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Directly Observed Physical Activity among 3-Year-Olds in Finnish Childcare
Abstract

The main purpose of the study was to determine 3-year-olds’ physical activity (PA) levels and how these vary across season, gender, time of day, location, and the physical and social environment in childcare settings in Finland. A modified version of the Observational System for Recording Physical Activity in Children-Preschool (OSRAC-P) was used to measure PA levels and contextual variables (e.g., group composition, prompts) of children attending childcare centres. In total, 81 children (42 boys and 39 girls) were observed in autumn and in winter. Three-level linear regression analyses were used to assess differences between the seasons in the association between the context variables and PA.

During the observations, the present sample of children was mostly sedentary in nature, engaging in MVPA in only 2% of all observations. The results further showed a significant difference between season and the children’s PA levels: in winter, the children spent significantly more time in sedentary-level activities and less time in MVPA than in autumn.

The present sample of children was physically more active outdoors than indoors. Boys showed significantly higher PA levels than girls. The majority of the observations did not include any oral prompting. We conclude that childcare centres offer good opportunities to increase children’s PA. Interventions should focus on enhancing children’s outdoor time, free play, and positive prompting and encouragement by teachers.

Key words: childcare; direct observation; physical activity; preschool children

Résumé

L’objectif principal de l’étude était de déterminer les niveaux d’activité physique (PA) chez les enfants de trois ans, et la façon dont ils varient selon la saison, le sexe, le moment de la journée, le lieu et l’environnement physique et social dans les garderies en Finlande. Une version modifiée de l’OSRAC-P (Observational System for Recording Physical Activity in Children-Preschool) a été utilisée pour mesurer les niveaux d’activité physique et les variables contextuelles (notamment la composition du groupe, les incitations) des enfants fréquentant les garderies. Un total de 81 enfants (42 garçons et 39 filles) ont été observés en automne et en hiver. Des analyses de régression ont permis d’étudier les variables liées à l’activité physique des enfants à différentes saisons. Au cours des observations, l’échantillon des enfants était principalement de nature sédentaire avec une activité physique d’intensité modérée à élevée (MVPA) dans seulement 2% des observations. Les résultats ont révélé une différence significative entre la saison et les niveaux d’activité physique. En hiver, les enfants ont passé sensiblement plus de temps dans des activités de niveau sédentaire et moins de temps dans des activités d’intensité modérée à élevée qu’en automne. L’échantillon des enfants était physiquement plus actif à l’extérieur qu’à l’intérieur. Les garçons ont manifesté des niveaux d’activité nettement plus élevés que les filles. La majorité des observations ne présentait aucune incitation verbale. Nous en concluons que les
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Garderies offrent de bonnes possibilités pour augmenter l’activité physique des enfants. Les interventions devraient se concentrer sur l’augmentation du temps passé à l’extérieur et consacré aux jeux libres ainsi que sur les incitations et les encouragements positifs de la part du personnel chargé de la petite enfance.

Mots-clés : garderie, observation directe, activité physique, enfants d’âge préscolaire

Resumen

El objetivo de este estudio fue determinar la intensidad de la actividad física de niños finlandeses de tres años en la guardería en tiempos diferentes del día y del año. Además, fue investigada la relación del sexo, de entornos diferentes y de factores sociales y físicos con la actividad física de los niños. Durante el día en la guardería, los niveles de actividad física y las variables contextuales (como la composición del grupo o incentivación) fueron determinados con un método de observación modificado de OSRAC-P (Observational System for Recording Physical Activity in Children – Preschool Version). En total 81 niños (42 chicos, 39 chicas) participaron en las observaciones en el otoño e invierno. La relación de las variables elegidas con la actividad física de los niños entre las estaciones del año fue investigada con el análisis de regresión. La mayoría de la actividad física de los niños fue de intensidad muy ligera; solo el dos por ciento del tiempo fue como mínimo semipesada. Los resultados evidenciaron que en el invierno los niños tuvieron más actividad física muy ligera y menos actividad como mínimo semipesada que en el otoño. Los niños que participaron en la investigación fueron físicamente más activos fuera que dentro de la guardería. La actividad física de los chicos fue más cargante que la de las chicas. La mayoría de las observaciones no incluyeron persuasión relacionada con la actividad física. En base a los resultados podemos concluir que las guarderías ofrecen buenas oportunidades para aumentar la actividad física de los niños. Las intervenciones tendrían que centrarse en el aumento de actividades al aire libre, de juego espontáneo y de consejos positivos e incentivación por educadores preescolares.

