (OSA) (min/week) was determined through the following question: "Does your child participate in organized PA or sport in a group or sports club?" If the response was "yes," further information was asked: "How many times a week?" and "For how many minutes at a time?" The total number of minutes spent in OSA a week was calculated and used in the analyses. Finally, the child's access to electronic devices was assessed through the question: "Does your child have access to any or some of the following: 1) TV, 2) game console, 3) computer, 4) smartphone, tablet, IPad or other smart device, 5) something else, what?" The number of accessible electronic devices was used in the analyses.

Family-related factors

Due to divergent family backgrounds, we used the concepts of respondent and partner instead of referring to mother or father. Later on, female respondents were called mothers and males fathers. Parent mean education level is a mean value of the respondent's and partner's educational level (1 = comprehensive school; 2 = high school/vocational school; 3 = polytechnic; 4 = university). Parent mean education level was used instead of separating the covariates into respondent and partner so that single parents would not be eliminated from the linear regression models. The respondents' own PA frequency was divided on a scale from 0 to 4 (0 = not at all; 1 = randomly few times a month; 2 = approximately once a week; 3 = 2-3 times a week; 4 = over four times a week). Their sedentary behaviour (SB) was collected using the International Physical Activity Questionnaire's (IPAQ) short form, which has provided acceptable reliability and validity in 12 countries.[29] The respondents had to evaluate, in hours and minutes, the time spent sitting on a regular weekday. Mean values and interquartile ranges were used.

Environmental factors

The parental questionnaire included questions about the child's access to sport facilities, e.g. "Evaluate how often your child has used sport or outdoor facilities situated in your own locality or municipality nearby." The questionnaire included 10 divergent and organised sport facilities (e.g. playing field, playground, swimming hall, sports indoor hall) and an open space for the facilities that were being used but were not listed. Additionally, the respondents were asked to estimate: "Is there a large area for the child's free-play on your home yard (front- or backyard, garden etc.)?" and furthermore, "How often is your child allowed to play in the yard?" Use of each facility was scored on a scale from 0 to 4 (0 = no access to a facility; 1 = nearly never; 2 = randomly; 3 = weekly; 4 = approximately daily). Total access to sport facility use was calculated by adding all the respondents' evaluations.

Statistical analyses

IBM SPSS version 24.0 was used for the analyses. Data normality was checked, and descriptive statistics for all variables (means, standard deviations, minimum and maximum values) and for girls and boys separately (mean and standard deviation) were calculated for covariates of perceptions of LM and OC skills (Table 1). Due to the non-normal distribution of the perception of LM and OC skills, sex differences were tested using the Mann–Whitney *U* test. Frequencies and sex differences in perceptions of individual skills are depicted in Table 2. Differences between the age groups were examined with a one-way ANOVA.

In order to analyse the associations between the covariates and dependent variable, linear regressions were carried out. First, the linear regression model with the enter method was used to examine the associations between perceptions of LM and OC skills and the predictor variables. In base model 1, all the child, family and environmental factors predicting PMC were entered into the base model simultaneously. The least significant factors were removed from the base model one at a time. The base model was re-run with all the remaining factors until there were only significant factors left in the final model 2. The order of removal from the base model is represented in Table 3. This so-called backwards method made it possible to take the interdependency (mutual covariance) of predictors into account at each step of modelling. The tolerance values (Tolerance) for all models were over 0.4, and the variance inflation factors (VIF) were all under 3, indicating no evidence of multicollinearity.

Because there were many children measured within the same childcare centre, intraclass correlations for skill variables within the centres were checked. Within the childcare clusters, the ICCs were small (0.06 for OC skills and 0.04 for LM skills). Therefore, it was not necessary to use linear mixed models to adjust for childcare clusters. The final models were therefore linear single-level regression models. In base model 1 and final model 2, the number of items varies due to missing data.

Results

Approximately half (*n*=247; 52.3%) of the 472 children were boys. All children were 5–7 years old (mean 6.2yrs, SD=0.63).The questionnaire respondents were more likely mothers (n=408/87.2%) than fathers (n=60/12.8%). The descriptive data are reported in Table 1.

