MASTEROPPGAVE

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“Oh oobe doo, I wanna be like you”

Associations between preschool teachers’- and children’s activity level

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Contents

Abstract

Background: Physical activity is generally considered crucial as it might prevent serious diseases and ailments. As lifestyle habits are likely to track from an early age to adulthood, it is important to establish physical activity as a habit at an early age. 90% of Norwegian children aged 1–5 are enrolled in preschools, and preschool staff can play an important role in children's activity levels. This study's purpose was to identify whether there are any associations between preschool staff's characteristics (initiative, participation, attitudes and activity levels), and children's activity in preschool.

Methods: 289 children aged of 4–6 and 72 preschool staff from 13 randomly selected preschools in a region of Nord-Troendelag, Norway, were enrolled in the study. All participants wore an Actigraph accelerometer for seven consecutive days. Observation was conducted in one preschool to identify whether children's activity levels increase after preschool staff's activity or vice versa. Lastly, questionnaires were used to identify correlates between preschool staff's attitudes and initiative in relation to children's physical activity, in addition to their participation in children's physical activity. A multilevel analysis, Linear Mixed Model (LMM), was used to examine associations between preschool staff and children's activity levels.

Results: There was a significant association between preschool staff's average activity levels during preschool hours and children's corresponding activity levels during preschool hour ($t = 2.57$; $p = 0.021$). There were, however, no significant associations found between the attitudes- ($t = -0.44$; $p = 0.666$), initiative- ($t = -0.14$; $p = 0.890$) and participation variable among preschool staff ($t = 0.66$; $p = 0.522$) and children's activity levels during preschool hours.

Conclusion: The findings demonstrate that there is a significant association between preschool staff's aggregated activity levels and 4–6-year-olds' individual activity levels. Taken together with the observational findings, which indicate that children have increased activity levels when preschool staff participate and play along with them as equals, the present study demonstrates the importance of preschool employees being physically active, as they might have the power to affect children's activity levels based on actions and mediated expectations.

Introduction

Lack of physical activity is identified as carrying a considerable risk of several diseases, such as stroke, diabetes and cancer, among others (WHO, 2010), and lifestyles characterized by obesity and physical inactivity have a tendency to last from early childhood to adulthood (Oliver, Schofield, & Kolt, 2007; Raitakari, Juonala, & Viikari, 2005). Statistics from 2010 show that globally, approximately 81% of 11–17-year-olds and 23% of adults aged 18 and over were insufficiently physically active and did not meet the global health recommendations of minimum 60 minutes daily MVPA for children and adolescents (5–17 years old), and minimum 150 minutes in moderate- or 75 minutes in high intensity for adults per week (WHO, 2010). Research indicates that children and adolescents are less physically active (Dumith, Gigante, Domingues, & Kohl, 2011) and spend more time in sedentary activities than their predecessors (Ekornrud, 2012; Vaage, 2012). Similar results were found in a survey study regarding 6-, 9- and 15-year-olds' physical activity in Norway, demonstrating that 9- and 15-year-olds were more sedentary than in a previous population study from 2005–2006, while most of the 6-year-olds met the recommendations of 60 minutes daily moderate to vigorous physical activity (MVPA) (Kolle, Stokke, Hansen, & Andersen, 2012). Additionally, Andersen et al. (2017) found that most of their participants (Norwegian preschoolers aged 3–4) met the health recommendations of daily physical activity. In contrast, several international studies show that preschoolers are not as active as initially assumed (Hesketh & van Sluijs, 2016; Hinkley, Salmon, Crawford, Okely, & Hesketh, 2016; Russell R Pate et al., 2013), and point to the time children spend inside as an unfortunate factor (W. H. Brown et al., 2009a). As a matter of fact, longitudinal studies report that sedentary time already starts to increase from age 3–5 (Basterfield et al., 2011) and age 7–9 (Taylor et al., 2009). Moreover, a cross-sectional study conducted by Cooper et al. (2015) found that the total amount of physical activity decreases by an average of 4.2% (3.7% for boys and 4.6% for girls) each year from the age of 5 to 18.

It is disquieting that children are less physically active than their predecessors and this raises concerns for several reasons. Physical activity has been reported to have an impact on children's and adolescents' growth and development, especially fatty tissue, tendons, ligaments and cartilage (Meen, 2000), in addition to strengthening skeleton and increasing bone mass (M. Karlsson, 2002; M. K. Karlsson, Nordvist, & Karlsson, 2008; Oliver et al., 2007). As for adults, findings indicate that physical activity contributes to a large extent maintaining the skeleton's strength, which supports the importance of physical activity at a

young age (M. Karlsson, 2002), as lifestyle behaviors might track from preschool age into adulthood (van Rossem et al., 2012).

Several studies also suggest that physical activity might have a positive effect on self-esteem (Buss, Block, & Block, 1980; Garcia, Pender, Antonakos, & Ronis, 1998; Kirkcaldy, Shephard, & Siefen, 2002) and lead to less symptoms of anxiety and depression (WHO, 2010). A physically active lifestyle is for this reason well established as a goal in the Norwegian curriculum for physical education (Kunnskapsdepartementet, 2015), emphasizing the importance of inspiring children and adolescents to a lifelong enjoyment of being physically active, as a result of experiencing a sense of mastery and joy (Telama et al., 2005). The Norwegian preschool framework plan also emphasizes physical activity, as promoting positive attitudes and actions is considered crucial for children's perception of physical activity (Utdanningsdirektoratet, 2016).

Adult involvement in play situations and physical activity might thus lead to more recognition for children, especially through interaction and collaboration (Vygotsky, 1978), which are essential for staff to promote physical activity and a healthy lifestyle (Mikkelsen, 2011). In this regard, Goldfield, Harvey, Grattan, and Adamo (2012) claim that physical activity should be prompted as early as possible since children's activity patterns are more easily influenced by role models' attitudes. In addition, the foundation for a physically active lifestyle is formed by bodily experiences at a young age (Sansolios & Mikkelsen, 2011; Telama et al., 2005), in which children should be introduced to how much fun physical activity can be (Sørensen, 2012). Open areas and riding vehicles (Nicaise, Kahan, & Sallis, 2011), in addition to portable equipment and toys have, among others, been identified as key factors for children's physical play, as they provide children opportunities to play while they are in motion (Bower et al., 2008; W. H. Brown et al., 2009a; Dowda et al., 2009; Gubbels et al., 2011). By using focus group interviews in five preschools, Cashmore and Jones (2008) demonstrated in a like manner that preschool staff considered child-directed play as most valuable and were therefore reluctant to interfere.