Palabras clave: guardería infantil; observación directa; actividad física; niños de la edad preescolar
Behavioural habits, such as physical activity (PA) and sedentary behaviours (SB), are formed in early childhood (Janz et al. 2005; Timmons et al. 2007; Ward et al. 2010). PA in preschool children (age 3–5 years) may be described as “play”, and occurs at various levels of intensity (Timmons et al. 2007). Play, like learning, is a natural component of a child’s everyday life and assists the child to make sense of his or her world (Pramling Samuelsson & Asplund Carlsson 2008). Further, PA has been found to have a positive effect on children’s physical, cognitive, emotional and social development (Timmons et al. 2007, Ward 2010). An active lifestyle in childhood serves as the foundation for an active lifestyle later in life (Janz et al. 2005; Singh et al. 2008). Therefore, the enhancement of PA and reduction in SB in early childhood are important from a public health perspective (Strong et al. 2005; Tremblay et al. 2011).

Various studies have shown that the childcare centres children attend influence their levels of PA (Bower et al. 2008; Finn et al. 2002; Pate et al. 2004; Pate et al. 2008; Ward 2010). Typically, very low PA levels and very high SB have been reported among preschool children during attendance at childcare settings (Brown et al. 2009; Gubbels et al. 2011; Oliver et al. 2007; Pate et al. 2008; Reilly 2010). Features of the physical environment of the childcare setting, such as the ground surface, playground markings, open space, and the availability of play equipment, have previously been linked to higher levels of PA (Bower et al. 2008; Cardon et al. 2008; Cosco et al. 2010; Hannon & Brown 2008; Gubbels et al. 2012; Nicaise et al. 2011; Ridgers et al. 2007). Children have been shown to be more active when they spend more time outdoors (Boldeman et al. 2006; Finn et al. 2002; Hinkley, Crawford et al. 2008; Pate et al. 2004) and when recess is shorter in duration (Cardon et al. 2008; Dowda et al. 2004). Furthermore, children’s PA has been observed to increase in warm seasons and decrease in colder seasons (Carson & Spence 2010; Fisher et al. 2005; Poest et al. 1989). Factors related to the social environment, such as positive prompts by teachers or peers, have also been associated with increased PA (Brown et al. 2009; Gubbels et al. 2011). Despite this positive association, Brown et al. (2009) reported that teachers and peers rarely prompt children to raise their level of PA. Finally, child-initiated instead of teacher-initiated play (Brown et al., 2009), smaller group size (Brown et al. 2009; Cardon et al. 2008) and higher educational level of teachers (Dowda et al. 2004) have been linked to increased levels of children’s PA.

Although studies assessing PA and SB in preschool children have increased over the past decade (Bornstein et al. 2011), observational research yielding contextual information to promote PA is still lacking, especially in Europe (Bower et al. 2008; Brown et al. 2009; Gubbels et al. 2011). Additionally, only a small set of studies exists where preschool children’s PA levels have been determined during different seasons (Carson & Spence 2010). An improved understanding of the determinants of PA in the childcare setting could support the development of interventions aimed at promoting PA levels of younger preschool children throughout the year. Therefore, the purpose of this study was to
examine Finnish 3-year-olds’ PA levels and SB during attendance at childcare, and their seasonal variation, related
demographic and biological characteristics, and physical and social contexts.

