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What factors relate to three profiles of perception of motor competence in young children?

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ABSTRACT

The study aims were to 1) examine profiles of perception of motor competence (PMC) in relation to actual motor competence (AMC), i.e. under-estimators (UEs), realistic estimators (REs) and over-estimators (OEs) and 2) investigate associations between the profiles and selected socioecological factors at the individual, family and environmental levels. PMC (Pictorial Scale of Perceived Movement Skill Competence) and AMC (Test of Gross Motor Development-Third Edition) were administered to a representative sample of children from 37 childcare centres in Finland (n=441;6.2±0.6yrs;52% boys). Socioecological factors were investigated using a parental questionnaire. The three profiles were formed based on age- and gender-adjusted PMC and AMC z-scores. Multinomial logistic regression showed that OEs (n=81; p=0.04) tended to be younger than REs (n=306; p=0.04) and UEs (n=54; p=0.03). Parents of OEs reported more child health and developmental issues than parents of REs (p=0.03). Parents of UEs self-reported providing more support for physical activity than parents' of REs (p=0.04). REs tended to live in denser population areas than UEs (n=54; p=0.03). Whilst PMC profiles revealed some socioecological differences, future research needs to focus on a broader range of potential correlates and untangle methodological analyses challenges to deepen the knowledge about PMC development in children.

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Physical self-perception; fundamental movement skills; competence motivation theory; socioecological model; tgmd-3

1. Introduction

Perception of motor competence (PMC) reflects a child's own expectations and conviction of having competence in given motor tasks (Estevan & Barnett, 2018). Developmental theories (Harter, 1999; Stodden et al., 2008) and previous studies (Brian et al., 2018; Lopes et al., 2016) suggest that children less than eight years old do not yet compare themselves to others and tend to have inflated self-perceptions, including PMC. High PMC can motivate children to practice motor skills and be more physically active, as well as predict a healthier lifestyle and body composition (De Meester, Maes et al., 2016; Robinson et al., 2015; Stodden et al., 2008). Therefore, children's tendency to overestimate their actual motor competence (AMC) is considered to be a positive motivator for increasing physical activity (PA) (Stodden et al., 2008; Robinson et al., 2015). Due to the inflated PMC of children, the relationship between PMC and AMC is not expected to correlate (Lopes et al., 2016; Hall et al., 2019; Lopes et al., 2018; True et al., 2017; Barnett et al., 2021). Yet, not all young children have inflated PMC (Robinson, 2011). Therefore, it is crucial to study not only the PMC level but also the discrepancy between PMC and AMC in children (Weiss & Amorose, 2005).

PMC development is closely related to comparison to others and to self-esteem, thus, cognitive maturation is a key element in constructing (accurate) PMC (Harter, 1999; Harter & Pike 1984). According to Harter's competence motivation theory (1978), motivation increases when a child successfully masters a task; thus, if a child has plenty of opportunities to be physically active, it enables also the development of AMC. Stodden et al., (2008) stated that if a child does not have AMC, perceptions of competence will drop as the child gets older, and the cognitive maturation level allows him/her to evaluate his/her AMC more precisely (Goodway & Rudisill, 1997). Consequently, as a function of age, PA may also drop (True et al., 2017; Babic et al., 2014; Carcamo-Oyarzun et al., 2020). Interestingly, however, a recent systematic review and meta-analysis including 69 studies found that the strength of the relationship between AMC and PMC was not moderated by age or developmental status of the person (De Meester et al., 2020), contradicting the conceptual model of Stodden et al. (2008). Hence, more research on this matter is warranted.

One way of examining the accuracy between PMC and AMC and associated factors, is to study different profiles of PMC. Previous studies made with children's PMC profiles have used different statistical analyses to identify PMC profiles. A study by De Meester, Stodden et al., (2016) used cluster analysis and reported that a combination of high AMC and PMC was related to a higher levels of PA and lower weight status. In another study (Bardid et al., 2016) cluster analyses identified four AMC-based profiles; two groups were characterized by corresponding levels of AMC and PMC (i.e., low–low and high–high) and two groups were

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characterized by divergent levels of AMC and PMC (i.e., high–low and low–high). Children in the low–low and high–low group displayed significantly lower levels of autonomous motivation for sports and lower levels of global self-worth than children in the low–high and high–high group. Pesce et al., (2018) used regression techniques to identify three profiles of PMC; under-estimators (UEs), realistic estimators (REs), and over-estimators (OEs). According to Pesce et al., (2018) most girls underestimated their ball skills whereas most boys overestimated theirs. Also, OEs practiced a larger amount of sport than UEs. Finally, in a study by Duncan et al., (2018) children were classified as profiles of low, medium, or high PMC based on tertile analysis. In their study, boys tended to have higher AMC and PMC. In addition, they reported that children characterized as low PMC tended to also have lower AMC (Duncan et al., 2018). All of these aforementioned studies investigated differences between the profiles via individual-related correlates, such as PA, weight status, motivation, sport participation and gender differences. However, as past studies have managed to explain less factors associated with PMC (Crane et al., 2017) rather than AMC (Mota et al., 2020) in young children, we questioned if there is a need to broaden the study beyond the individual factors related to PMC profiles.

According to the socioecological model (Bronfenbrenner, 1994), behaviours can be influenced on many different levels, not solely on the individual level. In the socioecological model, family factors include interacting closely with the child and his/her individual factors (Bronfenbrenner, 1994). 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 AMC and PA opportunities (e.g., equipment, surveillance, attitudes). Moreover, parental encouragement and the quality of instruction are important for motor development (Donnelly, et al., 2017; Gallahue & Donnelly 2003). One previous study has already shown that a family factor, such as parental educational level (Niemistö et al., 2019), can be associated with child's PMC. Moreover, according to the socioecological model, the importance of environment is related to the possibilities the child has to interact actively with the environment (Niemistö et al., 2019). Niemistö et al., (2019) showed that less access to electronic devices (an environmental factor) was associated with better perception of locomotor skills in five to seven year olds. Nevertheless, so far, there is less evidence on family and environmental factors associated with PMC or PMC profiles as most available studies consider only individual factors. However, AMC studies have shown that family and environmental factors are important to consider in relation to a child's development (Barnett et al., 2016; Freitas et al., 2013; Iivonen & Sääkslahti, 2014) and therefore, future research should broaden the PMC investigation to consider these aspects. The first study aim was to explore the possibility of three PMC profiles in young children in relation to their AMC: UEs, REs and OEs profiles and secondly, to examine the differences of the profiles related to socioecological variables.

2. 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 assent. Children were informed about the study procedures and their right to opt out of participation without any consequences.