Preschools are considered as an important arena in which to reach as many children as possible, as Statistics Norway (SSB, 2017) has shown that 90% of Norwegian children aged 1–5 go to a preschool. Additionally, Finn, Johannsen, and Specker (2002) identified preschools as a great determinant of physical activity, given that more than 50% of the average daily activity counts occurred during children's preschool hours. Furthermore, a new study using accelerometery among Norwegian preschool staff, found that preschool staff in

general had a high activity level during work (Lagestad & Kippe, 2016), whereas preschool staff working with older children (4–6 years old) had the highest activity level (Kippe & Lagestad, in press). These findings highlight the fact that preschool is an arena where children can meet and interact with adults who have high activity levels. An appropriate follow-up question is therefore whether or not preschool staff's activity levels during work, affect children's activity levels when they are in preschool.

Nevertheless, the field of research on physical activity in preschools covers survey studies of activity levels and factors contributing to increased physical activity, in which the type of preschool, outdoor areas and socioeconomic inequalities are included (Sallis, Prochaska, & Taylor, 2000). The growing interest in researching preschoolers' activity levels (Biddle & Goudas, 1996; R. R. Pate, Pfeiffer, Trost, Ziegler, & Dowda, 2004; Sallis et al., 2000) seems especially important as some children do not naturally participate in play because it might require a certain social competence (Utdanningsdirektoratet, 2016). In a Danish study of preschoolers' barriers to physical activity, Nielsen and Eiberg (2006) found a correlation between previously satisfying experiences with physical activity, self-esteem and increased welfare in social environments, which is in line with findings conducted by Bower et al. (2008), who found that children had a higher activity level if they attended a preschool with a supportive environment where preschool staff participated in their play and gave positive prompts regarding being physically active. These findings also support the view of Sørensen (2012), who suggests that preschool staff should engage in physical activity with children, whereby physical activity is expressed as fun rather than a duty through verbal instructions. That is, the way preschool staff and adults generally respond to and confirm children's activity is crucial to how children perceive themselves (Utdanningsdirektoratet, 2016).

Nevertheless, findings from a study conducted by Sansolios and Mikkelsen (2011) showed that some preschool staff felt pressured to take all the responsibility for initiating children's health habits, which they did not agree with. On this subject, it may be expedient to point out that researchers that are often referred to (Festinger, 1962; LaPiere, 1934), early claimed that attitudes and actions do not necessarily always correspond. In preschool, this is seen as preschool staff might act in terms of their own preferences in spontaneous reactions, rather than following others' expectations of what to do (Madland, 2013). Copeland, Kendeigh, Saelens, Kalkwarf, and Sherman (2011) demonstrated thus that preschool staff held the key to children's physical activity as they were the ones to decide what opportunities children should have to be physically active, in addition to the degree of involvement or dedication they

should have with the children. Regarding this, Eagly and Chaiken (1993) claim that attitudes are evaluated on the basis of a favor–disfavor relationship. Furthermore, Bower et al. (2008) found during an observation study using the Environment Policy Assessment and Observation (EPAO) instrument, that preschoolers are more likely to reach a higher activity level during activities initiated by preschool staff who participate and possess positive attitudes towards physical activity. Similarly, Mikkelsen (2011) reported that preschool policy and guidelines where play and movement are encouraged, are associated with more children taking part in moderate activity.

Several studies have investigated the effects of adult-structured activities in preschools. (W. H. Brown et al., 2009a; De Marco, Zeisel, & Odom, 2015; Goldfield et al., 2016). In an observation study by De Marco et al. (2015), preschool staff received a sheet with 40 activities appropriate to each age group, in addition to suggestions for changes within each activity. They were also given a two-hour training session emphasizing the importance of physical activity at an early age. Observations were conducted in six different departments at the three preschools before and after the intervention, and showed increased activity levels. Significantly, children's MVPA increased in four departments, light activity in three, and a reduction in sedentary activity was observed in five departments (De Marco et al., 2015), which is in line with Biddle and Goudas's (1996) findings showing that adult encouragement might increase children's physical activity through perceived sport competence.

William H Brown, Googe, McIver, and Rathel (2009b), who also report increased physical activity in their intervention regarding the effects of adult-structured activities, claim that, in particular, engagement in terms of encouragement, praise and recognition may affect children's activity levels in a positive direction. This is supported by Gubbels et al. (2011) and W. H. Brown et al. (2009a), who argue that positive encouragement and involvement by preschool staff is associated with higher activity levels in children. Preschool staff's individual attitudes and behavior may therefore play an essential role in promoting children's physical activity (Mikkelsen, 2011). However, as expressed attitudes do not always correspond to behavior, De Marco et al. (2015) emphasize the importance of providing preschool staff necessary training and knowledge in order to ensure that children's health and development are taken care of with the adequate provision of physical activity.

Physical activity has been assessed using various techniques, which might, according to Oliver et al. (2007) and Westerterp (2009) be divided into three main categories: (1) objective measures of physical activity, including pedometers, accelerometery, doubly labeled

water (DLW), calorimetry, heart rate and GPS; (2) subjective measures of physical activity, including questionnaires, diaries and interviews; and (3) observation. Self-reports in particular, were widely used before validity and reliability issues were addressed (Shephard, 2003). However, among others, Sirard and Pate (2001) and Bailey et al. (1995) suggested that direct observation should be used as a gold standard when researching physical activity, as it might capture duration, intensity, frequency and context. In contrast, Troiano, Gabriel, Welk, Owen, and Sternfeld (2012) argue that techniques should be selected on the basis of population characteristics and purpose of the assessment, hence there is not one significant gold standard for physical activity assessment.

Nevertheless, during the last two decades, researchers have tended to use more objective measurements in order to describe participants' intensity as metabolic equivalents (METs) (Dencker et al., 2006; Trost, 2007), where 1 MET is defined as the resting energy expenditure, while moderate activities equate to 3–6 METs and vigorous activity is considered to have ≥ 6 METs (Metcalf, Voss, Hosking, Jeffery, & Wilkin, 2008; Nerhus, Anderssen, Lerkelund, & Kolle, 2011). This is due to the definition of physical activity as any muscular activity that increases energy expenditure (Ainsworth, Cahalin, Buman, & Ross, 2015; Shephard, 2003). Consequently, several researchers view the doubly labeled water (DLW) technique as the "gold standard" in assessing physical activity under free-living conditions, considering only a small amount of errors (Trost, 2007). However, due to the fact that DLW is quite expensive and does not identify duration, frequency and intensity, motion sensors, including accelerometery, have become a popular tool in order to measure physical activity, as they are considered to be at an acceptable cost when assessing a large group of individuals (Brage et al., 2015; Sirard & Pate, 2001).