The children generally recorded high PMC, and most of them evaluated themselves as 'pretty good' or 'really good' in terms of perception of LM and OC skills. Of the individual skills, the children had the lowest perceptions in ‘two-hand strike’ and ‘one-hand forehand strike’. Their highest perceptions were in ‘run’, ‘kick’, ‘hop’ and ‘overhand throw’ (Table 2).

Considering sex differences, boys had higher perceptions than girls (p<0001) in perceptions of OC skills. When using the Mann–Whitney *U* test to ascertain skill-by-skill sex-related differences, some differences in patterns of associations were found. The girls had higher perceptions than boys in 'slide' (p = .002). Boys had higher perceptions than girls in 'two-hand strike' (p = .001), 'kick' (p = .002), 'underhand throw' (p = .010) and 'overhand throw' (p = .027) (Table 2).

Age was negatively associated with the children’s PMC. The younger the children, the more competently they evaluated themselves. However, age differences were only significant for the perception of LM skills. The five-year-old children (n = 167) perceived themselves as more competent in LM skills than the 6-year-old (n = 249; p = .034) and 7-year-old (n = 56; p = .028) children.

In the final model 2 of perceptions of LM skills, the children’s age (younger), BMI (higher), actual LM skills (higher) and less access to electronic devices explained 5.7% of the variance in perceptions of LM skills. In the final model 2 regarding perceptions of OC skills, the children’s age (younger), actual OC skills (higher), participation in organised sport activities (higher) and lower parent mean educational level explained 7.5% of their perception of OC skills (Table 3).

Discussion

The purpose of the study was to investigate the perception of LM and OC skills in 5 to 7-year-old children in a socioecological context. This is the first study to investigate such a wide range of factors in a geographically representative sample and the first to examine young Finnish children’s PMC.

There were several important findings. First, as expected in this young age group, perceptions of LM and OC skills were high. Second, some child and family factors were associated with the children’s PMC, supporting the socioecological model. Interestingly, the associations varied between specific factors and types of PMC. Most strongly associated with PMC were age and actual MC. In addition, higher BMI and less access to electronic devices were associated with higher perceptions of LM skills. Higher perceptions of OC skills were associated with lower parent mean education level and higher participation in organized sport activities (OSA). However, the explained variance was only 5.7% of the LM skill perceptions and 7.5% of OC skill perceptions. This is in line with a number of recent studies that have tried to comprehend children's PMC but in which the majority of variance remains unexplained.[30,31] Although the current study included a comprehensive range of possible child, family and environmental predictors of PMC, much remains unknown. However, one of the suggestions for future research is to take into account the fact that more variance in PMC can be explained in the perception of OC skills with sex differences and as a function of age.[30,31]

The level of perception of LM and OC skills was generally high, which supports previous investigations.[3,11,32] Only one study has reported low perceptions of physical competence in children.[8] Past and current investigations have shown that young children have naturally inflated PMC, which Harter (1999) noted was due to their more limited ability to evaluate their mastery.[6,9] According to Stodden et al. (2008), this inflated feeling of competence works in favour of young children, as it has the propensity to motivate and excite them to be more physically active. This positive spiral of engagement can lead to increased PA and subsequently, enhanced mastery of MC, supporting health-related fitness and healthy body composition and, hopefully, strengthening relationships between these factors as a function of time.[4]

Similar to our findings, Slykerman et al. (2016), Estevan et al. (2018) and Afthentopoulou et al. (2018) found that boys outperform girls in evaluations of their OC skills but not in their evaluations of LM skills. In this study, as seen in Table 1, boys had higher actual OC skills, so the difference in perception might reflect their actual skills. Furthermore, according to Blatchford and colleagues (2003), boys tend to prefer engaging in OC skills, especially in games, while Slykerman et al. (2016) suggested that girls prefer PA types that do not require OC skills. However, other similar studies reported associations with sex differences only for total PMC and did not separate perceptions of LM skills from those of OC skills. Among those studies, some reported higher total PMC in boys,[18,33] in girls[32] as well as a lack of sex differences.[11] Due to these equivocal findings, future research should separate perceptions of LM from OC skills in order to better identify sex differences.