The study participants were part of the Skilled Kids study (Niemistö et al., 2019; Laukkanen et al., 2018), which aimed to explore children's AMC, PMC and its covariates in a geographically representative sample of three to seven-year-old children from Finnish childcare centres. In this study, due to more validity evidence of the PMC for children who are over five years of age (Barnett et al., 2015; Venetsanou et al., 2018; Estevan et al., 2018), the sample of this study includes only those children who are 5–7 years of age. Cluster-random sampling was done according to the protocol of the international Health Behaviour in School-aged Children (HBSC) (World Health Organization, 2020). The childcare centres were chosen from the Finnish National Registry of Early Educators, which included in total 2600 childcare units. The number of childcare centres involved in a single region was weighted with the population density of the area. Altogether, 37 childcare centres participated, while 10 centres (27%) refused to participate due to lack of space (n = 1), interest (n = 4), time (n = 2) or low numbers of children (n = 3). If a randomly chosen childcare centre declined to participate, the next one on the list from the same area was recruited. In total, the majority of the children (78.5%) gave assent for study participation. Measurements were conducted in the childcare centre settings between November 2015 and September 2016 by two researchers (DN and AS) with two research assistants (Niemistö et al., 2019; Laukkanen et al., 2018).

Throughout the data collection process, the protocols of several assessment tools were carefully followed (Niemistö et al., 2019). PMC was measured with the version of the pictorial scale of Perceived Movement Skill Competence (PMSC) (Barnett et al., 2015) for young children that aligns with the Test of Gross Motor Development-Third Edition (TGMD-3; Ulrich, 2019). The PMSC test contains 13 items subdivided into locomotor skills (six skills, such as run, gallop, hop, skip, horizontal jump and slide, max. 24 points) and ball skills (seven skills, such as two-hand strike, one-hand forehand strike, dribble, catch, kick, overhand throw and underhand throw, max. 28 points) (Barnett et al., 2015; Ulrich, 2019). During data collection, the test was done one-to-one with each child in a quiet room. For the PMSC administration, children were shown images of each skill (a good and poor performance) from the gender-specific PMSC booklet. First, the child was asked "Have you tried this skill before?" If the child responded "yes", (s)he was then asked to specify which of the two following picture options most resembled him/her. If a child had never tried the skill before, (s)he was asked to imagine how good (s)he would be in the given task. For example, two images showed a boy/a girl galloping. The child was asked "this child is pretty good at galloping, this child is not that good at galloping, which child is most like you?" If the child chose the more competent child, (s)he was asked to then choose between "really good" (4 points) or "pretty good" (3 points). If the child chose the less competent child, (s)he was asked to choose between "sort of good" (2 points) or "not that good" (1 point). The test per child took on average 10 minutes and it was done before the AMC measurements. In total, the maximum total score for PMSC was 52 points. The higher the child scored, the higher the PMC. Internationally, the PMSC has demonstrated good reliability and validity for assessing young children's PMC in many countries and cultures (Barnett and 2015; Venetsanou et al., 2018; Estevan et al., 2018; Diao et al. 2018). In the present sample, the test–retest reliability of the PMSC (conducted over 14 days) was tested with 53 children. The intraclass correlation (ICC) estimates and their 95% confident intervals were calculated based on a single measurement, absolute-agreement, 2-way mixed-effects model. The ICC of locomotor skills was 0.75 (95% CI = 0.60–0.85), in ball skills 0.82 (95% CI = 0.72–0.90) and in total PMSC 0.85 (95% CI = 0.76–0.91).

AMC was measured with the TGMD-3 (Ulrich, 2019) through live observation in different childcare centres. In the TGMD-3, each skill and its criteria were evaluated by an experienced observer. Two observers collected the data and both observers had passed Ulrich's (the test developer) official TGMD-3 reliability test performed via video-analysing and also had prior experience with live and video-recorded observation. Every skill had three to five skill criteria scored as either present (1) or absent (0). The AMC skills were aligned with PMSC skills, thus, divided into locomotor (six skills; run, gallop, hop, skip, horizontal jump and slide, max. 46 points) and ball skills (seven skills; two-hand strike, one-hand forehand strike, dribble, catch, kick, overhand throw and underhand throw, max. 54 points). Each skill was demonstrated once by the researcher before the practice trial of each child. The assessment trials were performed twice, as instructed in the manual. The TGMD-3 was completed in groups of three to four children. One group session took approximately 45 to 60 minutes. The TGMD-3 gross motor index (max. 100 points) was the sum of both subscales (locomotor and ball skills), and the raw test scores were used in the analysis. The test has good to excellent intrarater and interrater reliability (Ulrich, 2019) and is valid and reliable internationally (Cools et al., 2009) and nationally (Rintala et al., 2017). In this sample, to determine interrater reliability between the two observers, both coded the same performance for the 167 children. One observer evaluated the skills based on live-observation and the other evaluated the same skills through video-observation. The results were 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) (Niemistö et al., 2019).

BMI was calculated based on weight (Seca 877) and height (Charder HM 200P) assessments as weight/height^2 (kg/m^2). To use age-appropriate BMI scores, BMI was later converted to BMI standard deviation 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 parental questionnaire included the following elements of the socioecological model, individual-related factors (age, gender, BMI SDS, age of independent walking, time spent sedentary and outdoors, participation in organised sports, and child health issue) (Niemistö et al., 2019; Laukkanen et al., 2018), family-related factors (respondent's gender, parents' mean educational level, respondents' PA frequency and sedentary behaviour, PA parenting, shared family PAs) and finally, environmental factors (electronic devices used and residential density), described in detail in Table 1. The parental questionnaires were based on three internationally well-known parental questionnaires (Cleland et al., 2011; Rodrigues et al., 2005; Telford et al., 2004) modified for the Skilled Kids study. They were administered to families through childcare centre staff. Moreover, for child health, parents were asked about additional health factors that could have influenced their children's development/PA. If the respondent answered "yes", a more specific description was required.

For family factors, the gender of the respondent and his/her partner were collected. Henceforth, they are called mothers and fathers. The term "respondent" refers to the parent who answered the questionnaire, so each respondent was one parent of choice not both parents. Respondents' sedentary behaviour was collected using the International Physical Activity Questionnaire's (IPAQ) short form, which has acceptable reliability and validity (Craig et al., 2003). Parents' educational level was classified into four categories and their percentage distribution within the sample is reported. Finally, respondents' PA frequency was collected via parental questionnaire by asking if the respondent exercises: Not at all (0 points), randomly a few times per month (1 point), approximately once per week (2 points), two to three times per week (3 points) or over four times per week (4 points) (Niemistö et al., 2019; Laukkanen et al., 2018) (Table 1).

PA parenting questions (shown to be valid in Finnish children) (Laukkanen et al., 2018) refer to the sum and mean values of three types of practices: Parents' co-participation in PA, direct support of child's PA and encouragement of PA (Cleland et al., 2011). Additionally, shared family PAs were ascertained with the following question: "*Please evaluate how often you engage in physical activities, 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 environmental factors were a) the number of electronic devices used by the child and b) the residential density of the place where the child attended childcare. Residential density was evaluated indirectly using the postal code of the childcare

Table 1. Socioecological variables included in the study.

