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A Comparison of Physical Activity Levels in Childcare Contexts among Finnish and Dutch 3-Year-Olds

Abstract

To determine Finnish and Dutch 3-year-old preschool children's physical activity (PA) levels and how levels vary across gender, location, time of day and social contexts in both countries.

A modified version of the Observational System for Recording Physical Activity in Children-Preschool (OSRAC-P) was used to measure children's PA levels and contextual variables (e.g., group composition, prompts) of children attending childcare centres in Finland and the Netherlands. In total, 90 Finnish children (46 boys) and 97 Dutch children (46 boys) were observed. Three-level linear regression analyses with cross level interactions were used to assess differences between the countries in the association between the context variables and PA. During the observations, the present sample of children was mostly sedentary in nature. Outdoor location and prompts (both positive and negative) were associated with higher levels of activity in both countries. Non-solitary playing was associated with higher activity levels in the Netherlands, but not in Finland, whereas child-initiated play was positively associated with Finnish but not Dutch children's PA levels. Finnish children were more active in the morning compared to the afternoon, while in the Dutch children PA was unaffected by time. The present findings indicate that better understanding of the contextual factors and interactions in children's PA behaviours across the two countries could help in planning childcare interventions to increase the PA levels of preschool children.

Keywords: physical activity; direct observation; childcare centre; country comparison; preschool children

Introduction

Nearly 70% of 3-year-old children in Europe attend childcare or early education services, whereas in other continents the numbers are much lower (OECD Family database 2008). There is some evidence that childcare centres influence children's physical activity (PA) levels (Finn, Johannsen, and Specker 2002; Pate et al. 2004; Strong et al. 2005; Pate et al. 2008). Finn, Johannsen, and Specker (2002) concluded that among children attending childcare, the childcare centre was the strongest predictor of activity levels, with more than 50% of the daily PA performed during childcare hours. However, various studies have indicated that PA levels are generally very low among preschool children during their time in childcare settings (Oliver, Schofield, and Kolt 2007; Pate et al. 2008; Brown et al. 2009-II; Reilly 2010; Gubbels et al. 2011). A U.S. study by Brown et al. (2009-II) reported 94% of the indoor activities observed to be sedentary. A smaller but nevertheless substantial proportion (59%) of the indoor activities observed among Dutch children also classified as sedentary (Gubbels et al. 2011), indicating that sedentariness might be more pronounced in U.S. pre-schoolers.

In a light of the socio-ecological framework, Hinkley et al. (2008) reviewed correlates of preschool children's PA level and showed that children's demographic and biological characteristics, as well as their physical and social environments are significantly associated with a children's total PA. Various studies have found links between physical environment factors in the childcare setting (e.g., the ground surface, playground markings, open space, play equipment) and children's PA (Zask et al. 2001; Dowda et al. 2004; Boldemann et al. 2006; Ridgers et al. 2007; Bower et al. 2008; Cardon et al. 2008; Hannon & Brown 2008; Cosco et al. 2010; Gubbels, Van Kann, and Jansen 2012). Furthermore, boys have been found to be more active than girls (Oliver, Schofield, and Kolt 2007; Hinkley et al. 2008; Pate et al. 2008), children are more active outdoors (Finn, Johannsen, and Specker 2002; Pate et al.

55 2004; Boldeman et al. 2006; Hinkley et al. 2008), and children's PA increases in warm
56 seasons and decreases in the colder seasons (Carson and Spence 2010).

57 Social environment factors, such as positive prompts by staff members (Brown et al.
58 2009-I) and peers (Gubbels et al. 2011), have been shown to be associated with children's
59 increased PA intensity. Despite these positive associations, teachers and peers rarely prompt
60 children to increase their PA. Moreover, teacher-initiated play was negatively associated with
61 children's levels of PA (Brown et al. 2009-II). European studies have also indicated negative
62 relationships between the presence of more childcare staff and peers (Cardon et al. 2008) or
63 direct involvement of staff and peers in children's play (Gubbels et al. 2011), and children's
64 activity levels.

