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The Effect of Activity Videos on Preschool Children and Preschool Employees' Physical Activity Level During Preschool Time

RESEARCH

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ABSTRACT

Physical activity (PA) improves the quality of life in many ways and is of major importance in the lives of children. Almost all three- to six-year-old Norwegian children are in preschool most of their waking hours, and therefore the preschool constitutes the main arena for children's PA. This study aims to examine the effect of PA videos on children and preschool employees' PA levels during preschool time according to moderate to vigorous activity (MVPA) and counts per minute (CPM). Six preschools were randomly selected and participated in an intervention study. Two preschools served as a control group and four served as an intervention group. The study included 110 children aged 4-6 years, and 31 preschool employees, all wearing accelerometers during preschool time for two weeks. In the first week, both the control group and the intervention group carried out their ordinary activities. In the second week, the four preschools in the intervention group used the activity videos, while the control group kept doing their ordinary activities. The results show that the activity videos significantly increased CPM at preschool time in children. However, the activity videos did not significantly increase MVPA during preschool time in children. The findings indicate that the activity videos did not offer the children a high enough intensity level to increase PA in MVPA. Furthermore, the results show that the activity videos increased both MVPA and CPM during preschool time in the preschool employees. This is the first study to examine both children and employees PA level using activity videos at preschool time as a strategy. submission progresses knowledge on this subjectOur findings indicate that the use of activity videos can be an important contribution to more PA in preschools, both in children and employees.

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INTRODUCTION

Physical activity (PA) reduces the risk of illness, improves the quality of life, and increases functional ability (Ministry of Health and Care Services, 2013). PA can also help decrease stress and improve sleep and mental health (Michel et al., 2022). Moreover, the pattern of PA in four- to six-year-old children is characterised by an intermittent pattern of long periods of low activity intensity mixed with very short shots of vigorous activity, such as jumping or running, which is suggested as extremely important for bone mineralisation (Barbosa & de Oliveira, 2016). Furthermore, PA significantly reduces the risk of cardiovascular disease in children (Vejalainen et al., 2019; Carson et al., 2017; Jimenez-Pavon et al., 2013). Therefore, it is recommended that children engage in moderate to vigorous PA (MVPA) for a minimum of 60 min per day, on average (WHO, 2020). According to WHO (2019), intensity in MVPA involves physical activities where the children are likely to be breathless, hot, and sweaty. However, research shows that not all children satisfy these health recommendations for PA (Steene-Johannesen et al., 2019; Aalto-Nevalainen et al., 2018; Kippe & Lagestad, 2018; Larsen et al., 2017; Berglind et al., 2017; Brasholt et al., 2013; Gunter et al., 2012). In addition, a cross-sectional study reports that the total amount of PA decreased by an average of 4.2% each year from the age of 5 to 18 (Cooper et al., 2015). Such findings have become a legitimate cause of great concern, considering that physical inactivity is a leading risk factor for global mortality (WHO, 2009) and that inactivity among children and youth has been linked with lower PA levels in later life (Telama et al., 2005).

Almost all Norwegian children from three to six years old are in preschool most of their waking hours (Norwegian Directorate of Education, 2022); thus, preschool constitutes the main arena for children's PA. However, several studies provide evidence that children do not meet the health recommendations for PA during preschool time (Kippe & Lagestad, 2018; Berglind et al., 2017; Andersen et al. 2017). Consequently, it is asserted that preschool can contribute to influencing children's health in both the short and long terms (Osnes et al., 2022). Furthermore, the preschool can contribute to levelling social differences, which constitutes an important principle underlying public health work (Ministry of Health and Care Services, 2013). Several studies show that lifestyle behaviour will follow the same trend from preschool age up to adulthood (Telama et al., 2014; Rossem et al, 2012; Borraccino et al., 2009). It is suggested that PA should be prompted within the first five years of life because children's activity patterns are relatively more easily influenced and open to changes and adoptions during this developmental period (WHO, 2019; Goldfield et al., 2012). Several researchers highlight the importance of preschool employees being involved and making efforts to promote children's PA, and that policy and practice in preschool have a great influence on children's total PA levels (Bjørgen & Svendsen, 2015; Bugge & Froberg, 2015; Goldfield et al., 2012). According to Vanderloo et al. (2014), lack of stimulation or inactive role models will demotivate children's participation in physically active play. Finn et al. (2002) reported that preschool was the strongest determinant of PA among children. Several studies highlight that children are more physically active during preschool time than in leisure time (Berglind & Tynelius, 2018; Hesketh et al., 2015; Kippe & Lagestad, 2018; Ofrim Nilsen et al., 2019). Fossdal et al. (2018) found that Norwegian preschool children performed 66% of their PA in preschool, while Lohne et al. (2021) show that preschool children performed 70% of their daily PA in MVPA in preschool. Ofrim Nilsen et al. (2019) reported that preschool contributed to as much as 77% of the children's total PA.