	Units of analysis/coding	Question	Test–retest reliability (95% CI)*
Individual-related factors			
Age	in months		
Gender	n / 1 = girl 2 = boy	PQ. "Girl:_______ Boy:________"	
Weight	kg		
Height	cm		
BMI SDS	z-score / weight/height (Saari 2011), (kg/m^2) converted into BMI SDS		
Age of independent walking	in months	PQ. "How old was your child when he/she learned to walk independently (in months)?"	0.51 (0.19–0.73)
Time spent on sedentary activities	mins/day / PQ 1. 1 = 15 mins 2 = 30 mins 3 = 60 mins 4 ≥ 90 mins PQ 2. 1 = 1 time/d 2 = 2–3 times/d 3 = 4–5 times/d 4 ≥ 6 times/d The amount of sedentary time (in minutes) during a day was calculated using the aforementioned information (minutes/time* times/day).	PQ 1. "Think about your child's typical day and situations when he/she is sitting, lying down or sedentary in some other way, e.g., in a car or sandbox or trolley, in front of the television or playing with a puzzle. For approximately how long, at the most, does such a sedentary activity last continuously and without breaks?" PQ 2. "How often is your child engaged in long and continuous sedentary activities during a day?"	0.45 (−0.09–0.80)
Time spent outdoors	scale 1 to 7 / sum scale of two scales (weekdays and weekend days spent outdoors) (1) Weekday scale: 0 = not at all 1 = under 30 mins/d 2 = approx. 30–60 mins/d 3 = over 60 mins/d (2) Weekend scale: 0 = not at all 1 = under 30 mins/d 2 = approx. 30–60 mins/d 3 = 1–2 h/d 4 = over 2 h/d	PQ. "How much time, on average, does your child spend outdoors after a preschool day (1)/on weekends (2)?"	0.62 (−0.12–1.0)
Participation in organised sport	mins/week / total number of minutes spent in organized sport per week	PQ. "Does your child participate in organized PA or sport in a group or sport club?" If yes, "How many times a week?" and "For how many minutes at a time?"	0.81 (0.60–0.91)
PMSC	scale 13 to 52 / PMSC LM skills = 24p PMSC ball skills = 28p PMSC total = 52p		PMSC total 0.85 (0.75–0.91)
TGMD-3	0 to 100 points / LM skills = 46p Ball skills = 54p TGMD-3 gross motor index = 100p		TGMD-3 gross motor index 0.88 (0.85–0.92)
Child health issue	0 to 1 / 0 = no 1 = yes, what?_____________________	PQ. "Does your child have some special characteristic that needs specific support?"	0.79 (0.60–0.89)
Family-related factors			
Respondents' gender	n / 1 = female 2 = male	PQ. 'Respondent's gender: _______Male _______Female'	
Parents' mean educational level	scale 1 to 4 / 1 = comprehensive school 2 = high/vocational school 3 = polytechnic 4 = university	PQ. "Education of the respondent/and partner"	0.95 (0.87–0.98)
Respondents' PA frequency	scale 0 to 4 / 0 = not at all 1 = randomly a few times/month 2 = approx. once/week 3 = 2–3 times/week 4 = over 4 times/week	PQ. "Respondent's exercises"	0.73 (0.50–0.86)

(*Continued*)

Table 1. (Continued).

	Units of analysis/coding	Question	Test–retest reliability (95% CI)*
Respondents' sedentary behaviour	mins/d	PQ. The respondents evaluated, in hours and minutes, the time spent sitting on a regular weekday. Mean values and interquartile ranges were used (IPAQ).	Acceptable reliability and validity (Venetsanou et al., 2018)
PA parenting	possible range 0–7 / 0 = never 0.5 = less than once/week 1.5 = 1–2 times/week 3.5 = 3-4 times/week 5.5 = 5-6 times/week 7 = daily	PQ. PA parenting refers to the sum of parents' co-participation in PA, direct support of child's PA and encouragement for PA.	Acceptable reliability and validity (Gallahue & Donnelly, 2003)
Shared family PAs	possible range 1–5 / 0 = never 1 = less than once/week 2 = 1 to 2 times/week 3 = 3 to 4 times/week 4 = 5 to 6 times/week 5 = every day	PQ. "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".	0.58 (0.28–0.77)
Environmental factors			
Electronic devices used	n / The sum of the number of electronic devices used	PQ. "Does your child have access to any or some of the following: (a) television; (b) game console; (c) computer; (d) smartphone, tablet, iPad or other smart device; (e) something else, what?"	0.58 (0.23–0.79)
Residential density	possible range 1 to 4 / 1 = metropolitan area 2 = city 3 = rural area 4 = countryside		

*Test–retest reliability was conducted over 21 days in the parental questionnaire and over 14 days in the PMSC. Only those test-retest values that were measured with the present study sample are presented in the current table. CI = confidence interval, n = Number, PQ. = Parental questionnaire, kg = Kilogram, cm = Centimetre, BMI SDS = Body mass index standard deviation score, m = Metre, mins = Minutes, d. = Day, approx. = Approximately, PMSC = Pictorial Scale of Perceived Movement Skill Competence, LM skills = Locomotor skills, TGMD-3 = Test of Gross Motor Development – third version, IPAQ = International Physical Activity Questionnaire.

centre attended by the child and the national population density registry for categorisation (Laukkanen et al., 2018; Niemistö, Finni et al., 2019).

The significance level was set at $p < 0.05$. From the Skilled Kids study participants, all those children who were over 59 months old (4.9 yrs.) and had PMSC and TGMD-3 gross motor results were included in the analysis. The children were categorized based on z-scores into the three PMC profiles (UE, RE and OE). First, we tested the z = 1 limit, as in previous studies (Pesce et al., 2018; Schmidt et al., 2013). However, as young children tend to have inflated PMC (Lopes et al., 2016; Stodden et al., 2008), the typically used z = 1 did not allow enough children to be categorized into the negative (UE) and positive (OE) profiles. Our goal was to identify the 10% of children with the highest and the lowest AMC and PMC scores, relative to their age. Those children who had lower PMC than AMC belonged to the UE profile, and those who had higher PMC than AMC belonged to the OE profile. Therefore, we modified the PMC and AMC z-scores as follows based on our data: low $z \leq -1.5$, 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 years) by gender. Subsequently, we unified the groups so that, regardless of age or gender, the three profiles were established. For example, a child with high PMC and low AMC was classified into the positive profile (OE), a child with middle PMC and high AMC was classified into the negative profile (UE) and a child with consistent evaluations was classified into the RE profile. To analyse gender differences between the profiles, a t-test was used.

To examine associations between the PMC-AMC ratio and individual-related, family-related and environmental factors, a multinomial logistic regression was used. The socioecological factors were added to the multinomial logistic regression model simultaneously, and the variables were excluded one by one, when the p-value was less than 0.05. Gender was retained in the final model (Table 4) regardless of its statistical insignificance, as it has been shown to be associated with PMC (Robinson, 2011; Pesce et al., 2018) and AMC (Barnett et al., 2016; Iivonen & Sääkslahti, 2014; Barnett et al., 2013). All other statistically insignificant factors were removed. The statistically insignificant factors removed were as follows: Respondents' sedentary behaviour, parents' mean educational level, respondents' PA frequency, child's time spent on sedentary activities, BMI SDS, child's time spent outdoors, child's age of independent walking, shared family PAs, participation in organised sport, and finally, electronic devices used. The model's goodness of fit showed that it was suitable for the data (Pearson $\chi2 = 812.70$, df = 792, p = 0.30; Deviance $\chi2 = 656.05$, df = 792, p = 1.00). The likelihood ratio tests for comparing the intercept only model and the model with covariates were significant ($\chi2 = 22.814$, df = 10, p = 0.011), so the final model with covariates (gender, age, child health issue, parental support for PA and residential density) was significantly better than

Table 2. Actual and perceived motor competence of the study sample (n = 441).