65 Currently, there is a lack of observational studies on pre-school children in Europe.
66 Such observational studies provide valuable information on the context of PA behaviours,
67 which cannot be derived from studies using accelerometer or other objective measurements
68 of PA. Such contextual information can inform preventive interventions promoting PA in
69 childcare, and have implications for both practitioners and researchers. The childcare setting
70 holds great potential to make an important contribution to the welfare and health of young
71 children by promoting PA (Pate et al. 2004; Bower et al. 2008; Hinkley et al. 2008; Pate et al.
72 2008; Ward 2010). Furthermore, positive patterns of engagement in PA demonstrated during
73 childhood are critical for the maintenance of a physically active lifestyle during both
74 adolescence and adulthood (Strong et al. 2005).

75 The aim of this study was to determine existing PA levels among 3-year-old children
76 and how these vary by gender, primary location (i.e. indoor vs. outdoor), time of day (i.e.
77 morning vs. afternoon), social context (i.e. group composition, initiator of activity, prompts),
78 outdoor temperatures and weather conditions during childcare in Finland and in the
79 Netherlands.

Methods

Participants and Sampling

Finland. Recruitment was performed in the city of Jyväskylä. A total of 14 childcare centres volunteered their participation in the study. In Finland, 3-year-olds in childcare are most commonly mixed in a group with 4- and 5-year-olds, while 1- and 2-year-olds are often grouped together. Finnish childcare centres in the present study provided care for an average of 74 children (SD = 20) in 4 groups (SD = 1). The mean number of staff members per centre was 16 (SD = 5). All the families of the 3-year-old children attending the childcare centres (N = 179) were invited to participate. One hundred and two (57%) parents provided informed consents. The children's PA data were collected between August and October 2010. Six children were not present and six children were attending for only half a day during the observations, and were therefore excluded from the final sample of 90 children (46 boys and 44 girls) observed in Finland.

The Netherlands. A large Dutch childcare organization was approached to participate in the study, and gave consent to conduct the study. All 9 childcare centres in Maastricht run by this organization centres were approached and agreed to participate. In the Netherlands, childcare centres offer care for babies as young as 6 weeks to children up to four years, 3-year-olds are often grouped with 2-year-olds. In the present study, the Dutch childcare centres provided care for an average of 92 children (SD = 28) in 5 groups (SD = 1). The mean number of staff members per centre was 20 (SD = 6). All the parents of the 3-year-old children attending these childcare centres were informed about the study, and none of them refused to participate. Children's PA was observed in May and June 2008. A total of 97 3-year-olds (46 boys and 51 girls) were observed in the Netherlands.

The typical daily timetables in the Finnish and Dutch childcare centres are described in Table 1. The ethics committee of the University of Jyväskylä, and the Social Affairs and

Health officer of the city of Jyväskylä approved the study. The Dutch study complied with the Dutch 'Medical Research Involving Humans Act'.

INSERT Table 1 NEAR HERE (Table 1. Typical daily programmes in Finnish and Dutch childcare centres.)

Measures and Procedures

A translated and modified version of the Observational System for Recording Physical Activity in Children-Preschool Version (OSRAC-P; Brown et al. 2006) was used to measure children's PA intensity, location, contexts, prompts and interactions. The design of the Finnish study was based on the Dutch study by Gubbels and colleagues (2011), with some minor adjustments to adapt to the Finnish situation. Two researchers in each country observed PA and contextual factors using a procedure in which an observation period of 15 seconds was followed by 30 seconds for recording the observation. This procedure was repeated eight times for a total of six minutes per child. In Finland, each child was observed twice a day, both in the morning (between 8 a.m.-12 p.m.) *and* afternoon (2 p.m.-5 p.m.), yielding a total of sixteen observations per child. In the Netherlands, each child was observed either in the morning *or* afternoon, yielding a total of eight observations per child. The total number of single observations for both countries combined was thus 2,216 (1,440 in Finland; 776 in the Netherlands). In both countries, children were randomly selected for observation and they were not observed during meals or rest times. To ensure accuracy of data, observer training (e.g., initial observer orientation, study of the observation manual and the memorization of codes and categories, direct in situ training session in field settings) is recommended (Brown et al. 2009-III). Therefore in both countries, before the measurements all field researchers were trained with the method by studying the instruments and background information, and subsequently observing children via videotape and 'live' in the childcare settings. Inter-observer agreement measures were done in both countries.