Considering previous findings, it seems crucial to identify which are the factors in the activity itself that can lead children to increase their time being physically active. However, there is limited research that addresses the importance of preschool staff's attitudes, initiative and participation in physical activities along with children, and qualitative methods seem to be the most frequently used method. No one has explicitly investigated the extent to which preschool staff's expressed attitudes towards physical activity are related to spontaneous activities. Nor have researchers studied children's and preschool staff's activity levels using accelerometery to identify associations between the physical activity level of preschool staff and children's physical activity level in preschool. The fact that preschool staff's role in children's physical activity has been objectively measured only in intervention studies, confirms the need for

researching preschool staff's attitudes, participation and initiative along with children in spontaneous activities, as it may lead to a greater awareness of the importance of preschool staff's initiation of and/or participation in children's physical activity. The aim of this study was therefore to identify whether there are any associations between preschool staff's characteristics in relation to children's activity in preschool, controlled for children's activity levels at leisure time. The preschool staff's characteristics were: activity levels during preschool hours, attitudes towards children's physical activity in preschool, willingness to take the initiative in children's physical activity in preschool, and participation in children's physical activity during preschool hours.

Methods

The present study was conducted in collaboration with a larger PhD research project (unpublished), that used accelerometers, questionnaires, interviews and observations. However, as the aim of the present study did not touch all the aspects of the data collection, only accelerometer data, questionnaire data and observational data were included.

Subjects and procedures

Independently of size and type of preschool, 13 preschools in a region of Nord-Troendelag, Norway, were randomly chosen to participate in the study. A condition for participating in the study was that both staff and children were full-time in preschool. Of 364 children aged of 4–6 attending full-time in the 13 preschools, 289 children (145 boys and 144 girls) volunteered to participate by the approval of their primary guardian, – giving a response rate of 79.40%. All the 72 preschool staff (57 women and 15 men) who worked mainly with the children aged 4–6, agreed to participate. The distribution of sexes among children and adults, reflects the natural sex distribution in preschools. Prior the data collection, preschool staff and parents were presented with and informed orally about the benefits of being physically active at a young age. They also received written and oral information about the procedures and ethical standards for testing related to sports science before signing the written consent form. Preschool staff and parents were also informed that the study was voluntary. All data were collected during a six months period in 2017, in which accelerometer data and questionnaire data were collected during five consecutive weeks from middle of May until the end of June, while a three-day-observation was conducted in the beginning of October. During the data collection, participants (or their primary guardian) received an SMS each morning reminding them to wear the accelerometer. The study was approved by the Norwegian Social Science Data Services (NSD).

Accelerometery

Accelerometers can detect intensity, frequency and duration of both adults' and children's physical activity (Nielsen & Eiberg, 2006; Plasqui & Westerterp, 2007), in addition to inactivity estimates (Evenson, Catellier, Gill, Ondrak, & McMurray, 2008) and filter out other noises that are beyond normal human movement (Kolle et al., 2012), such as from electrical items or vibration from transport in motor vehicles (Chen & Bassett, 2005). Furthermore, accelerometers decrease subjectivity (Sirard & Pate, 2001) and eliminate bias such as social desirability and recall problems (Evenson et al., 2008). Moreover, several researchers seem to agree that calorimetric- (including DLW) validated accelerometers may be the most promising method to capture physical activity in free-living situations (Brage et al., 2015; Plasqui & Westerterp, 2007; Van Cauwenberghe, Labarque, Trost, De Bourdeaudhuij, & Cardon, 2010) as direct observation is imprecise in identifying intensities and level of energy expenditure during physical activity (Butte et al., 2014).

Raw data output produced from accelerometers is expressed as counts per minute (CPM), which refers to all acceleration the accelerometer has been exposed to, divided by the number of minutes the accelerometer has been used (Kolle et al., 2012; Vale, Santos, Silva, Soares-Miranda, & Mota, 2009). However, in order to capture as precise data as possible, counts are summed during user-defined epochs and classified as various intensities (i.e. sedentary, light, moderate and vigorous) of physical activity based on categorized count thresholds or cutoffs (Kim, Beets, Pate, & Blair, 2013; McClain, Sisson, & Tudor-Locke, 2007).

Actigraph GT1M accelerometers (ActiGraph, Fort Walton Beach, FL) were assessed to objectively measure preschool staff and 4–6-year-olds' physical activity over seven consecutive days, which is recommended by several researchers (Addy, Trilk, Dowda, Byun, & Pate, 2014; Penpraze et al., 2006; Trost, McIver, & Pate, 2005), and the same type of accelerometer and length of the study were also applied in a large population study of Norwegian 6-year-olds (Kolle et al., 2012). The accelerometer had to be placed at the participant's right hip, which is recommended by Ainsworth et al. (2015), and the participants were required to wear it every day except during sleep, showering or other water activities. The Actigraph GT1M is validated and reliability tested for testing physical activity levels for adults (Plasqui & Westerterp, 2007), children aged 0–5 (Cliff, Reilly, & Okely, 2009; Russell R Pate, Almeida, McIver, Pfeiffer, & Dowda, 2006), and against the global health recommendations (B. H. Hansen, Ommundsen, Holme, Kolle, & Anderssen, 2014).

For initializing and data reduction, Actilife v6.13.3 (ActiGraph, LLC, Pensacola, FL) was utilized. Accelerometers were set to start recording at 6 a.m. the day after they were distributed and put on, as an attempt to counteract the Hawthorne effect (McCambridge, Witton, & Elbourne, 2014). In addition, they were programmed to save data in two different epochs (time intervals) as children by nature spend more time in sporadic and intermittent physical activity than adults (Cliff et al., 2009; Kim et al., 2013; Vale et al., 2009). Researchers have therefore recommended 15 s epochs or less when monitoring children, and 60 s epochs for adults (Cliff et al., 2009), whereas the present study chose to use 10 s epochs for children aged 4–6 and 60 s epochs for preschool staff, following the test protocols of Kolle et al. (2012) and Anderssen et al. (2009). This was important in order to be able to compare the findings with other large Norwegian population studies of children and adults that include accelerometer data.

Count thresholds for the various intensities were defined following Norwegian population studies. Activity with less than 100 CPM was interpreted as sedentary, while light activity was defined as 100–1999 CPM for children (Kolle et al., 2012) and 100–2019 for adults (Anderssen et al., 2009). Furthermore, physical activity between 2000 and 5998 CPM for children (Kolle et al., 2012) and 2020–5998 CPM for adults was considered as moderate intensity (Anderssen et al., 2009), requiring 3–6 times as much energy as the resting energy expenditure. The count threshold for vigorous activity was defined as 5999 CPM for both adults and children (Anderssen et al., 2009; Kolle et al., 2012), and requires more than 6 METs (Dencker et al., 2006). These differences in intensity cutoffs are, according to Troiano et al. (2008), due to adjusting for children's and youths' higher resting energy expenditure.