	Mean (SD)	Min	Max	Mean (SD) girls (n = 212)	Mean (SD) boys (n = 229)	Gender dif. p-value
Actual motor competence						
- Locomotor skills (from 0 to 46 points)	30.62 (6.28)	9	43	32.12 (5.55)	29.24 (6.60)	**0.000 *****
- Ball skills (from 0 to 54 points)	28.87 (8.00)	8	50	26.16 (6.77)	31.38 (8.24)	**0.000 *****
- Gross motor index (from 0 to 100 points)	59.49 (11.94)	18	88	58.27 (10.62)	60.62 (12.98)	**0.039 ***
Perceived motor competence						
- Locomotor skills (from 6 to 24 points)	19.96 (3.20)	7	24	20.27 (3.05)	19.67 (3.32)	**0.050 ***
- Ball skills (from 7 to 28 points)	22.14 (4.32)	7	28	21.57 (4.43)	22.66 (4.16)	**0.008 ****
- PMSC total score (from 13 to 52 points)	42.10 (6.77)	14	52	41.84 (6.80)	42.33 (6.75)	0.446

n = Number, SD = Standard deviation, Min = Minimum value, Max = Maximum value, dif. = Difference, PMSC = The Pictorial Scale of Perceived Movement Skill Competence in young children. Statistically significant difference between girls and boys, the level of significance at * $p < 0.05$, **$p < 0.01$ ***$p < 0.001$

the model without any covariates. There was no evidence of multicollinearity between covariates (maximum VIF value = 1.03).

For the PMC-AMC ratio model, the Nagelgerke pseudo R-squared was 0.06. The overall correct classification percentage was 69.4%, indicating that it would be possible to re-classify 69.4% of the children to the profiles in which they were originally classified.

3. Results

All children were five to seven years old (6.2 yrs±0.64 yrs.). About half of the 441 children were boys (n = 229; 52%). Most of the respondents (n = 435; mean age = 35.9 ± 5.5 yrs.) were mothers (n = 383; 88%) and more than half had a polytechnic or university-level education (n = 251; 57%). The sample was predominantly Finnish speaking (n = 416; 95%). The majority of the children lived in a metropolitan area (n = 70; 16%) or cities (n = 205; 46%). A minority of the children lived in rural areas (n = 102; 23%) or in the countryside (n = 64; 15%). The PMC of the young children was high (42.10 ± 6.77/52 points). Gender differences emerged in the TGMD-3 gross motor results, as boys (60.62 ± 12.98) scored higher than girls (58.27 ± 10.62; p = 0.04). In the PMSC total score, there were no gender differences between girls (41.84 ± 6.80) and boys (42.33 ± 6.75; p = 0.45) (Table 2).

The descriptive data of the UE, RE and OE profiles (mean and SD) are reported in Table 3.

The children in the OEs profile (6.06 yrs.) were likely to be younger than children in REs (6.25 yrs.; p = 0.04) and children in UEs (6.25 yrs.; p = 0.03) profile. Parents of children in the OEs (14.8%) were more likely to report that their children had some health issue compared to REs (7.6%; p = 0.03). The four most common additional factors possibly influencing the development of these children (n = 41/441) were asthma (n = 9; 21.9%), attention deficit hyperactivity disorder (ADHD) (n = 6; 14.6%), verbal difficulties in producing or understanding speech (n = 5; 12.2%) and diabetes (n = 3; 7.3%). UEs received more parental support for PA compared to REs (p = 0.04) as 56.9% of the UEs and 46.2% of the REs were reported to have parental support for PA over three times a week. REs tended to live in denser population areas compared to UEs (p = 0.03) as 17.3% of the REs lived in a metropolitan area compared to 7.4% of the UEs. Also, 12.1% of the REs while 24.1% of the UEs lived in countryside (Table 4).

4. Discussion

The main purposes of the present study were to divide the sample of children into profiles of PMC in relation to AMC and to discover which factors relate to these profiles based on the socioecological model. To date this was the first study investigating children aged five to seven years by unifying the AMC and PMC scores and examining the possibility for profiles and their differences related to socioecological variables. This knowledge could, according to the socioecological model (Bronfenbrenner, 1994), explain children's PMC and AMC, in addition to target those factors that may be associated with PMC in interventions. Therefore, this study contributes to the growing field of PMC with its large sample size in addition to the use of socioecological model.

One of the main findings of the study was that three different PMC profiles could be identified, despite the children's young age. Although, a challenge in identifying the profiles was that the children's PMC was high – most probably due to young age of the participants. This led to an inability to use statistical methods that have been used previously, such as cluster analyses (Bardid et al., 2016; De Meester, Stodden et al., 2016; Weiss & Amorose, 2005), or regression analysis (Pesce et al., 2018). More specifically, the cluster analysis was not suitable due to the homogeneous data sample, which lead to profiles based on AMC scores leaving PMC values aside. The regression analysis was not executed as there was a peak in the maximum value of PMSC assessment tool leading to skewness which could not be logged successfully. Finally,

Table 3. Descriptive statistics of the three profiles of children with different combinations of perceived and actual motor competence (n = 441).