Methods

Sample and data collection

Participants were recruited in a city in central Finland. Principals of childcare centres were provided with
information regarding the study at a regional administrative meeting. A total of 14 childcare centres volunteered their
involvement in the study. The childcare centres were situated in different environmental and socioeconomic
neighbourhoods in the city. All the families of the 3-year-old children (year of birth 2007) attending the participating
childcare centres were invited to join the study. The parents of 102 (57%) of the 179 families provided informed
consent.

The children’s PA data were collected in two phases using a repeated-measure design. The first data collection
phase was between August and October 2010 (autumn), and the second between January and February 2011 (winter). A
total of 96 children (48 boys and 48 girls) participated in the autumn data collection and 94 children (50 boys and 44
girls) in the corresponding winter collection. Data from both collection phases were gathered for 81 children (42 boys
and 39 girls).

Instruments

A 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, type of activity, location, contexts,
prompts and interactions. Two trained researchers observed the children’s PA and contextual factors using a procedure
in which 15 seconds of observation were followed by 30 seconds of recorded observation. The observation sheets were
completed manually and the procedure was repeated eight times over six minutes for each child. Each child was
observed at least twice per day, in the morning (between 8 a.m. and 12 p.m.) and in the afternoon (between 2 p.m. and 5
p.m.), including indoor and outdoor observations, during three consecutive days (from Wednesday to Friday). Children
were randomly selected for observation and were not observed during the scheduled meal or rest times. The data
collection was conducted without disturbing the daily routines of the childcare centres and without undue influence on
the children or teachers.

Children’s 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, and 5 = fast movements) and
reflected the highest intensity level reached by the child during each 15-second observation interval. For the purpose of
this study and further comparison, activity levels 1–2 were regarded as SB, activity level 3 as light PA and levels 4–5 as
moderate-to-vigorous physical activity (MVPA) (Bower et al. 2008; Brown et al. 2009; Gubbels et al. 2011; Nicaise et al. 2011; Pate et al. 2008).

OSRAC-P scales assessing contextual variables such as time of day and primary location were used. In addition, the following social OSRAC-P scales were assessed: group composition, initiator of activity and prompts. In the present study, Brown and colleagues’ (2006) original 18 activity-type codes (e.g., sitting, standing, running) were complemented with four typical Finnish types of activity (i.e., balancing, sliding, skiing, ice-skating) and used as descriptive categories. Finally, the indoor contexts were complemented with i.e., toys (e.g., playing with cars, dolls), household chores (e.g., baking, cleaning), rage (crying scene), pool activities and small-group variables, and the outdoor contexts with i.e., rage, forest, sport field and transition variables.

Background information

Weather conditions and outdoor temperatures were recorded per observation day. Body weight and height of the children were measured between the two observation phases at the time of the PA data collection, and body mass index (BMI: kg/m\(^2\)) was calculated for each child. The BMI results indicated, in accordance with the International Obesity Task Force BMI definition, that nine children (12%) during the autumn assessments and six children (8%) during the winter assessments were overweight. All the other children were in the normal BMI range (Cole et al. 2000).

Background information on children’s attendance times was recorded in diaries kept by the children’s parents. Outdoor times were recorded by the researchers during the observation days. In general, Finnish childcare centre hours are from 6.30 a.m. to 5 p.m. Meal (i.e., breakfast at 8 a.m., lunch 11.30 a.m. and snacks at 2 p.m.) and rest times give a rhythm to the childcare centre’s daily schedule. Typically, a childcare day includes two outdoor recess periods, one in the morning and one in the afternoon. The ethics committee of the local university, and the city’s social affairs and health officer approved the study.

Statistical analyses

The observers’ scores for the dichotomous variables (e.g., prompt by teacher, 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 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 during the observations of the OSRAC-P variables (i.e., activity intensity, activity types, group composition, contexts, initiator of activity, prompts). Mean IRR of the variables assessed was .70 (SD = 0.2; p < .001).