The present results showed that BMI was positively associated with perceptions of LM skills, but not with perceptions of OC skills. This is in contrast to previous findings that leaner children had higher PMC at the age of 4–7 years[37] and over 8 years of age.[38] Based on the present results, higher BMI may reflect muscle strength in addition to (over)weight and (in)activity. In fact, muscle strength may bring along greater peer support, admiration and acceptance, which could explain higher PMC in children with higher BMI. Furthermore, in the study by Spessato et al. (2013), 15% of children were classified as obese, while in our study, only 3.4% of children were so classified. The difference in the proportion of obese children might partly explain the results, as the number of overweight children (19%) was similar in these two studies. To conclude, further research is recommended to understand the aforementioned relationship in under- and over-eight-year-old children.

Another significant child-related factor associated with PMC evaluations was the process measure (TGMD-3), though not the product measure (KTK). Previously, Duncan et al. (2018) found an association between perceived and actual MC, measured with both process and product type of measures, in 4–7-year-old children, whereas True et al. (2017) did not find any associations. Additionally, studies with aligned process measures of perceived and actual OC skills have found associations in boys,[39] or in both sexes,[3,19] but not in LM skills. One possible explanation for these differences is that in True et al.'s (2017) study, the assessment tools were non-aligned; in other words, there was no match between actual and perceived MC, unlike in the other abovementioned studies. Secondly, it is evident that OC skills are more distinctive, so children tend to evaluate their OC skills more in line with their actual OC skills than they do their LM skills. Brian and colleagues (2018) questioned whether this result reflects the fact that children learn OC skills in specific contexts with accurate instructions and are therefore more aware about their actual OC skills. However, in order to be able to understand whether young children manage to distinguish different parts of self-perception, aligned measures of PMC and actual MC need to be used.[40] Even though Brian and colleagues (2018) state that, as children get older, the association between actual and perception of MC increases, based on our results and the existing literature, it seems that even in young children, an association can be found if aligned assessment tools are used.

Participation in organised sport activities (OSA) was significantly associated with perceptions of OC skills. In addition, there were sex differences in perceptions of OC skills, as boys had higher perceptions than girls did. Moreover, boys had higher perceptions in regards to ‘two-hand strike’, ‘kick’, ‘underhand throw’ and ‘overhand throw’. According to Masci et al. (2018) girls underestimate themselves, while boys tend to overestimate their abilities in OC skills. However, a recent systematic review confirmed that boys do outperform girls in their actual OC skills.[17] Therefore, boys might have higher evaluations of their OC skills. For boys, ball games are a typical way to gather to play together, which concurrently enhances boys’ development in OC skills.[36] Due to boys’ natural tendency to practice, engage and develop OC skills, it is recommended that early educators especially encourage girls to play ball games, while giving them positive and constructive feedback. Good OC skills are crucial for children, as they are known to predict higher PA behaviour and fitness in both sexes later on in adolescence.[7]

Finally, children with less access to electronic devices had higher perceptions in LM skills. Only a handful of studies have investigated the relationship between electronic devices and skills. In 2012, Barnett et al. found that children's (ages 3–6 years) time spent in sedentary electronic game use had a negative association with children's locomotor skill (p = .06). Interestingly in our study, boys had greater access to electronic devices (Table 1), and girls had higher perceptions of LM skills, on average. Conversely, the younger children in this study had higher PMC, though they might have had more limitations regarding the use of electronic devices. We assume that the aforementioned sex and age differences in PMC may confound the association between perception of LM skills and use of electronic devices. It would, therefore, be beneficial for future research to examine this association, taking into consideration possible sex differences and parental patterns in limiting children's electronic device use.

Lastly, one family factor (i.e. parent mean educational level) was negatively associated with OC skill evaluations. Thus, the surprising result of the present study was that a higher educational level did not predict higher evaluations in OC skills. On the one hand, this may reflect differences in cognitive maturation supported by parents. While it has been shown that the perceptions become more realistic with age,[6] in highly educated families, parents may help a child's self-perceptions to mature earlier. On the other hand, today's parents spend less time with their children than earlier generations did.[41] It thus may be that even though highly educated parents are aware of the benefits of PA, they may struggle to find the time to support what is necessary, especially during the development of OC skills (throwing or kicking back). In fact, according to Trost et al. (2003), to build children’s confidence levels in PA, parents’ time and supportive behaviours are more important than a positive attitude or the parents’ own PA behaviour. However, as there was a high level of education and income in the participating families, as more than half of the families were highly educated (polytechnic or university), and around three-quarters of the families had an income level over 40,000 euros per year, the generalisability of the results can be questioned. We encourage future research to further explore this relationship and to consider mothers and fathers separately.