	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)
• Underweight	%	5.6	12.5	0	4.3	4.9	3.7	2.5	2.2	2.8
• Normal weight		66.7	70.8	63.3	73.9	76.9	71.2	76.5	75.6	77.8
• Overweight		22.2	16.7	26.7	19.0	14.7	22.7	16	15.6	16.7
• Obesity		5.6	0	10.0	2.9	3.5	2.4	5.0	6.7	2.8
Child's independent walking	at month	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 behaviour	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	%									
• Less than 1 h/day		0	0	0	8.8	12.6	5.5	15.0	15.6	14.3
• Approximately 1 h/day		53.8	60.9	48.3	49.0	47.6	50.3	45.0	40.0	51.4
• 1–2 h/day		46.2	39.1	51.7	42.2	39.8	44.2	40.0	44.4	34.3
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 total	range 13–52	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 gross motor index	range 0–100	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	%									
• No		88.7	91.3	86.7	92.4	96.5	88.9	85.2	91.1	77.8
• Yes		11.3	8.7	13.3	7.6	3.5	11.1	14.8	8.9	22.2
Family factors										
Parent mean education level	%									
• Elementary school		5.8	0	10.3	0.3	0	0.6	2.5	2.2	2.8
• Secondary school		34.6	47.8	24.1	37.2	38.1	36.4	37.0	40.0	33.3
• Polytechnic		34.6	30.4	37.9	39.8	40.8	38.9	33.3	31.1	36.1
• University		25.0	21.8	27.6	22.7	21.1	24.1	27.2	26.7	27.8
Respondent's physical activity frequency	%									
• At least couple of times per month		14.3	8.7	10.3	14.5	12.1	16.6	15.1	15.5	14.3
• Once a week		11.4	8.7	13.8	14.5	17.8	11.7	15.0	17.8	11.4
• 2–3 times a week		48.6	52.2	41.4	42.3	42.8	41.7	52.5	55.6	48.6
• Over 4 times a week		25.7	30.4	34.5	28.7	27.3	30.0	17.6	11.1	25.7
Respondent's sedentary behaviour	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	%									
• Less than two times a week		43.1	40.9	44.8	53.6	51.4	55.6	51.9	51.1	52.8
• 3–4 times a week		43.1	50.0	37.9	33.6	40.1	27.8	38.3	42.2	33.3
• Over 5 times a week		13.8	9.1	17.3	12.8	8.5	16.6	9.8	6.7	13.9
Shared family physical activities	%									
• Less than two times a week		43.4	34.8	50.0	45.8	48.3	43.6	45.7	48.9	41.7
• 3–4 times a week		26.4	34.8	20.0	29.4	30.7	28.2	35.8	33.3	38.9
• Over 5 times a week		30.2	30.4	30.0	24.8	21.0	28.2	18.5	17.8	19.4
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	%									
• Metropolitan area		7.4	12.5	3.3	17.3	16.8	17.8	16.0	15.6	16.7
• Cities		48.1	41.7	53.3	47.4	46.1	48.5	42.0	44.4	38.9
• Rural areas		20.4	16.7	23.3	23.2	28.0	19.0	24.7	22.2	27.8
• Countryside		24.1	29.2	20.0	12.1	9.1	14.7	17.3	17.8	16.7

n = Number, % = Percentage, SD = Standard deviation, BMI SDS = Body mass index standard deviation scores, mins. = Minutes, d. = Day, h. = Hour, wk. = Week, PMSC = The Pictorial Scale of Perceived Movement Skill Competence in young children, TGMD-3 = Test of Gross Motor Development – third edition, access to electronic devices = list of TV, game console, computer, smartphone, tablet, Ipad, or other smart device and an open space for devices not listed. Statistically significant difference between girls and boys, the level of significance at * $p < 0.05$, ** $p < 0.01$ *** $p < 0.001$.

Table 4. Comparison of three profiles' differences in perception of motor competence.

	UE vs. RE		RE vs. OE		UE vs. OE	
Individual factors	P	OR (95% CI)	P	OR (95% CI)	P	OR(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 (range 0.5–7)	**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 (range 1–4)	**0.03¤**	0.68 (0.49–0.95)	0.34	1.14 (0.87–1.50)	0.21	0.78 (0.53–1.15)

Under estimation (UE), Realistic estimation (RE), Over estimation (OE), P = p-value, OR = Odds ratio,
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

tertile analysis (Duncan et al., 2018) was not used as we aimed to use both PMC and AMC scores while identifying the profiles. Therefore, these results could be considered as preliminary.

The second aim of the study was to investigate if there were some socioecological factors which differentiated the three profiles. According to our hypothesis, children in the OE profile were the youngest while children in the RE profile were the oldest. Past studies suggest that children under eight years of age have inflated PMC (Stodden et al., 2008; Lopes et al., 2016), and, as a function of age, their PMC approximates their AMC more closely (Harter, 1999). This inflated PMC enhances children's willingness to participate in PA or motor tasks (Stodden et al., 2008; Robinson et al., 2015) and stems from young children's cognitive incapacity to make realistic estimations about actual skills (Harter, 1999). The current findings of children's PMC profiles related to age of the children attest these theories. However, a recent systematic review and meta-analysis stated that age is not a moderator of the relationship between AMC and PMC (De Meester et al., 2020). Interestingly, while previous studies have noted that, overall, PMC decreases with age, at the same time, it is important to bear in mind that this assumption was not adequately tested from a person-centred approach using longitudinal data, supported by AMC assessments. Hence, future research with this topic is warranted.

Another individual factor associated with differences between the PMC profiles was "child possessing a health issue". Children who estimated their AMC realistically were less likely to be reported by their parents as having factors influencing their development (n = 23/304, 7.6%), while nearly 15% (n = 12/81) of the children in the OE profile had some kind of a developmental or health issue. These findings should be considered as preliminary because the focus of the current study was not on health or risk factors; as such, the specificity and quantity of information on these factors is insufficient to make any further conclusions. Interestingly, however, it has been found that half of the children with ADHD have problems in motor development (Kaiser et al., 2015), and yet they are likely to overestimate their motor skills (Hoza et al., 2004). As ADHD was the second most frequently mentioned additional developmental factor by parents of OEs, future research should identify any special conditions that may influence young children's motor development and, especially, how they may relate to their PMC, AMC and PA. Also, in a study by Emck et al., (2009) children with emotional, behavioural and pervasive developmental disorders exhibited poorer AMC and unrealistic PMC, with certain indications of disorder-specific characteristics (Emck et al., 2009). As a result, they questioned if the type of developmental issue or disorder may be associated with children's MC and PMC development leading to unrealistic estimations (Emck et al., 2009). In the case of unrealistic evaluations, it has been also questioned if it is a way to protect one's self-image from failure, a sort of self-defence (Pönkkö, 1999).

The present study also provided novel information on potential correlates at the family level related to differences between the PMC profiles. Children in the UE profile were reported to have more parental support for PA than their REs peers. Interestingly, when looking the profiles closely, it can be seen first of all, that UEs (adults and children), are reported to have less sedentary activities (respondents 5.11 hours daily, children 1.36 hours daily) compared to REs (respondents 5.39 hours daily, children 1.50 hours daily) and OEs (respondents 5.40 hours daily, child 1.48 hours daily) profiles, although these differences are not statistically significant. Also, parents of UEs self-reported more time in engaging shared family PAs. It may be that parents of the UEs engage more in light (physical) activities with their children, but children may not perceive this engagement as support for PA as it is not directly associated to sport-related hobbies, which only by attempting may prompt young children' higher PMC. In general (Korelitz & Garber 2016), discovered in their meta-analysis that parents' reports were more favourable than their children's reports about the parents' behaviours. Thus, it can be inferred that the parents in the current study also overestimated their positive feedback towards their children. However, it remains a question why this was seen only in the profile for UEs. Also, according to the study by Laukkanen et al., (2020) perceptions of high demandingness and high responsiveness in PA parenting, specifically parental expectations and facilitation of PA, were associated with satisfaction of competence need of the child. They stated that it may be possible to identify different types of PA parenting practices that are associated with children's motivation for PA. Therefore, future research focusing on coherence of parental support and children's perceptions of the amount and quality of such support is needed.