Various background characteristics were explored using descriptive statistics. General Linear Models (GLM) for repeated measures (MANOVA) were used to analyse differences between autumn and winter. Differences in the
observed contextual variables between observations and seasons were examined using Chi-square tests. The association between the mean level of PA intensity as the dependent variable and independent variables such as, gender (girl vs. boy), BMI (linear), primary location (outdoor vs. indoor), time of day (afternoon vs. morning), group composition (solitary vs. non-solitary), initiator of activity (adult vs. child), prompts (no prompts vs. negative or positive prompts), temperature (linear) and weather condition (rain vs. sunny, with clear sky or cloudy but dry), was examined using three-level linear regression. All analyses were performed using SPSS 18.0 and STATA 12. In all analyses, P-values < .05 were considered statistically significant.

Results

Childcare and outdoor times, temperature and weather conditions

During the data collection periods, the participants attended their childcare settings for approximately 7.7 hours/day in the autumn and 7.5 h/day in the winter. A total of 1 978 observations and 15 824 single observation intervals (1 978 x 8 times) were analysed; 966 observations (an average 5.96 (SD = 2.49) observations/child) were observed in the autumn and 1012 observations (an average 6.25 (SD = 2.96) observations/child) in the winter. The results indicated a significant difference between autumn and winter in mean outdoor time during childcare attendance (minutes per day 179 vs. 120, respectively; p = .002). The mean outdoor temperature was 11.6ºC during the autumn observations (range: -2°C to 20°C) and -9.9°C during the winter observations (range: -30°C to 2°C). The differences between the autumn and winter mean temperatures were significant (p < .001). Most of the time, the weather was cloudy but dry (49% autumn; 51% winter) or sunny with a clear sky (27% autumn; 36% winter); the least prevalent weather type was precipitation of rain (23% autumn) or snow (13% winter). The differences between the seasons in the percentages of intervals observed in the different temperature categories and weather conditions, and in engagement in SB, light PA and MVPA associated with these categories, are described in Table 1.

Prevalence of contextual variables and physical activity levels

During the observations, the children’s PA levels were mostly sedentary: 69% (indoors 86%; outdoors 46%) of total intervals were recorded as SB, and only 2% (indoors 1%; outdoors 2%) as MVPA. The initiators of activities were most frequently children (77%), and the children’s play was most frequently non-solitary (74%). Teachers or peers rarely prompted children to increase or decrease their PA: no prompts were recorded in 92% of all observations. In prevalence (%) of observations, significant seasonal differences were found in all the variables, except gender and time of day (see Table 1).

In winter, the children engaged in MVPA outdoors significantly less in than in autumn. Seasonal variations were observed in boys’ but not in girls’ PA levels. The percentages of PA in the categories SB, light and MVPA
observed during autumn and winter are shown in Table 1.

**Activity types, indoor and outdoor contexts and physical activity levels**

In both seasons, the three most frequently observed physical activity types were: 1) *sitting/squatting/kneeling*, 2) *walking/marching* and 3) *standing*. In the autumn, the most frequently observed *indoor activity variables* were 1) *toys* (25%), 2) *other* (25%; e.g., being in some other indoor context or engaging in some activity other than the option listed, and 3) *sociodramatic* (8%), whereas in the winter these were 1) *toys* (36%), 2) *other* (26%), 3) *art* (9%) and *transition* (9%; both lining up or moving from one activity context to another area). When examined more closely for seasonal variations, several differences in the activity variables were found; in the autumn, the children were engaged significantly more frequently in the variables *large blocks* (*p* = .007), *manipulative* (*p* = .017), *music* (*p* = .035), *snacks* (*p* < .001) and *self-care* (*p* = .013) than in the winter, during which the children more often played with *toys* (*p* < .001) and engaged in *art* activities (*p* = .009) than in the autumn. The three most frequently observed *outdoor context* variables were 1) *open space* (30%), 2) *sandbox* (20%) and 3) *fixed equipment* (16%) in the autumn, and 1) *open space* (26%), 2) *portable equipment* (14%), and 3) *fixed equipment* (13%) in the winter. In the autumn, the children more frequently played in an *open outdoor area* (*p* = .016), touched, ride or pushed *wheeled toys* (*p* < .001), used *sandbox materials* or played in the sandbox (*p* < .001), played using *sociodramatic props* (*p* = .003), and engaged in *other activities* (*p* < .001) than in the winter. Finally, during the winter, the children more often made use of *portable equipment* (other than balls or wheeled toys) brought into the playground (*p* < .001) than in the autumn. The most common activity types, physical and social environments at the different levels of PA are shown in Table 2.