Valid days required at least 480 minutes of daily recorded activity, whereas sequences of 60 minutes or more for preschool staff (Anderssen et al., 2009) or 20 minutes or more for children with consecutive zero counts, were interpreted as nonwear time and removed (Kolle et al., 2012). Furthermore, in accordance with the test protocols of Kolle et al. (2012) and Anderssen et al. (2009), preschool staff were required to have at least three valid days, while children needed only two, in order to be included in the study. Data between 00:00 and 05:59 a.m. were excluded due to instructions regarding no accelerometer-wear during sleep, while wear-time was categorized in the following variables; preschool hours (8 a.m.–3.29 p.m.) leisure time on weekdays (6 a.m.–7.59 a.m. and 3.30 p.m.–11.59 p.m.) and weekend (06 a.m.–11.59 p.m.). A total of 244 children and 64 preschool staff had valid accelerometer data – giving a response rate of respectively 84.4% for children and 100% for preschool staff.

However, it should be noted that accelerometers do not record any information regarding type of activity, nor what leads to it. Thus, it does not detect whether children play alone or with others, or if they initiate physical activity by themselves or participate in adult-structured activities (Sørensen, 2012). Self-reported data will therefore be supplementing measurements to objective measures, in order to achieve a nuanced assessment (Anderssen et al., 2009) and identifying potential correlates of physical activity (Oliver et al., 2007) as an explanation to the accelerometer data.

Questionnaires

The main purpose of using self-reported questionnaires was to identify preschool staff's:(a) attitudes towards physical activity, both for themselves and children; (b) physical activity habits concerning both leisure time and work; and (c) climate for prompting physical activity. The questionnaire was designed on the basis of already validated and reliability-tested questions from the studies of Anderssen et al. (2009) and HUNT3 (Rangul, Bauman, Holmen, & Midthjell, 2012). Such a strategy has its advantages as questionnaires rely heavily on respondents' understanding of the questions (Boon, Hamlin, Steel, & Ross, 2008), in addition to the fact that it provides an opportunity to make comparisons across studies (Johannessen, Tufte, & Christoffersen, 2010). Nonetheless, preschool staff were advised to fill in the questionnaire at the end of the week as self-report questionnaires impose demands on respondents' memory and abilities to recall physical activity (Boon et al., 2008). Sixty-eight preschool staff completed the questionnaire – giving a response rate of 94.4%.

Observation

Direct observation might be useful when seeking detailed contextual information concerning physical activity (Oliver et al., 2007), especially when no other method manages to identify a phenomenon (Johannessen et al., 2010). In order to explain whether children's activity levels increase after preschool staff's activity or vice versa, one preschool was observed for three days by one observer. The observation took place during the times that were categorized as children's and staff's preschool hours (calculated by average delivery and retrieval times of children). Moreover, one preschool was considered as sufficient to discover whether children's activity levels increase after preschool staff's activity or vice versa, as significantly higher activity levels were found among children compared to adults in the preschools enrolled in the study.

Nevertheless, frequency tables were used to structure and organize the frequency of three phenomenon: (1) preschool staff's initiation of children's physical activities, where preschool

teachers participated with the children; (2) preschool staff's initiation of children's physical activities without participating themselves; and (3) participation, when preschool staff spontaneously joined child-initiated physical activities. This method is similar to the EPAO instrument used in other observational studies concerning preschoolers' physical activity by Bower et al. (2008) and Vanderloo et al. (2014), but is simplified due to a narrowed focus area in the present study. However, a criterion for the three phenomena to be counted was a minimum of 1.5 minutes in physical activity. In addition, field notes and informal conversations regarding the preschool's habits and values were taken in order to gain more insight and to supply the frequency tables with more specific details concerning the purpose of the observation.

Statistical analysis

All calculations were performed in SPSS statistical software version 23 (IBM SPSS, Chicago, IL, USA). A factor analysis was considered to identify variables concerning the concept of attitude, initiative and participation, but due to the recommended sample size of 300 cases or more (Yong & Pearce, 2013), the variables in the present study were computed on basis of a theoretical perspective. Respectively five questions from the questionnaire were thus computed into an initiative variable, and four into a participation variable. However, only one variable was considered to be directly related to preschool staff's attitudes towards children's physical activity in preschool (see Table 1).

Table 1: The variables concerning the concept of attitude, initiative and participation, with their numbers and description of questions, with reply options ([a- c])

Attitudes
1. To which extent is it important that children are physically active at least one hour per day? [a]
Initiative
1. When you are with the children; how often do you suggest/initiate physical activities for the children during an average day in preschool? [b]
2. If you notice one or several children that is not physically active; how do you respond to this? (answer the statements below based on the extent of agreement): Provide children guidance and suggestions for how they can play in physical activity. [c]

3. If you notice one or several children that is not physically active; how do you respond to this? (answer the statements below based on the extent of agreement): Initiate physical activities for the children. [c]
4. If children initiate physical activity by themselves; how do you usually respond to this? (answer the statements below based on the extent of agreement): Provide children guidance and suggestions during the activity. [c]
5. If children initiate physical activity by themselves; how do you usually respond to this? (answer the statements below based on the extent of agreement): Provide children guidance and suggestions when the activity is ending. [c]

Participation

1. When you are with the children; how often do you participate in children's physical activity during an average day in preschool? [b]
2. If other preschool staff initiate children's physical activity when you are present; how often do you participate in these during an average day in preschool? [b]
3. If you notice one or several children that is not physically active; how do you respond to this? (answer the statements below based on the extent of agreement): Participate in children's physically play along with the children. [c]
4. If children initiate physical activity by themselves; how do you usually respond to this? (answer the statements below based on the extent of agreement): Participate along with the children. [c]

[a] Unimportant, less important, neither important nor unimportant, a bit important, very important (valued 1-5).

[b] Never, seldom, occasionally, usually, all the time (valued 1-5).

[c] Totally disagree, partially disagree, neither disagree nor agree, partially agree, totally agree (valued 1-5).