Finally, one environmental factor was associated with differences between the three profiles of PMC as REs tended to live in denser population areas compared to UEs. A fifth (17.3%) of the REs lived in a metropolitan area compared to 7.4% of the UEs. It can be questioned if children from denser areas are more aware of their skill levels as they may have more possibilities to compare their own AMC level to other children' AMC, as they do not yet go to school at this age. Also, the childcare groups may be smaller in less dense areas of population. In this study, children in a metropolitan area participated in organized sport (56.8 mins/week) significantly more than those in the rest of the country (46.7 mins/week) (Niemistö et al., 2019). The role of participating in hobbies for the PMC of the young child may be important for children' self-belief. Previous studies investigating the correlates of PMC have found that higher sport participation (Niemistö et al., 2019) can be associated with higher PMC. In a study by Pesce et al., (2018) with respect to sport participation, the profile of OEs in locomotor skills practised a larger amount of sport than the UEs profile. Also, by engaging more in sport-related hobbies, they may have had more feedback from external sources, such as coaches and peers, supporting their realistic perception. Therefore, these preliminary results suggest that residential density can be relevant when investigating PMC profiles.

Previous studies investigating the correlates of PMC profiles, have found that gender differences exist (Duncan et al., 2018; Pesce et al., 2018) in contrast to the current study. In a Duncan et al., (2018) study, boys obtained significantly higher scores than girls for both AMC and PMC scores. In a study by Pesce et al., (2018) most girls underestimated and most boys overestimated their actual ball skills. However, other studies investigating only correlates of PMC, excluding the PMC profiles, have stated that boys seem to have higher overall PMC compared to girls (Venetsanou et al., 2018; Slykerman et al., 2016), even though there are several studies reporting no gender differences (Lopes et al., 2016; Lopes et al., 2018; De Meester et al., 2020). Past studies have tried to explain these gender differences by reflecting on engagement and participation in motor skill activities (Robinson, 2011), as well as differences in content of play and hobbies between the genders (Barnett et al., 2013). Additionally, environmental or socio-cultural factors, such as equal possibilities and enhancement provided for PA (Iivonen & Sääkslahti, 2014; Robinson, 2011) may influence boys and girls motor development. Interestingly, however, a recent systematic review and meta-analysis investigating the strength of association between MC and PMC/physical self-perception, did not find that the relationship between AMC and PMC differed according to gender (De Meester et al., 2020). Authors questioned if this result may be due to methodological issues (such as divergent assessment tools) and recommended that future research should aim to overcome these methodological challenges (De Meester et al., 2020).

Also, previous studies have shown that a lower BMI is a positive correlate for PMC (Duncan et al., 2018; Spessato et al., 2013) as well as lower body weight (Jones et al., 2010; De Meester, Stodden et al., 2016). In contrast, one study has shown that higher BMI (Niemistö et al., 2019) (rather than lower) was positively associated with PMC. As a potential explanation of this finding, Niemistö et al., (2019) stated that in their data sample, there was a lack of obese children, which made it hard to investigate these relationships between PMC and BMI accurately. Indeed, this finding contrasts with the results of the study by Spessato et al., (2013) who reported that the PMC of four to seven year old children was *lower* in obese children; even though their AMC was similar to children with a normal BMI. Meanwhile, a study of older children (9.50 ± 1.24 yrs) found that a combination of high AMC and PMC was related to higher PA and lower BMI (De Meester et al., 2016). In the current study, no such differences within BMI SDS between the profiles were found. In general, it appears that, in contrast to our findings, PMC can be lower in obese children. Future research could investigate how perception relates to BMI as a function of age in a sample that reflects children of different BMI status.

Overall, the strengths of our study include (i) a geographically representative sample of children, which enables divergent residential densities to be considered within one country; (ii) a large number of children and families; and (iii) PMC and AMC measurements were matched to align. The major limitation of the study, in line with previous studies using a profile approach to PMC (Duncan et al., 2018; De Meester, Stodden et al., 2016; Pesce et al., 2018) is that the results cannot be generalized to other samples. Another sample may under- or over-represent particular profiles if the participants are categorized into the profiles based on the current overall AMC levels. Furthermore, the present study sample mainly consists of high socio-economic status families and has an under-representation of obese participants. This bias could explain why some individual- and family-related factors were the same across the profiles in this sample. Moreover, in the parental questionnaire, some of the test-retest reliability levels were slightly low with high CIs. Additionally, it would be useful for future research to collect more detailed information from parents of young children on their children's early development and possible health factors related to PMC. Lastly, as PA, AMC and PMC interact with each other (Robinson et al., 2015; Stodden et al., 2008), the lack of objectively measured PA levels in children can be seen as a study limitation.

In essence, the current study created three PMC profiles in young children. However, as young children have high PMC, future research should investigate if particular PMC profiles would offer more knowledge on profile differences in PMC and their associated factors. Furthermore, there were few differences between the PMC profiles based on certain socioecological factors. The study consolidated the research by showing that age is crucial element of PMC (profiles). Also, the results imply that a child's health related issues, as well as PA parenting and residential density of the living place may need to be considered while investigating the PMC profiles and their differences. To conclude, future research would benefit from longitudinal studies as well as a broader range of correlates relating to PMC profiles, as children's development occurs in a socioecological context and is driven by many influencing factors.

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References

Babic, M. J., Morgan, P. J., Plotnikoff, R. C., Lonsdale, C., White, R. L., & Lubans, D. R. (2014). Physical activity and physical self-concept in youth: Systematic review and meta-analysis. *Sports Medicine*, *44*(11), 1589–1601. https://doi.org/10.1007/s40279-014-0229-z

Bardid, F., De Meester, A., Tallir, I., Cardon, G., Lenoir, M., & Haerens, L. (2016). Configurations of actual and perceived motor competence among children: Associations with motivation for sports and global self-worth. *Human Movement Science*, *50*, 1–9. https://doi.org/10.1016/j.humov.2016.09.001

Barnett, L., Hinkley, T., Okely, A. D., & Salmon, J. (2013). Child, family and environmental correlates of children's motor skill proficiency. *Journal of Science and Medicine in Sport*, *16*(4), 332–336. https://doi.org/10.1016/j.jsams.2012.08.011

Barnett, L. M., Lai, S. K., Veldman, S. L. C., Hardy, L. L., Cliff, D. P., Morgan, P. J., Zask, A., Lubans, D. R., Shultz, S. P., Ridgers, N. D., Rush, E., Brown, H. L., & Okely, A. D. (2016). Correlates of gross motor competence in children and adolescents: A systematic review and meta-analysis. *Sports Medicine*, *46*(11), 1663–1688. https://doi.org/10.1007/s40279-016-0495-z

Barnett, L. M., Ridgers, N. D., Zask, A., & Salmon, J. (2015). Face validity and reliability of a pictorial instrument for assessing fundamental movement skill perceived competence in young children. *Journal of Science and Medicine in Sport*, *18*(1), 98–102. https://doi.org/10.1016/j.jsams.2013.12.004

Barnett, L. M., Webster, E. K., Hulteen, R. M., De Meester, A., Valentini, N. C., Lenoir, M., Pesce, C., Getchell, N., Lopes, V. P., Robinson, L. E., Brian, A., & Rodrigues, L. P. et al. (2021). Through the looking glass: A systematic review of longitudinal evidence, providing new insight for motor competence and health. *Sports Medicine*. https://doi.org/10.1007/s40279-021-01516-8

Brian, A., Bardid, F., Barnett, L., Deconinck, F. J. A., Lenoir, M., & Goodway, J. D. (2018). Actual and perceived motor competence levels of Belgian and US preschool children. *Journal of Motor Learning and Development*, *6*(S2), S320–S336. https://doi.org/10.1123/jmld.2016-0071

Bronfenbrenner, U. (1994). Ecological models of human development. In T. Husen & N. T. Postlethwaite (Eds.), *International Encyclopedia of Education* (2nd ed., pp. 1643–1647). Elsevier.