**Associations between observed contexts and physical activity in autumn and in winter**

Gender was significantly associated with children’s activity levels in both seasons. Boys showed significantly higher mean PA intensity levels than girls (activity intensity 2.42 vs. 2.24, respectively *p* < .001). When controlled for other variables (i.e., gender, location, time of day, group composition, initiator of activity, prompts and weather conditions), BMI was not associated with children’s activity levels. An outdoor location associated positively with children’s activity levels in both seasons (*p* < .001). In the autumn, children were less active in the afternoon compared to morning, while in the winter, the children’s PA levels were unaffected by time of day. Similarly, child-initiated play was positively associated with PA in the autumn but not in the winter. Solitary play had a stronger association with the higher activity levels in the autumn, although the influence was significant in both seasons. All prompts (both positive and negative) were associated with an increase in PA in both seasons in comparison to observations where no prompts were observed. Finally, temperature associated with children’s PA levels in the winter but not autumn, whereas rain had no influence on PA during either season. (See Table 3.)
Discussion

Physical activity levels in childcare

In line with earlier studies (Brown et al. 2009; Pate et al. 2008), the present study found that, for most of the childcare day, the children’s PA levels and their PA types were sedentary in nature, with MVPA accounting for only 2% of all observations. The results further showed that, in the winter, the children spent significantly more time in sedentary-level activities than in the autumn. The seasonal variation in PA levels was more pronounced during the outdoor observations than indoor observations. The association on PA levels of the significant interaction between time of day and season showed that in the autumn the present sample of children were more physically active in the morning than afternoon, while in the winter their PA levels were unaffected by time of day.

Indoor environment

The most common activity types – sitting, standing, walking – and the indoor context were primarily sedentary in nature: 86% of indoor activities were observed as SB. This level of sedentariness is similar to that reported by Brown et al. (2009), and considerably more than found by Gubbels et al. (2011) in their Dutch study. Children were sedentary when engaged in art or in large group activities organized or led by a teacher. Although several activity types and contexts were associated with higher PA levels, children were rarely observed indoors in activities such as running, climbing, pulling or pushing. One potential explanation relate to the childcare facilities and behavioural rules. For safety reasons, running or climbing indoors is likely to be prohibited, while indoor spaces are often small rooms with narrow corridors. Nevertheless, a place in hallways and corridors for children’s play and physical activities is commonly found. To enable children to move around freely and engage in physically active play indoors, childcare centres need to optimize their indoor space specifically for these purposes (Gubbels et al. 2012). Although Finnish childcare centres mostly have a large room or hall with gross motor equipment for physical activity and play, children, in groups, typically use them only once a week, during a structured physical education (PE) lesson, as laid down in the recommendations for physical activity in early childhood education (2005). Moreover, in its current format, PE plays a very small role in meeting the PA requirements of pre-schoolers (Van Cauwenberghe et al. 2012).