Based on the fact that children are nested in different preschools, it was natural to categorize data as hierarchical, as a child's activity level might be affected by other children's activity levels in the same specific preschool. A multilevel analysis, linear mixed model (LMM) was therefore used to examine associations between preschool staff's and children's activity levels, as it can handle data dependency that occurs in cases like this. To explain the activity level, the average MVPA per day was preferred, as MVPA is, according to Kolle et al. (2012) linked directly to the global health recommendations. Moreover, a multilevel analysis has been considered as a suitable method to capture social contexts with several levels (Snijders,

2011). Preschool staff's accelerometer data were aggregated into average activity level among staff in each specific preschool, as children were not in contact with only one employee, but all the preschool staff. Therefore, it was natural to assume that preschool staff's average MVPA reflects their impact on children, as some of the staff might be very active while others are less active in engaging children in physical activity, whereby both behaviors may affect children in different ways. The variable for preschool staff's MVPA during preschool hours was also controlled for other predictors in the same LMM analysis.

Results

Eighty-four percent of the children met the health recommendations, whereas 39% met the health recommendations during preschool hours. 81% of the preschool staff met the health recommendations, in which 49% met the health recommendations solely during preschool hours.

Table 2: Descriptive characteristics of children (age 4–6): MVPA and fulfilling of health recommendations

	Boys (SD)	**Girls (SD)**
Sample size (n)	125	119
MVPA Preschool hours	61.7 ± 18.3	55.1 ± 17.3
MVPA Leisure time weekdays	33.6 ± 12.6	30.8 ± 12.8
MVPA Weekend	75.6 ± 31.5	69.3 ± 27.9
Health recommendations		
Met (%)	89.6	78.2
Met during preschool hours (%)	45.6	33.6
Not met (%)	10.4	21.8

Table 3: Descriptive characteristics of preschool staff: MVPA and fulfilling of health recommendations

	Men (SD)	**Women (SD)**
Sample size (n)	[12]	52
Age	36 ± 10.9	39.8 ± 10.3
MVPA Preschool hours	28.6 ± 14.0	14.8 ± 11.4
MVPA Leisure time weekdays	25.2 ± 12.3	14.0 ± 12.5

MVPA Weekend	28.1 ± 26.2	33.3 ± 25.5
Initiative	3.7 ± 0.7	3.6 ± 0.5
Participation	3.8 ± 0.4	3.7 ± 0.5
Attitudes	2.9 ± 0.7	3.2 ± 0.8
Health recommendations		
Met (%)	100.0	61.5
Met during preschool hours (%)	66.7	30.8
Not met (%)	0.0	38.5

The LMM analysis showed that, controlled for other predictors (children's MVPA at leisure time, preschool staff's attitudes, preschool staff's initiation, and preschool staff's participation), there is a significant association between preschool staff's average activity levels during preschool hours and children's activity levels during preschool hours ($t = 2.57$; $p = 0.021$). This is illustrated with two figures in order to show preschool staff's aggregated data during preschool hours with; children's aggregated average MVPA during preschool hours in each preschool (Figure 1); and children's individual average MVPA during preschool hours linked to the preschool they are attending (Figure 2).

Figure 1: Associations between children's and preschool staff's average objectively measured MVPA during preschool.

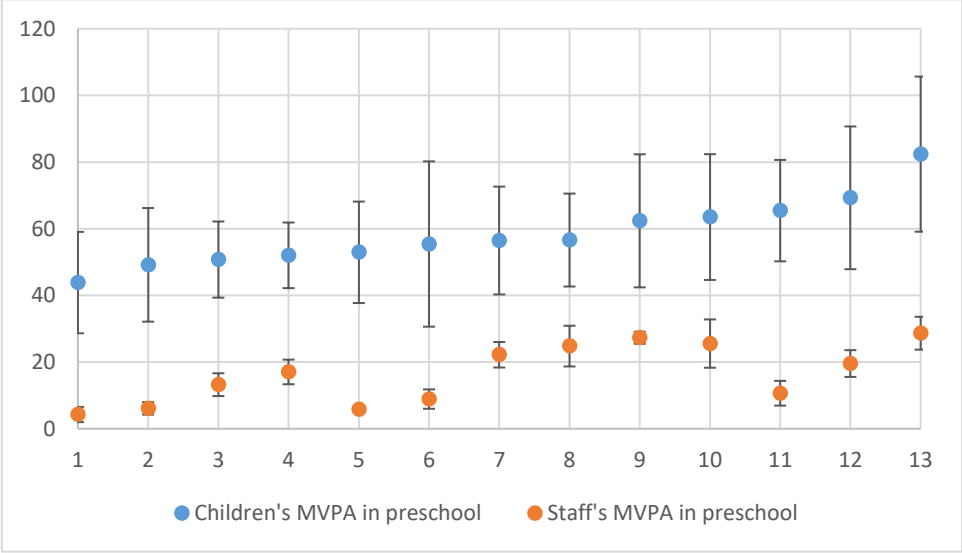
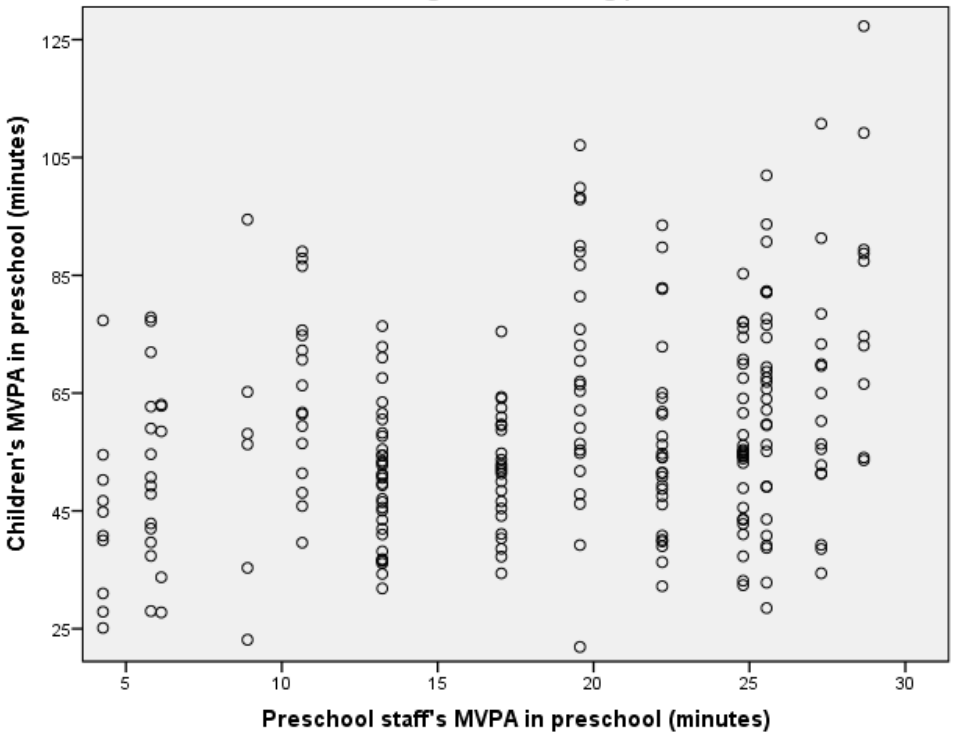


Figure 2: Association between preschool staff's aggregated MVPA- and children's individual average MVPA during preschool hours.