Furthermore, to assess cross-country inter-observer agreement, a separate sample of children not included in the final study, was independently observed via videotape by one of the two researchers of each country. This resulted in cross-country coding of 305 observation intervals, i.e. 13.8% of the observation intervals in the main study (2216 intervals), sufficing the OSRAC-P norm of at least 12% independent coding (Brown et al. 2009-III).

PA intensity levels were measured on a five-point scale (1=stationary or motionless, 2=stationary with limb or trunk movements, 3=slow or easy movements, 4=moderate movements, 5=fast movements) and reflected the highest intensity level reached by the child during each 15-second observation period. For the purpose of this study and further comparison, activity levels ≤ 2 were regarded as sedentary behaviour, activity level 3 as light PA and 4–5 levels as moderate-to-vigorous physical activity (MVPA) (Bower et al. 2006; Brown et al. 2009-II; Gubbels et al. 2011).

In addition to PA intensity, OSRAC-P scales assessing contextual variables primary location (inside vs. outdoor) and time of day (morning vs. afternoon) were used (Brown et al. 2006). In addition, the following social OSRAC-P scales were assessed: group composition (i.e., solitary, one-to-one adult, one-to-one peer, group of children, group of children with adult(s)), initiator of activity (child or adult) and prompts (no prompts, staff member's/peers' positive prompts to increase PA or negative prompts to decrease PA). Children's gender was also recorded. Finally, weather conditions and outdoor temperatures were recorded per observation day.

Statistical Analyses

The scores of both observers on dichotomous variables (e.g., prompt by staff, yes/no) were combined by coding the variable as present (1) when one or both observers rated that variable as present, and coding it as absent (0) when both rated it as absent. For the continuous variables (e.g., activity intensity), the mean of the scores of both observers was calculated.

Cohen's kappa was used to determine the inter-rater reliability (IRR) of the two observers for the observations of the OSRAC-P variables (i.e., activity intensity, type of activity, group composition, indoor and outdoor contexts, initiator of activity, prompts). The mean IRR of the variables assessed was 0.6 (SD = 0.2; $p < .001$) in Finland, and 0.7 (SD = 0.2; $p < .001$) in the Netherlands. The intraclass correlation used to determine cross-country IRR of two observers for the activity intensity variable was 0.7 ($p < .001$).

Differences in the contextual variables, social context and gender between Finnish and Dutch children were examined using chi-square tests. Differences in mean activity intensity between the Finnish and Dutch children were examined using independent sample *t*-tests.

The association between gender (boy vs. girl), primary location (outdoor vs. indoor), time of day (afternoon vs. morning), group composition (non-solitary vs. solitary), initiator of activity (child vs. adult), prompts (no prompt vs. positive or negative prompt), temperature (linear) and weather condition (rain vs. sunny, with a clear sky or cloudy and dry) as independent, and mean PA intensity levels as dependent variables was examined using three-level linear regression, with cross-level interaction (MLR; with measurement level, child level, centre level) to examine differences between countries in these associations. All analyses were performed using SPSS 18.0 and STATA 12. In all analyses, *P*-values < .05 were considered statistically significant.

Results

Temperature and Weather Conditions

The mean outdoor temperature was 12.5ºC during the Finnish observations (range: 2°C-20°C) and 20.5ºC during Dutch observations (range: 14°C-26°C). This difference was significant ($p < .001$). Most of the time weather was cloudy and dry (53%) or sunny with a clear sky (33%); the least prevalent was rain (14%). Differences between the countries in temperature

categories and weather conditions, and in sedentary and MVPA associated with these categories are described in Table 2.

INSERT Table 2 NEAR HERE (Table 2. Differences between countries in percentages of observations observed and levels of sedentary activities and MVPA (N = 187).