Carcamo-Oyarzun, J., Estevan, I., & Herrmann, C. (2020). Association between actual and perceived motor competence in school children. *International Journal of Environmental Research and Public Health*, *17*(10), 3408. https://doi.org/10.3390/ijerph17103408

Cleland, V., Timperio, A., Salmon, J., Hume, C., Telford, A., & Crawford, D. (2011). A longitudinal study of the family physical activity environment and physical activity among youth. *American Journal of Health Promotion*, *25*(3), 159–167. https://doi.org/10.4278/ajhp.090303-QUAN-93

Cools, W., De Martelaer,K., Samaey, C., & Andries, C.(2009). Movement skill assessment of typically developing preschool children: A review of seven movement skill assessment tools. *Journal of Sports Science & Medicine*, *8*(2), 154–168.

Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J. F., & Oja, P. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise*, *35*(8), 1381–1395. https://doi.org/10.1249/01.MSS.0000078924.61453.FB

Crane, J., Foley, J., Naylor, P.-J., & Temple, V. (2017). Longitudinal change in the relationship between fundamental motor skills and perceived competence: Kindergarten to grade 2. *Sports*, *5*(3), 59. https://doi.org/10.3390/sports5030059

De Meester, A., Barnett, L. M., Brian, A., Bowe, S. J., Jiménez-Díaz, J., Van Duyse, F., Irwin, J. M., Stodden, D. F., D'Hondt, E., Lenoir, M., & Haerens, L. (2020). The relationship between actual and perceived motor competence in children, adolescents and young adults: A systematic review and meta-analysis. *Sports Medicine*, *50*(11), 2001–2049. https://doi.org/10.1007/s40279-020-01336-2

De Meester, A., Maes, J., Stodden, D., Cardon, G., Goodway, J., Lenoir, M., & Haerens, L. (2016). Identifying profiles of actual and perceived motor competence among adolescents: Associations with motivation, physical activity, and sports participation. *Journal of Sports Sciences*, *34*(21), 2027–2037. https://doi.org/10.1080/02640414.2016.1149608

De Meester, A., Stodden, D., Brian, A., True, L., Cardon, G., Tallir, I., & Haerens, L. (2016). Associations among elementary school children's actual motor competence, perceived motor competence, physical activity and BMI: A cross-sectional study. *PLoS One*, *11*(10), 1–14. https://doi.org/10.1371/journal.pone.0164600

Diao, Y., Dong, C., Barnett, L. M., Estevan, I., Li, J., & Ji, L. (2018). Validity and reliability of a pictorial instrument for assessing fundamental movement skill perceived competence in Chinese children. *Journal of Motor Learning and Development*, *6* (S2), S223–S238. https://doi.org/10.1123/jmld.2016-0082

Donnelly, F. C., Mueller, S, S., Gallahue, D. L. (2017). *Developmental physical education for all children: Theory into practise*. Human Kinetics.

Duncan, M. J., Jones, V., O'Brien, W., Barnett, L. M., & Eyre, E. L. J. (2018). Self-perceived and actual motor competence in young British children. *Perceptual and Motor Skills*, *125*(2), 251–264. https://doi.org/10.1177/0031512517752833

Emck, C., Bosscher, R., Beek, P., & Doreleijers, T. (2009). Gross motor performance and self-perceived motor competence in children with emotional, behavioural, and pervasive developmental disorders: A review. *Developmental Medicine & Child Neurology*, *51*(7), 501–517. https://doi.org/10.1111/j.1469-8749.2009.03337.x

Estevan, I., & Barnett, L. M. (2018). Considerations related to the definition, measurement and analysis of perceived motor competence. *Sports Medicine*, *48*(12), 2685–2694. https://doi.org/10.1007/s40279-018-0940-2

Estevan, I., Molina-Garcìa, J., Abbott, G., Bowe, S. J., Castillo, I., & Barnett, L. M. (2018). Evidence of reliability and validity for the pictorial scale of perceived movement skill competence in Spanish children. *Journal of Motor Learning and Development*, *6*(S2), S205–S222. https://doi.org/10.1123/jmld.2016-0065

Freitas, T. C. B., Gabbard, C., Caçola, P., Montebelo, M. I. L., & Santos, D. C. C. (2013). Family socioeconomic status and the provision of motor affordances in the home. *Brazilian Journal of Physical Therapy*, *17*(4), 319–327. https://doi.org/10.1590/S1413-35552013005000096

Gallahue, D., & Donnelly, F. (2003). *Developmental physical education for all children*. Human Kinetics.

Goodway, J. D., & Rudisill, M. E. (1997). Perceived physical competence and actual motor skill competence of African American preschool children. *Adapted Physical Activity Quarterly*, *14*(4), 314–326. https://doi.org/10.1123/apaq.14.4.314

Hall, C., Eyre, E., Oxford, S., & Duncan, M. (2019). Does perception of motor competence mediate associations between motor competence and physical activity in early years children? *Sports*, *7*(4), 77. https://doi.org/10.3390/sports7040077

Harter, S. (1978). Effectance motivation reconsidered. Toward a developmental model. *Human Development*, *21*(1), 34–64. https://doi.org/10.1159/000271574

Harter, S. (1999). The construction of the self: A developmental perspective. Guilford Press

Harter, S., & Pike, R. (1984). The pictorial scale of perceived competence and social acceptance for young children. *Child Development*, *55*(6), 1969–1982. https://doi.org/10.2307/1129772

Hoza, B., Gerdes, A. C., Hinshaw, S. P., Arnold, L. E., Pelham, W. E., Molina, B. S. G., Abikoff, H. B., Epstein, J. N., Greenhill, L. L., Hechtman, L., Odbert, C., Swanson, J. M., & Wigal, T. (2004). Self-perceptions of competence in children with ADHD and comparison children. *Journal of Consulting and Clinical Psychology*, *72*(3), 382–391. https://doi.org/10.1037/0022-006X.72.3.382

Iivonen, S., & Sääkslahti, A. (2014). Preschool children's fundamental motor skills: A review of significant determinants. *Early Child Development and Care*, *184*(7), 1107–1126. https://doi.org/10.1080/03004430.2013.837897

Jones, R. A., Okely, A. D., Caputi, P., & Cliff, D. P. (2010). Perceived and actual competence among overweight and non-overweight children. *Journal of Science and Medicine in Sport*, *13*(6), 589–596. https://doi.org/10.1016/j.jsams.2010.04.002