Despite an LMM analysis on an individual level, Figure 1 may be beneficial in gaining a visual impression of how the average in both the staff's and children's MVPA in each specific preschool correspond, while Figure 2 shows the individual variation in MVPA among the children in the 13 preschools. Furthermore, although Figure 2 illustrates great differences between children's activity levels on an individual level, a tendency for children's activity levels to increase along with the preschool staff's aggregated activity levels in each specific preschool is visible in both Figures 1 and 2. There were, however, no significant associations between preschool staff's attitudes ($t = -0.44$; $p = 0.666$), initiative ($t = -0.14$; $p = 0.890$), participation ($t = 0.66$; $p = 0.522$), and children's activity levels during preschool hours. Nonetheless, the LMM analysis also revealed a significant association between children's objectively measured activity levels during preschool hours and leisure time ($t = 6.60$; $p = 0.000$). This finding is presented in Figure 3 and Figure 4,

Figure 3: Associations between children's average objectively measured MVPA during preschool hours (PH) and leisure time (LT).

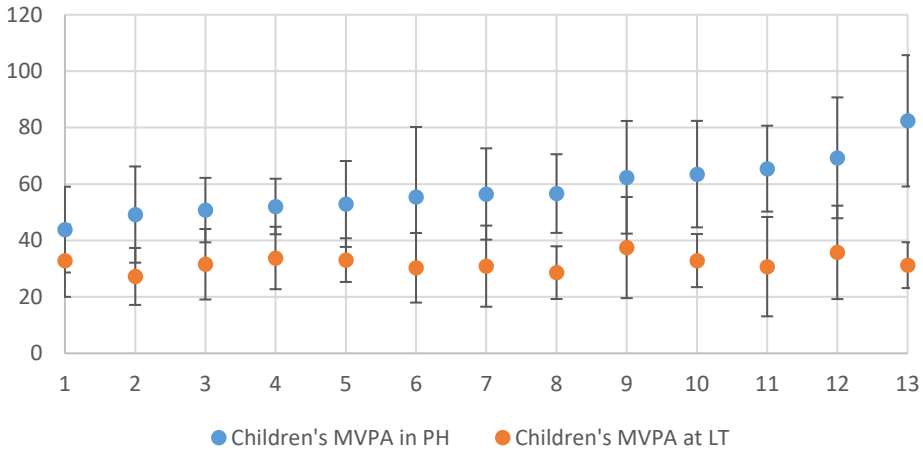
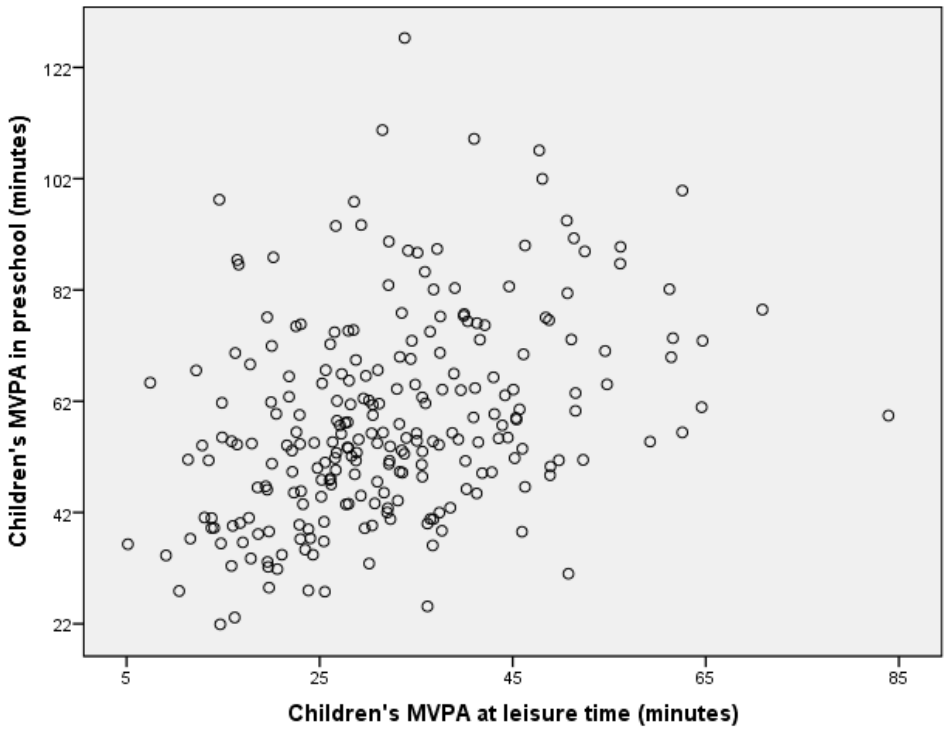


Figure 4: Association between children's individual MVPA during preschool hours and at leisure time.



where especially Figure 4 indicates that the most active children at leisure time also is the ones' that have the highest activity level during preschool hours.

Observation results

Direct observations revealed that preschool staff might affect children's activity levels, and not vice versa. The observations indicated that most of the children were quite active outside

and played by themselves. Preschool staff on the other hand, mostly took a role as observers, and due to the varied activity levels among children, it was obvious that it was the children's play itself that was important to the preschool staff. The observations showed that when children dropped out of a game, the preschool staff were quick to respond. It was in this phase where the individual differences between the staff became visible. Some gave them advice concerning how to get back into the game or what kind of game they could try (e.g. as a police officer capturing thieves on bikes), while others joined the children to initiate a new game. When other children noticed that an adult was playing with a child, many wanted to join the new game. This suggests that children enjoy adults participating in games and are likely to join games with adult involvement. In addition, some children seemed to be very physically active by nature, but for those who were not, adult-initiated games often offered a more physical game. This was especially true for girls, as the observation showed that boys were more physically active than girls, especially when bikes were accessible. However, adult-initiated activities did not only attract children, but when adults were involved in the game, the observation indicated that children spent more time in activities that involved more physical play.

In contrast, the observations revealed that indoor activities were characterized as being mostly sedentary and children were not allowed to run or shout inside unless adults were involved, which may be due to the limited space indoorse. However, in this setting, preschool staff took on a new role and used most of their time inside sitting next to the children and participating in sedentary activities, for instance playing with Lego, doing puzzles, drawing or cooking, or carrying out their duties. Nevertheless, as the frequency table (see Table 4) shows, preschool staff also initiated physical activities inside, but these were always controlled and organized by an adult. These organized physical activities could last from 15–30 minutes, and the intensity seemed to vary. In addition, organized physical activities inside seemed to be planned, which was not the case outside, where preschool staff had to initiate games spontaneously.