One of the study's strengths is the geographically wide sample of children. Second, the study assessed a range of PMC child and environmental covariates based on a socioecological model. Third, the study examined sex and age differences in perceptions of LM and OC skills separately. Additionally, the association between perceived and actual MC was investigated with more than one assessment tool, and at least one of the measurement tools was matched with the PMC assessment tool.

However, some study limitations should be noted. Although the *Skilled Kids* – study included a large number of children and families, due to the short data collection period in each childcare location, missing data could not be avoided. Concerning the assessment tools, the questions from AHEMD-SR[28] have been validated for ages up to 42 months while the study participants in this article were older. During the data collection, as young children tire quickly, a range of practical approaches can be beneficial to sustain interest and good attention towards assessments. As such, we preferred assessment times when the children were most alert, and we arranged measurements over two days per child (PMSC and KTK on the first day and TGMD-3 on the second day) so as to avoid lack of attention in assessment compliance. However, occasionally, a child was unwell or absent from the childcare centre. The recovery of the missing data was challenging, as the participants and childcare centres involved were busy and were distributed around Finland. However, the families were provided a later opportunity to return incomplete questionnaires.

Perspectives

The current study suggests that as young children have naturally high perceptions of MC, they should be encouraged to be physically active in order to sustain and improve their motor skills. Even though a range of potential correlates of perceptions of MC were examined, the majority of the perceptions of MC variance remained unexplained. Nonetheless, based on the results, we recommend that girls need to be provided with opportunities to practice their OC skills, which would likely improve their OC perceptions. Finally, our recommendation is to use aligned perception and actual MC assessment tools to better understand the association between perceived and actual motor skills in young children.

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Table 1

Child, family and environmental factors: descriptive data.

Child factors	**N**	**Mean (SD)**	**Min**	**Max**	**Mean (SD) girls**	**Mean (SD) boys**	**Sex differences *p*-value**
Age (years)	472	6.22 (0.63)	5.00	7.75	6.23 (0.64)	6.22 (0.62)	0.838
BMI SDS (%)	470	0.17 (1.02)	-4.55	3.13	0.19 (1.11)	0.14 (0.93)	0.566
- Significantly underweight	4	0.9			1.8	0	
- Underweight	15	3.2			3.1	3.3	
- Normal weight	347	73.8			76.0	71.8	
- Overweight	88	18.7			15.6	21.6	
- Obesity	16	3.4			3.5	3.3	
Height (cm)	470	119.51 (6.37)	102.10	137.30	118.91 (6.26)	120.05 (6.42)	0.054
Weight (kg)	471	23.39 (4.19)	15.10	41.60	23.38 (4.59)	23.41 (3.79)	0.941
Child's independent walking (%)	433	100					0.642
- at 7-10 months	94	21.7			22.4	21.1	
- at 11-12 months	189	43.7			43.8	43.5	
- at 13-21 months	150	34.6			33.8	35.4	
Sedentary behavior (mins / day)	463	89.22 (49.94)	15	405	88.42 (48.05)	89.97 (51.72)	0.739
TGMD-3 locomotor skills (0-46p.)	443	30.58 (6.30)	9	43	32.00 (5.64)	29.24 (6.59)	**0.000*****
TGMD-3 object control skills (0-54p.)	450	28.90 (7.97)	8	50	26.18 (6.76)	31.43 (8.19)	**0.000*****
TGMD-3 total score (0-100p.)	441	59.49 (11.94)	18	88	58.27 (10.62)	60.62 (12.98)	**0.039***
KTK	433	103.75 (33.84)	6	193	105.85 (32.69)	101.84 (34.82)	0.219
Time spent outdoors (%)	469	100					**0.014***