Kaiser, M. L., Schoemaker, M. M., Albaret, J. M., & Geuze, R. H. (2015). What is the evidence of impaired motor skills and motor control among children with attention deficit hyperactivity disorder (ADHD)? Systematic review of the literature. *Research in Developmental Disabilities*, *36*, 338–357. https://doi.org/10.1016/j.ridd.2014.09.023

Korelitz, K. E., & Garber, J. (2016). Congruence of parents' and children's perceptions of parenting: A meta-analysis. *Journal of Youth and Adolescence*, *45*(10), 1973–1995. https://doi.org/10.1007/s10964-016-0524-0

Laukkanen, A., Niemistö, D., Finni, T., Cantell, M., Korhonen, E., & Sääkslahti, A. (2018). Correlates of physical activity parenting: The Skilled Kids study. *Scandinavian Journal of Medicine & Science in Sports*, *28*(12), 2691–2701. https://doi.org/10.1111/sms.13287

Laukkanen, A., Sääkslahti, A., & Aunola, K. (2020). "It is like compulsory to go, but it is still pretty nice": Young children's views on physical activity parenting and the associated motivational regulation. *International Journal of Environmental Research and Public Health*, *17*(7), 2315. https://doi.org/10.3390/ijerph17072315

Lopes, V., Barnett, L., & Rodrigues, L. (2016). Is there an association among actual motor competence, perceived motor competence, physical activity, and sedentary behavior in preschool children? *Journal of Motor Learning and Development*, *4*(2), 129–141. https://doi.org/10.1123/jmld.2015-0012

Lopes, V. P., Saraiva, L., Gonçalves, C., & Rodrigues, L. P. (2018). Association between perceived and actual motor competence in Portuguese children. *Journal of Motor Learning and Development*, *6*(S2), S366–S377. https://doi.org/10.1123/jmld.2016-0059

Mota, J. G., Craig, C., Clark, T., Lemos, L., Reuter, C. P., Mota, J. A. P. S., Duncan, M. J., & Martins, C. M. D. L. (2020). Twenty-four-hour movement behaviours and fundamental movement skills in preschool children: A compositional and isotemporal substitution analysis. *Journal of Sports Sciences*, *38*(18), 2071–2079. https://doi.org/10.1080/02640414.2020.1770415

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. https://doi.org/10.1111/sms.13389

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), 1–17. https://doi.org/10.3390/ijerph16111989

Pesce, C., Masci, I., Marchetti, R., Vannozzi, G., & Schmidt, M. (2018). When children's perceived and actual motor competence mismatch: Sport participation and gender differences. *Journal of Motor Learning and Development*, *6* (S2), S440–S460. https://doi.org/10.1123/jmld.2016-0081

Pönkkö, A. (1999). Vanhemmat ja lastentarhanopettajat päiväkotilasten minäkäsityksen tukena [Parents' and teachers' role in self-perception of children in kindergarten]. University of Jyväskylä.*Studies in Sport,Physical Education and Health 62*. http://urn.fi/URN:ISBN:978-951-39-7924-9

Rintala, P., Sääkslahti, A., & Iivonen, S. (2017). Reliability assessment of scores from video-recorded TGMD-3 performances. *Journal of Motor Learning and Development*, *5*(1), 59–68. https://doi.org/10.1123/jmld.2016-0007

Robinson, L. E. (2011). The relationship between perceived physical competence and fundamental motor skills in preschool children. *Child: Care, Health and Development*, *37*(4), 589–596. https://doi.org/10.1111/j.1365-2214.2010.01187.x

Robinson, L. E., Stodden, D. F., Barnett, L. M., Lopes, V. P., Logan, S. W., Rodrigues, L. P., & D'Hondt, E. (2015). Motor competence and its effect on positive developmental trajectories of health. *Sports Medicine*, *45*(9), 1273–1284. https://doi.org/10.1007/s40279-015-0351-6

Rodrigues, L. P., Saraiva, L., & Gabbard, C. (2005). Development and construct validation of an inventory for assessing the home environment for motor development. *Research Quarterly for Exercise and Sport*, *76*(2), 140–148. https://doi.org/10.1080/02701367.2005.10599276

Saari, A., Sankilampi, U., Hannila, M-L., Kiviniemi, V., Kesseli, K., & Dunkel, L. (2011). New Finnish growth references for children and adolescents aged 0 to 20 years: Length/height-for-age, weight-for-length/height, and body mass index-for-age. *Annals of Medicine*, *43*(3), 235–248. https://doi.org/10.3109/07853890.2010.515603

Schmidt, M., Valkanover, S., & Conzelmann, A. (2013). Veridicality of self-concept of strength in male adolescents. *Perceptual and Motor Skills*, *116*(3), 1029–1042. https://doi.org/10.2466/06.10.PMS.116.3.1029-1042

Slykerman, S., Ridgers, N. D., Stevenson, C., & Barnett, L. M. (2016). How important is young children's actual and perceived movement skill competence to their physical activity? *Journal of Science and Medicine in Sport*, *19*(6), 488–492. https://doi.org/10.1016/j.jsams.2015.07.002

Spessato, B. C., Gabbard, C., Robinson, L., & Valentini, N. C.(2013). Body mass index, perceived and actual physical competence: The relationship among young children. *Child: Care, Health and Development*, *39*(6), 845–850. https://doi.org/10.1111/cch.12014

Stodden, D. F., Goodway, J. D., Langendorfer, S. J., Roberton, M. A., Rudisill, M. E., Garcia, C., & Garcia, L. E. (2008). A developmental perspective on the role of motor skill competence in physical activity: An emergent relationship. *Quest*, *60*(2), 290–306. https://doi.org/10.1080/00336297.2008.10483582

Telford, A., Salmon, J., Jolley, D., & Crawford, D. (2004). Reliability and validity of physical activity questionnaires for children: The children's leisure activities study survey (CLASS). *Pediatric Exercise Science*, *16*(1), 64–78. https://doi.org/10.1123/pes.16.1.64

True, L., Brian, A., & Goodway, J. (2017). Relationships between product- and process-oriented measures of motor competence and perceived competence. *Journal of Motor Learning and Development*, *5*(2), 319–335. https://doi.org/10.1123/jmld.2016-0042

Ulrich, D. A. (2019). *Test of gross motor development–third edition. Examiner's manual*. Pro-Ed.

Venetsanou, F., Kossyva, I., Valentini, N., Afthentopoulou, A.-E., & Barnett, L. (2018). Validity and reliability of the pictorial scale of perceived movement skill competence for young Greek children. *Journal of Motor Learning and Development*, *6*(S2), S239–S251. https://doi.org/10.1123/jmld.2017-0028

Weiss, M. R., & Amorose, A. J. (2005). Children's self-perceptions in the physical domain: Between- and within-age variability in level, accuracy, and sources of perceived competence. *Journal of Sport and Exercise Psychology*, *27*(2), 226–244. https://doi.org/10.1123/jsep.27.2.226

World Health Organization. *Health behaviour in school-aged children*. Collaborative cross-national survey. Published 2020. Accessed May 3, 2020. http://www.hbsc.org/