Outdoor environment

In line with previous studies (Boldeman et al. 2006; Brown et al. 2009; Hinkley et al. 2008; Pate et al. 2004), the present sample of children was physically more active outdoors than indoors. Outdoor locations had a strong positive association with higher PA levels in both seasons. However, even during outdoor play, nearly half of the children’s activities were recorded as SB, and only 2% as MVPA, which is much lower than the 17% found by Brown et al. (2009), 21% by Gubbels et al. (2011), and 12% and 21% by Nicaise et al. (2011). Outdoor engagement at the
sedentary level included children playing in a sandbox and/or playing with sandbox materials and activities with
sociodramatic play props. Touching, riding, or pushing wheeled toys such as tricycles, scooters and wagons showed
higher levels of PA. However, wheeled toys were used less frequently than fixed equipment such as the sandbox. This
might be explained by the fact that the sandbox is available at all times, while scooters and wagons are held in storage.
Children have to fetch these items and return them after use. Gubbels et al. (2012) showed that children were
significantly more active when jumping equipment was continuously present, and when a fixed track was marked on the
playground. Similarly, Nicaise et al. (2011) concluded that activity-genic portable equipment and riding vehicles
appeared to foster MVPA. A playground redesign, which utilizes multicolour playground markings and physical
structures, may be a suitable stimulus for increasing children’s recess PA levels (Ridgers et al. 2007). Scheduling
recesses to minimize the number of children sharing playground or play equipment (Cardon et al. 2008), and minimize
the time spent in sedentary locations, such as the sandbox (Cosco et al. 2010), may also help to increase children’s
engagement in MVPA (Nicaise et al. 2011). In this study, in the autumn, the use of wheeled toys was more pronounced
than in winter. In winter, snow, ice and cold weather do not present the same possibilities for their as in autumn. In the
winter, children were more involved with portable equipment such as sleds. Finnish childcare centres have the
possibility to utilize the natural environment, such as the forest, in their daily programme. During wintertime, children
often play with snow or mounds of snow, and push and pull sleds. Furthermore, it is not rare to encounter young
Finnish children in childcare skating or skiing. However, at the age of three, skiing and skating involve lower levels of
PA, such as balancing and learning to slide, than vigorous PA.

Weather conditions

In the present study, the differences between the autumn and winter mean temperatures were significant.
Temperature was significantly associated with children PA in winter, but not in autumn. Baranowski and colleagues
(1993) reported that differences in children’s PA levels were related more to time spent outdoors than to season or
weather conditions. In this study, significant seasonal variations in mean temperatures could explain why the average
outdoor time during childcare attendance in winter (116 min) was significantly less than in autumn (178 min). In cold
weather, -20°C or colder, children generally are not directed to play outdoors, or outdoor recesses are much shorter on
such days. Shorter outdoor activity times in winter may also explain children’s lower engagement in MVPA. However,
in the autumn, engagement in sedentary level-activities outdoors was higher than in the winter. Although temperature
was associated with PA, no association emerged between rain and children’s PA levels.

Social contexts
The majority of the observations did not include any oral prompting. In line with previous observational studies (Brown et al. 2009; Gubbels et al. 2011), prompts (both negative and positive) positively associated with children’s PA intensity in both seasons. Moreover, our results, like those of Brown et al. (2009), showed that even if teachers were present, they very rarely, if ever, implemented teacher-arranged activities and games to enhance children’s PA or encouraged children to engage in PA. Teachers may assume that children are naturally very active and that they engage in sufficient activity, and therefore lay less emphasis on the importance for children of an active lifestyle (Pate et al. 2008). In general, children tended to be less physically active when more staff members were present or were involved in children’s play (Brown et al. 2009; Cardon et al. 2008; Gubbels et al. 2011). Similarly, in this study, adult-initiated play had a negative association with the children’s PA behaviour in the autumn, although not in the winter. In the winter, the children showed significantly more SB and engaged less frequently in MVPA during child-initiated activities, whereas adult-initiated play showed no seasonal variation in PA levels. Furthermore, in both seasons, children’s solitary play was associated with increased PA levels, as also noted by Brown et al. (2009) and Nicaise et al. (2011). In contrast, in a Dutch study, non-solitary play was associated with higher activity levels (Gubbels et al. 2011).