- Less than 1 h/day	39	8.3			11.2	5.7	
- Approximately 1 h/day	231	49.3			48.2	50.2	
- 1 to 2 h/day	199	42.4			40.6	44.1	
Participation in organized sport activities (mins/week)	445	62.04 (74.20)	0	361.00	59.05 (68.74)	64.80 (78.93)	0.415
Access to electronic devices (%)	460	100					**0.042***
- Not at use	276	60.0			62.4	57.7	
- 1	104	22.6			22.6	22.6	
- 2 or more	80	17.4			15.0	19.7	
Family factors							
Parent mean education level[1] (%)	468	100					0.828
- Comprehensive school	6	1.3			0.5	2.0	
- High school / vocational school	174	37.1			39.4	35.1	
- Polytechnic	176	37.6			37.6	37.6	
- University	112	24.0			22.5	25.3	
Income level (%)	424	100					0.514
- under 39 999 euros / year	105	24.6			28.5	21.1	
- 40 000 – 69 999 euros / year	148	34.9			32.9	36.9	
- 70 000 – 99 999 euros / year	109	25.8			22.2	29.0	
- over 100 000 euros / year	62	14.7			16.4	13.0	
Respondent's physical activity frequency (%)	466	100					0.788
- Not at all (0)	15	3.2			1.8	4.5	
- Randomly few times a month	51	10.9			10.4	11.0	

- Approximately once a week	70	15.0			17.7	12.2	
- 2-3 times a week	207	44.4			46.6	43.2	
- Over 4 times a week	123	26.5			23.5	29.1	
Respondent's sedentary behavior (%)	448	100					**0.050***
- Do not know	79	17.7			17.5	17.8	
- 3 h / day or less	121	27.0			24.9	29.0	
- 3.1-6 h / day	126	28.1			21.7	34.2	
- Over 6 h / day	122	27.2			35.9	19.0	
Environmental factors							
Access to sport facilities (%)	429	100					0.120
- Rarely	4	0.9			1.0	0.9	
- Occasionally	255	59.4			62.4	56.7	
- Weekly	168	39.2			36.1	42.0	
- Daily	2	0.5			0.5	0.4	

Values are reported as mean (standard deviation) scores or percentages (%).

[1] Values were rounded to the nearest whole number.

*Statistically significant difference between girls and boys at the level of $p < 0.05$.

Table 2

Children's perception of LM skills and OC skills (n=472).

		Not that good		Sort of good		Pretty good		Really good	
		(n)	**%**	**(n)**	**%**	**(n)**	**%**	**(n)**	**%**
Perception of LM skills	**All**	**6**	**1.3**	**93**	**19.7**	**294**	**62.3**	**79**	**16.7**
	Girls	**1**	**0.4**	**41**	**18.2**	**144**	**64.0**	**39**	**17.4**
	Boys	**5**	**2.0**	**52**	**21.1**	**150**	**60.7**	**40**	**16.2**
Run	All	7	1.5	17	3.6	118	25.0	330	69.9
	Girls	4	1.8	7	3.1	60	26.7	154	68.4
	Boys	3	1.2	10	4.0	58	23.5	176	71.3
Gallop	All	32	6.8	78	16.5	143	30.3	219	46.4
	Girls	12	5.3	35	15.6	65	28.9	113	50.2
	Boys	20	8.1	43	17.4	78	31.6	106	42.9
Hop	All	22	4.7	39	8.3	118	25.0	293	62.0
	Girls	11	4.9	17	7.6	60	26.7	137	60.8
	Boys	11	4.5	22	8.9	58	23.5	156	63.1
Skip	All	49	10.4	84	17.8	120	25.4	219	46.4
	Girls	21	9.3	34	15.1	57	25.3	113	50.3
	Boys	28	11.3	50	20.2	63	25.5	106	43.0
Horizontal jump	All	30	6.4	57	12.1	136	28.8	249	52.7
	Girls	14	6.2	32	14.2	62	27.6	117	52.0
	Boys	16	6.5	25	10.1	74	30.0	132	53.4
Slide*	All	28	5.9	54	11.4	95	20.1	295	62.6
	Girls	10	4.4	20	8.9	37	16.4	158	70.3
	Boys	18	7.3	34	13.8	58	23.5	137	55.4
Perception of OC skills*	**All**	**14**	**3.0**	**150**	**31.8**	**244**	**51.7**	**64**	**13.6**
	Girls	**9**	**4.0**	**83**	**36.9**	**103**	**45.8**	**30**	**13.3**
	Boys	**5**	**2.0**	**67**	**27.1**	**141**	**57.1**	**34**	**13.8**
Two-hand strike*	All	115	24.4	144	30.5	70	14.8	143	30.3
	Girls	67	29.8	71	31.6	33	14.7	54	23.9
	Boys	48	19.4	73	29.6	37	15.0	89	36.0
One-hand strike	All	72	15.3	110	23.3	114	24.2	176	37.2