Contextual Variables and Activity Levels

According to Chi-Square tests, children's indoor PA levels were mostly sedentary in nature: 79% of total intervals recorded as sedentary, and only 3% coded as MVPA. Outdoors, 53% PA observations were classified as sedentary behaviour, whereas 10% were classified as MVPA. The initiators of the activities were most frequently children (81%). Staff and peers rarely prompted children to increase or decrease their PA: no prompts were recorded in 81% of all observations. Cross-country differences were more pronounced in the social and weather-related variables than in the non-social context variables. The Finnish children spent significantly more time in sedentary-level activities and less time in MVPA compared to the Dutch children in most of the observed categories (see Table 2).

Associations Between Observed Contexts and PA

The results of the multi-level linear regression are presented in Table 3. With respect to the primary location of the observations, children were significantly more active outdoors than indoors (activity intensity 2.65 vs. 2.18, respectively; $p < .001$). In the Netherlands, an outdoor location had a stronger positive influence on children's activity levels than in Finland ($p < .001$), although the influence was significant in both countries. All prompts (both positive and negative) were associated with an increase in the children's PA level in both countries. Non-solitary play was associated with higher activity levels in the Netherlands, whereas in Finland child-initiated play was positively associated with the children's PA levels. Finally, the Finnish children were less active in the afternoon compared to the morning, while the Dutch children's PA levels were unaffected by time of day.

INSERT Table 3 NEAR HERE (Table 3. Children's mean PA intensity levels in Finland and in the Netherlands: three level linear regression.)

Discussion

The present study applied direct observation to compare Finnish and Dutch 3-year-old children's PA behaviour during childcare. In line with previous findings (Oliver, Schofield, and Kolt 2007; Pate et al. 2008; Brown et al. 2009-II; Gubbels et al. 2011), the present sample of children engaged in sedentary activities in 79% of indoor and 53% of outdoor observations. The results further showed significant differences between the countries in children's PA levels: the Finnish children spent significantly more time in sedentary-level activities and less time in MVPA compared to the Dutch children.

Several contextual variables had a differential influence on PA depending on the country. Surprisingly, this mainly concerned non-social influences: time of day and location, in addition to group composition. The significant interaction between country and time of day showed that the Finnish children were less active in the afternoon compared to mornings, while the Dutch children's PA levels were unaffected by time of day. The activities planned during an average childcare day provide little explanation for this difference, as they were very similar in both countries. The only difference worth noting is that in Finland fixed time for indoor and outdoor playing was scheduled, while in the Netherlands afternoons were spent flexibly, playing either indoors or outdoors, depending on, for instance, the weather and opportunities that arose during the day.

In the present study, temperature and weather conditions varied significantly between the two countries. However, we found no significant association between the temperature or weather variables and children's PA behaviour, and the absence of significant interactions between country and these variables indicates that these variables did not explain the differences in PA levels between the two countries. In line with this, Finn, Johannsen, and

Specker (2002) found no seasonal variations in children's PA levels. Baranowski et al. (1993) indicated in their observational study that differences in children's PA were more related to time spent outdoors than to season or weather conditions. To date few seasonal studies have been conducted among preschool-aged children, and their findings have been conflicting (Carson and Spence 2010).

Consistent with previous findings (Pate et al. 2004; Boldeman et al. 2006; Hinkley et al. 2008; Brown et al. 2009-II), the present sample of children was physically more active outdoors than indoors. Outdoor location had a stronger positive influence on PA in the Dutch than Finnish children. Outdoor play in Dutch childcare centres is mainly unstructured, while in Finland it often involves teacher-arranged and teacher-initiated activities such as hiking. In general, children tend to be less active the more staff members there are present or involved with children's play (Cardon et al. 2008; Brown et al. 2009-II; Gubbels et al. 2011). Also in the present study, children were more sedentary when staff members were involved in children's activities, or when the initiator of the play was an adult. Perhaps a more unstructured and flexible approach is beneficial for raising children's PA levels. A Belgian study reported significant increases in children's objectively measured PA intensity during preschool recess and times of unstructured free plays that were taken as an opportunity to be physically active (Verbestel et al. 2011).