Gender variations

This study indicated a significant gender difference in PA levels, with boys showing significantly higher levels than girls. In line with the present findings, boys have generally been reported to be more active than girls (Hinkley et al. 2008; Oliver et al. 2007; Pate et al. 2004, 2008). Currently, there is no definitive explanation why girls participate less in physical activity than boys (Pate et al. 2004). Observational studies have demonstrated that boys are more interested in playing rougher games, engage in more risk-taking behaviour and play in larger groups and in more open settings than girls (Pate et al. 2004). Also boys’ activities may be more triggered by harder ground surfaces, which are mainly used for sports-related, competitive activities (Cardon et al. 2008). One potential explanation may found in teachers’ attitudes, which may affect children’s PA behaviour. It is possible that boys are regularly encouraged to engage in more physically active play and games, whereas girls are exposed to stationary activities and expected to behave in a calmer manner (Pellegrini & Smith 1998). Sandberg & Pramling Samuelsson (2005) found that despite emphasising the importance of creating inspiring environments for play and outdoor play, preschool teachers’ participation in play differed by gender. For instance, male teachers had more play willingness and participated more in physically active play, whereas female teachers tended to prioritise calm play, which, for the most part, they also experienced in their own childhood (Sandberg & Pramling Samuelsson 2005). Cardon et al. (2008) also found that girls preferred to stay close to their supervising teachers, who commonly supervise sitting down or standing still, and that this might be one
cause of the lower levels of PA in girls. It remains unclear whether the gender difference in PA is biologically based or environmentally determined, or a combination of both (Timmons et al. 2007).

Strengths and limitations

The assessment of young children’s PA is challenging, primarily because their behaviour is spontaneous, intermittent and sporadic. The benefit of the observation format used in the present study was that it recorded not only the intensity of activity, but also where, how and in what kind of interaction the activity was being performed. Moreover, the OSRAC-P has been shown to be a valid and reliable tool for measuring physical activity among preschool-aged children (Brown et al. 2006; Pate et al. 2010; Trost 2007). A major strength of this study was the use of a repeated-measure design, where the same 3-year-old children were measured using direct observation during two distinct seasons. However, one should be cautious when comparing PA levels over short time periods (e.g., 3–6 months), as children’s normal growth and maturation may influence their physical abilities and motor skills in relation to their engagement in physically active play (Fisher et al. 2005). It should also be noted that the direct observations subjective, although, the interobserver reliabilities indicated substantial agreement and a validated observation protocol was deployed (Brown et al. 2006). Furthermore, the generalizability of the findings could be limited by the fact that all the participating childcare centres and children were located in the same city. Finally, the children’s behaviour could have been influenced by other factors that were not taken into account in this study. For instance, fundamental motor skills (Stodden et al. 2008) and the educational level of teachers (Dowda et al. 2004) have been found to have an influence on children’s PA behaviour, but these were not taken into account in this study. Therefore, the interaction between motor skills and/or educational levels of teachers and children’s PA behaviour in different contexts merits further examination.

Conclusion

The present findings have important implications for the development of PA interventions aimed at increasing preschool children’s PA behaviour in the childcare centre setting. Our findings yield comprehensive behavioural and contextual information on a sample of 3-year-old preschool children. A notable proportion of the activities observed as sedentary in the sample may encourage teachers to work towards reducing the time children spend in SB and increasing time and opportunity for engaging in the higher levels of PA. Childcare centres offer good opportunities to increase children’s PA and also support their learning. Childcare organizations in collaboration with families can use the findings of this study as a basis on which to promote children’s PA. Interventions should focus on enhancing children’s outdoor time, free play and positive prompting and encouragement by teachers. To enhance children’s all-year-round PA, such changes should, in particular, target wintertime, given its consistently lower activity levels.

Conflict of interest
The Authors state that they have no conflicts of interest.
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