Table 4: Number of times preschool staff initiate and/or participate in physical activities with the children, inside and outside, during the three-day observation

	Inside	Outside
Initiate (participating)	7	11
Initiate (without participating)	0	8
Participation (without initiating)	2	14

Furthermore, observations indicated that the preschool staff did only encourage physical activities when a member of the staff participated in the activity, when they were inside. This seemed to be completely contradictory to what most of the preschool staff did outside when children dropped out of the games. Moreover, this suggests that there are some kinds of rules or expectations of what both children and preschool staff are supposed to do in various situations. Similarly, the preschool staff only joined children in physical indoor activities twice during the observation, while they did so far more frequently outside. However, the observation indicates that adult involvement in children's physical activity, whether it is adult-initiated or not, increases children's activity levels as the children tend to become more eager when preschool staff play along on the children's terms.

Discussion

The main finding demonstrates the importance of active employees in preschool, as there is a significant association between preschool staff's average activity levels and children's activity levels during preschool hours, controlled for other predictors. The LMM analysis also revealed that children spent more time in MVPA in preschool than in their leisure time during weekdays, which is similar to findings from a study by Finn et al. (2002), where preschoolers' accelerometer counts from 9 a.m. to 5 p.m. accounted for more than 50% of their daily average counts, and where the preschool was identified as a great determinant of children's physical activity. This is in contrast to the findings reported by Hinkley et al. (2016), which found that boys and girls in preschool were more physically active outside preschool hours on weekdays, using the same accelerometer type and statistical test as the present study. However, the differences were very small in the study by Hinkley et al. (2016), and neither Finn et al. (2002) nor Hinkley et al. (2016) gives information about how much time children spent at preschool or at leisure. While it seems like the preschool children in the present study spend twice as long in preschool than outside preschool hours, there is no indication that this has been taken into account in the studies by Hinkley et al. (2016) and Finn et al. (2002).

However, an essential question is whether the association between preschool staff and children is based on preschool staff's impact on children's physical activity, or if it is the children that initiate all the activity in the preschools and affect the preschool staff's activity levels, or a combination. The analyses from the observation study that was conducted to examine this question, indicate that preschool staff have the power to affect children's activity levels, and not vice versa, when they initiate and participate in children's activities. Compared with the results from the LMM analysis, in addition to the fact that both children and adults

spent in average more minutes in MVPA during weekdays than in the weekend, this finding suggests that preschool is an important arena for children's daily physical activity. In addition, other studies have found that preschool staff have generally high activity levels during work (Lagestad & Kippe, 2016), whereas those who work with children from 4–6 years old have been shown to have the highest activity levels with 56 minutes in MVPA per day (Kippe & Lagestad, in press), which is a lot more than other Norwegian women (34.3 min MVPA per day) and men (36.5 min MVPA per day) in the same age group as the preschool staff in the present study (B. Hansen, Kolle, & Anderssen, 2014).

However, the observation analysis revealed that there was a distinct difference in activity levels between the time children spent inside and outside during preschool hours, and indoor activities were characterized as more sedentary than outdoor activities. Observation suggests that preschool staff have an impact on children's activity levels based on actions and mediated expectations, which might partly explain the association between preschool staff and children's activity levels. The findings indicate that preschool staff enter situation-dependent roles, where they might demonstrate to the children that inside activities are supposed to be more calm and quiet than outside activities. The fact that all the physical activities inside had adult-involvement, supports the idea of a controlling role for preschool staff when inside. For children, this might affect their amount of daily physical activity, which has also been identified by W. H. Brown et al. (2009a), who pointed out the time children spend inside as an unfortunate factor for children's daily physical activity. In contrast, children were expected to be more independently physical active outside, although observation suggests that children enjoy preschool staff playing along with them like equals. Preschool staff's initiation of physical activities or participation and involvement in children-initiated games that are considered physical, may therefore play an essential role in children's daily physical activity, in addition to their perception of physical activities. This is similar to the findings by Sørensen (2012), who claims that preschool staff that express physical activity in preschool as fun rather than a duty might have a positive impact on preschoolers' perception of physical activity.

Regarding this, observation showed that adult-initiated activities did not only attract children, but when adults participated, children spent more time in physical activity, and it provided a more physical game for those who were not naturally as active. As previously reported by several intervention studies (William H Brown et al., 2009b; De Marco et al., 2015), adult-structured activities might increase children's daily physical activity. Additionally, during an

observation study using the EPAO instrument, Bower et al. (2008) found that preschoolers are more likely to reach a higher activity level during activities initiated by preschool staff who participate and possess positive attitudes towards physical activity.

Furthermore, it seems to be a general agreement among several researchers (Biddle & Goudas, 1996; W. H. Brown et al., 2009a; Gubbels et al., 2011) that positive adult encouragement is especially important when preschool staff participate in children's physical activity. Regarding this, positive adult encouragement might increase children's physical activity through perceived sport competence (Biddle & Goudas, 1996) and lead to more recognition for children, especially through interactions and collaboration (Vygotsky, 1978). In addition, a correlation was found between previously satisfying experiences with physical activity, self-esteem and increased welfare in social environments in a Danish study by Nielsen and Eiberg (2006), suggesting together with previously reported findings (Biddle & Goudas, 1996; W. H. Brown et al., 2009a; Goldfield et al., 2012; Gubbels et al., 2011) that preschool staff might have a crucial impact on children's activity levels if they provide a supportive environment where physical activity is prompted regularly. This might contribute to explain the findings in Figure 1 and 2.

Another main finding regarding the results from the LMM analysis, revealed that there were no significant associations between the preschool staff's initiation, participation and attitudes, and children's activity levels during preschool hours. However, an explanation regarding this might be due to the difficulty in operationalizing the terms of initiation, participation and attitudes into questions in a questionnaire. One may also be critical as to whether the questions are suitable to capture what is intended to be measured (validity) (Thomas, Silverman, & Nelson, 2015). In addition, self-reported questionnaires might have reliability issues as they rely heavily on the individual respondent's own perception, memory and concentration (Boon et al., 2008).