It is a matter for concern that the majority of the observations did not include any oral prompting by staff or peers, despite the fact that positive prompts were positively associated with time spent in MVPA. Other studies have confirmed that positive prompts by staff (Brown et al. 2009-I) and peers (Gubbels et al. 2011) have positive associations with children's PA intensity.

The differences between the two countries in children's PA levels were pronounced, although the differences in the social context, such as group sizes and numbers of children

and staff members in the current childcare centres, were not. However, one notable difference between the countries was revealed in the children's typical childcare attendance. If children attend childcare once or twice per week, as is typical in the Netherlands (European Commission's Expert Group on Gender and Employment Issues [EGGE] 2009), this factor alone may positively influence their level of PA. For Finnish children, who often attend childcare five days a week (OECD Family database 2008), childcare is part of their normal daily routine and may not exert any particular influence on their PA. Another explanation for the cross-country difference may be found in group membership: Finnish 3-year-olds were grouped with 4- to 5-year-old children, whereas Dutch 3-year-old children were often grouped with 2-year-olds. The Finnish observers may have unintentionally underrated the 3-year-olds' behaviour when this was observed against the backdrop of the older, more skilled children present, while in the Netherlands the opposite may have occurred: the observers may have overrated the PA of the Dutch 3-year-olds by unwittingly comparing them with the 2-year-olds. The sufficiently high cross-country IRR contradicts this explanation, though. A final explanation might lie in differences in the physical childcare environment in the two countries, which was not taken into account in the study. The physical environment has previously been shown to significantly influence the activity levels of children in childcare (e.g., Cosco et al. 2010; Gubbels, Van Kann, and Jansen 2012).

A strength of this study is that PA levels were directly observed using the OSRAC-P method in two European countries. Observations were made in a total of 23 childcare centres indoors and outdoors, and during both mornings and afternoons, thereby covering regular childcare attendance times in both Finland and the Netherlands. The childcare daily schedules and outdoor times in both countries were very similar, and no major differences were observed in programmes. The benefit of the observation format was that it recorded not only the intensity of activity, but also *where*, *how* and *in what kind of interaction* the activity was

being engaged. Moreover, the OSRAC-P has been shown to be a valid and reliable tool for measuring PA among preschool-aged children (Brown et al. 2006; Trost 2007; Pate, O´Neill, and Mitchell 2010).

This study has limitations that should be noted. The generalizability of the findings could be limited by the fact that in both countries all the participating childcare centres and children were located in the same city, though, the samples represented the general population structure. In Finland the number of observations was higher than in the Netherlands, however, comparisons were made between mean values, therefore it was possible to include all existing Finnish observations to provide more accurate data without affecting the final results. Furthermore, the direct observation method is based on subjective assessments. Indeed, the observers in the two countries were not the same, which might have influenced the findings, possibly explaining the systematically higher PA levels found in the Dutch compared to Finnish children. However, the interobserver reliabilities in both countries, as well as cross-country indicated appropriate levels of agreement.

Conclusion

In light of the growing concern about children's PA behaviour, this study indicated that interventions at the childcare level are needed to increase the PA levels of both Finnish and Dutch 3-year-old preschool children. The findings emphasized that the childcare setting itself may play an important part in promoting positive patterns of health behaviour during early childhood. Interventions should focus on increasing children's outdoor time, free play, positive prompting and encouragement by staff members. A better understanding of the interactions between and within different contextual factors in children's behaviours should help to identify ways of promoting participation in PA during childcare attendance.

Summary Bullets

- The present sample of children engaged in sedentary activities in 79% of indoor and

53% of outdoor observations.

- Children were more sedentary when staff members were involved in children's activities, or when the initiator of the play was an adult.
- The majority of the observations did not include any oral prompting by staff or peers, despite the fact that positive prompts were positively associated with time spent in MVPA.
- The Finnish children spent significantly more time in sedentary-level activities and less time in MVPA compared to the Dutch children.
- The present findings indicate that better understanding of the contextual factors and interactions in children's PA behaviours across the two countries could help in planning childcare interventions to increase the PA levels of preschool children.

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Conflict of interest

The Authors state that they have no conflicts of interest.

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