	Girls	38	16.9	56	24.9	56	24.9	75	33.3
	Boys	34	13.8	54	21.9	58	23.5	101	40.8
Dribble	All	36	7.6	62	13.1	108	22.9	266	56.4
	Girls	16	7.1	32	14.2	53	23.6	124	55.1
	Boys	20	8.1	30	12.1	55	22.3	142	57.5
Catch	All	28	5.9	45	9.5	115	24.4	284	60.2
	Girls	8	3.6	26	11.6	60	26.7	131	58.1
	Boys	20	8.1	19	7.7	55	22.3	153	61.9
Kick*	All	12	2.5	30	6.4	85	18.0	345	73.1
	Girls	8	3.6	16	7.1	54	24.0	147	65.3
	Boys	4	1.6	14	5.7	31	12.6	198	80.1
Underhand throw*	All	43	9.1	87	18.4	123	26.1	219	46.4
	Girls	24	10.7	50	22.2	59	26.2	92	40.9
	Boys	19	7.7	37	15.0	64	25.9	127	51.4
Overhand throw*	All	19	4.0	52	11.0	107	22.7	294	62.3
	Girls	9	4.0	28	12.4	65	28.9	123	54.7
	Boys	10	4.0	24	9.7	42	17.0	171	69.3

* Statistically significant difference between girls and boys. The level of significance $p < 0.05$.

Table 3

Child, family and environmental factors associated with children's perception of LM and OC skills.

Variables	**Perception of LM skills**					**Perception of OC skills**				
	Base model 1 (*n* =243) R^2 =.086			Final model 2 (*n* =437) R^2 =.057		Base model 1 (*n* =241) R^2 =.106			Final model 2 (*n* =421) R^2 =.075	
	Standardized *B*	*P*	*RE	Standardized *B*	*P*	Standardized *B*	*P*	*RE	Standardized *B*	*P*
Child factors										
Age (months)	-.169	**.027**		-.152	**.002**	-.165	**.029**		-.181	**.001**
Sex (1 = girls, 2 = boys)	-.139	**.035**	8.			-.065	.350	5.		
BMI SDS	.171	**.008**		.112	**.017**	.132	**.046**	10.		
Independent walking age	-.027	.684	3.			-.103	.126	8.		
Sedentary behavior	-.012	.851	1.			.009	.883	2.		
TGMD-3 -actual skill	.138	.073		.150	**.002**	.265	**.002**		.218	**.000**
KTK -motor coordination	.031	.727	2.			-.031	.719	4.		
Time spent outdoors	-.111	.099	9.			-.009	.897	1.		
Participation in organized sport activities	-.021	.760	4.			.098	.152		.119	**.017**
Access to electronic devices	-.100	.117		-.137	**.004**	-.078	.224	6.		
Family factors										
Parent mean education level	-.103	.150	6.			-.166	**.020**		-.130	**.007**
Respondent's physical activity	-.053	.418	5.			-.078	.224	7.		
Respondent's sedentary behavior	.106	.128	7.			.082	.241	9.		
Environmental factors										
Access to sport facilities	.164	**.019**	10.			.021	.767	3.		

Statistically significant values are shown in bold.

* RE= Removal order in which explaining variable was deleted from base model (1). In the final model (2) only statistically significant factors explaining PMC were left.

IV

WHAT FACTORS RELATE TO THREE PROFILES OF PERCEPTION OF MOTOR COMPETENCE IN YOUNG CHILDREN?

by

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