Nevertheless, previous research has shown conflicting findings regarding the concept of preschool staff's initiation, participation and attitudes in relation to physical activity. For instance, Mikkelsen's (2011) self-reported study on 3–5-year-olds' physical activity from a cross-sectional study among all Danish preschools, found that preschool policy and guidelines, which encourage play and movement, are associated with more children undertaking moderate activity. In addition, he claims that preschool staff's individual attitudes and behavior also play an essential role in promoting children's physical activity (Mikkelsen, 2011), indicating that all three of the computed variables in the present study might be

important. In contrast, Cashmore and Jones (2008) demonstrated in their interview study (focus group) with participants from five preschools, that preschool staff considered child-directed play as most valuable for the children and were therefore reluctant to interfere. Several researchers have for this reason identified portable equipment and toys as a key factor for children's physical play (Bower et al., 2008; Dowda et al., 2009; Gubbels et al., 2011), indicating that adults do not have to interfere as long as children have opportunities to play while they are in motion.

Nonetheless, Copeland et al. (2011) reported that the preschool staff in her interview study claimed that they held the key to children's physical activity, as the preschool staff were the ones to decide what opportunities children should have to be physically active, in addition to the degree of involvement or dedication they should have with the children. Moreover, findings from a qualitative self-reported study conducted by Sansolios and Mikkelsen (2011) showed that some preschool staff felt pressured to take all the responsibility for initiating children's health habits, which they did not agree with. These findings suggest that there are major differences in preschool staff's beliefs and behavior regarding their role in children's play and physical activity, and perhaps especially in outside activities according to observational findings from the present study.

The present study also showed a significant association between children's activity levels during preschool hours and leisure time. This association might be natural, but due to the fact that the variable concerning children's MVPA at leisure time was used as a control variable and not as a part of the research question, it will not be discussed any further. Lastly, an interesting aspect of the study is the high percentage of men who met the global health recommendations, and had more than twice as many minutes in MVPA than women during preschool hours. Although a very small sample of men in the present study, this finding suggests that men working in preschools are fairly physically active, and might have a positive impact on children's physical activity.

Strength and limitations of the study

The present study has several advantages. Firstly, it includes a large number of participants, whereby the distribution of children's sex is more or less equal, reflecting the actual sex distribution in preschools. In addition, both large and small preschools, in addition to different types of preschool were included in the study as a result of being randomly selected, which gives a representative sample as the size and type might differ greatly between preschools. Secondly, to the best of my knowledge, this is the first study to objectively assess both

children's and preschool staff's physical activity with accelerometers. Objective measurements, such as accelerometers have an advantage as they decrease subjectivity (Sirard & Pate, 2001) and eliminate bias such as social desirability and recall problems (Evenson et al., 2008). Furthermore, it provides opportunities to compare with other studies, as accelerometers have been widely used in the last two decades (Troiano, McClain, Brychta, & Chen, 2014). Furthermore, the present study's use of accelerometery is based on high-quality standard procedures and justified by two reasons: (1) the fact that accelerometers are demonstrated to correspond well with energy expenditure related to free-living activities (Brage et al., 2015); and (2) the fact that the Actigraph GT1M are validity- and reliability-tested for researching physical activity levels for adults (Plasqui & Westerterp, 2007), children aged 0–5 (Cliff et al., 2009; Russell R Pate et al., 2006), and against the global health recommendations (B. H. Hansen et al., 2014). Another advantage is the mix between accelerometery and observation, as they can complement each other, seeing that accelerometers are incapable of identifying different types of physical activity or what leads to it (Cliff et al., 2009). Lastly, it should be mentioned that the present study used a rather advanced statistical analysis in LMM, which has its advantages as it handles data dependency that occurs when participants are nested within groups, in addition to the fact that a multilevel analysis is considered as a suitable method to capture social contexts with several levels (Snijders, 2011).

Nevertheless, the present study is not without limitations. The sample includes many women and few men (adults), which could have affected the results, depending on how men and women behave differently in general regarding initiation and participation in children's physical activity. On the other hand, it is well known that the preschool profession is dominated by women, which makes the present sample representative of preschools in general. Another disadvantage concerns the use of questionnaires in order to describe the variables regarding preschool staff's initiative and attitudes to children's physical activity, in addition to their participation in child-directed physical activity, as it might be difficult to operationalize questions with good validity. In addition, as questionnaires rely on respondents' interpretation of the questions and their ability to recall actions, the questionnaires might have varied accuracy and validity (Boon et al., 2008). Furthermore, it might have been a disadvantage that there was not used a factor analysis in the present study, before computing variables into the concept of preschool staff's initiation and participation. However, due to the recommended minimal sample size for factor analyses, the assumptions

for factor analysis was not fulfilled (Yong & Pearce, 2013). Furthermore, one might be critical to the fact that only one variable was used to explain the concept of preschool teachers' attitudes towards children's physical activity in preschool. On the other side, the question might be quite important as it is directly related to the preschool staff's attitudes regarding children's physical activity.

Moreover, although accelerometery is considered to be a preferable measurement when assessing physical activity in free-living situations, it is not capable of assessing torso movement accurately when it is attached to the hip (Cliff et al., 2009), which also results in an underestimation of cycling or riding vehicles (Sirard & Pate, 2001). This is especially unfortunate as riding vehicles among other toys has been argued to be important for preschoolers' physical activity (Nicaise et al., 2011). In addition, due to no water contact, neither swimming nor other water activities that are considered as physical activities will be included in the data analysis, which might lead to an error estimation of the participants' accelerometer counts. The observation study is not without limitations either. A critical point is that although the observer takes an objective stand, all individuals have subjective perceptions of what is happening. Moreover, the observations were conducted by one observer, but several observers would have been preferable.

Conclusion

To the best of my knowledge, this is the first study to apply accelerometers as an objective measurement for both children and preschool staff when assessing staff's impact on children's physical activity. The findings demonstrate that there is a significant association between preschool staff's aggregated activity levels and 4–6-year-olds' individual activity levels. The observational findings, which indicate that children have an increased activity level when preschool staff participate and play along with the children as equals, demonstrate the importance of physically active employees in preschools as they might have the power to affect children's activity levels based on actions and mediated expectations. In addition, children spent more time in physical activity when preschool staff participated in children's physical activities, and this was especially true for those who are not naturally as active.

However, as there were no significant associations between the concept of preschool staff's initiation, participation and attitudes, and children's activity levels, the need to examine these characteristics remains, using more observers and a mixed-method design including objective measurements and more valid measurements of attitudes, initiation and participation.

Moreover, based on the finding that revealed a significant association between children's activity levels during preschool hours and at leisure time, researchers should objectively examine the association children's activity levels have with both their primary guardians' and preschool staff's activity levels. This might identify whether children are physically active or inactive by nature, or if they are affected by those who are supervising them. A longitudinal study would also be preferable in order to explain possible side effects from encouraged physical activity in terms of initiation, participation and general attitudes towards children's physical activity, by preschool staff and primary guardians.

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