An inclusion of the employees in this study can be seen in the light of a sociocultural perspective that points to the importance of interaction between the child and their environment. In new activities, such as the use of activity videos, the employees are a support for the children and constitute a safe base where the children can find support, help and guidance during the activity (Drugli, 2017). In the theory Circle of Security (Powell et al., 2015), this is called *to be together* in the circle as a basis for the child's development and learning. According to the proximal development zone of Vygotsky (1978), the children can carry out some PA alone, but children can do even more with help and support. At this level, children receive developmental tasks that they can master with guidance from an employee, which leads to mastery and meaning-making processes (Wertsch, 1997). This is in line with the Nordic model for preschools where care, play, learning and formative development are integrated parts. According to Säljø (2001), learning happens everywhere and all the time, and it is fundamentally social. The child's benefit in organized activities requires that the employees take care of the holistic approach to learning. Employees shall meet the children's need for care. Care is a prerequisite for

children's confidence and well-being and for developing empathy and compassion (Norwegian Directorate for Education and Training, 2017). This is a sociocultural approach where the social environment forms the framework around the child's experiences (Bøe et al., 2018). In this way, what is happening here and now (play and care) is taken care of, while at the same time the employees are oriented towards the children's future (learning and formal development) (Børhaug & Bøe, 2018). It is important to stimulate the children's joy of movement. An enthusiastic employee who initiates, takes the lead and is passionate about the activities is the key to stimulate the children's interest and motivation (Bjørgen & Svendsen, 2015). Children's participation together with the employees in promoting a healthy lifestyle is crucial (Hagsér et al., 2023). This is important for the development of children's lifestyle and health in a sustainable long-term perspective. Furthermore, working in preschool is physically demanding. Working with children aged 4–6 years in preschool require movement and PA for employees, as these children are constantly moving around, and the employees must follow the children to where their play take place. Furthermore, the preschool employees also participate in play and trips in the neighbourhood with the children. In addition, preschool employees need to lift and carry, and walk around the area in the preschool to observe children playing (Authors, C). All PA with the children can contribute to the employee's fulfilment of the daily recommendation of 20.4 minutes of PA in MVPA (WHO, 2020). This is in line with Kippe and Lagestad (2020), who found that the workplace may constitute an important arena for satisfying the recommendations for PA.

Research shows a significant correspondence between employees and children's PA in MVPA (Fossdal et al., 2018; Ofrim Nilsen et al., 2023), and employees and children's PA at low intensities in preschool (Ofrim Nilsen et al., 2023; Chen et al., 2020). Furthermore, the study of Kippe and Lagestad (2018) also highlighted that a difference exists between preschools regarding the children's PA level. The employee's participation in the activity is crucial in the short time perspective by help all children be included in physical play. In addition, the employees support to the children will help them develop their motor skills through the activity. Ennis (2011) highlighted that motor skills are fundamental for realizing the goal of lifelong joy in PA. This is line with Tidén et al. (2021) who found that pupils aged 8, 12 and 15 years with high level of assessed movement ability view themselves as more physically active and with a higher intensity than pupils with low level of self-assessed movement ability. Furthermore, Sigmundsson and Haga (2016) found a strong significant correlation between motor skills and physical fitness. Kippe & Lagestad (2018) found that a positive association exists between MVPA at leisure and MVPA at preschool, in which MVPA at preschool increases when MVPA at leisure increases. Through well-adapted interventions in preschools, the PA level among children can increase, and in a long-term perspective form the basis for good and healthy PA habits. The employees in preschool play an important role in the work with children's PA in preschool.

Bearing this in mind, it is of great importance that preschools offer varied PA through several activities, to ensure that all children are sufficiently physically active in line with health recommendations (WHO, 2019). The benefits of music in relation to activity in sports and exercise contexts have been studied mostly among adults (Pipsa et al., 2017). Music is often included in PA programs for children with disabilities by using rhythms, instructions set to music, listening to music, and movement-to-music to motivate children to engage in PA (Pipsa et al., 2017). A study by Mačak et al. (2022) focused on the improvement of preschool children's muscle strength, muscle endurance, and motor development with additional exercises in which music was implemented. After six months of a daily exercise program, preschool children in the intervention group had improved muscular strength compared to those in the control group. Furthermore, Elofsson et al. (2018) showed that children with different motor skill abilities benefit from learning mathematics in an environment characterized by PA and music.

According to Kooiman et al. (2016), video PA involves PA games in which children play remotely with other children over the internet. The terms for physically active games include: "Active video game", "Activity-promoting video game", "Exergame", "Kinect", "PlayStation", "Wii", "X-box", and "Nintendo" (Merino-Campos & Castillo-Fernández, 2016). Peng et al. (2012) claim that playing active video games is generally equivalent to light-to-moderate PA among children. This is in line with Ramirez-Granizo et al. (2020), who found that activity videos are not able to replace PA in MVPA. In contrast, Kooiman et al. (2016) highlights that exergaming

among secondary students can affect the heart rate, corresponding to moderate intensity. Furthermore, a study by Ramirez-Granizo et al. (2020) shows that activity videos can counteract sedentary behaviour and increase participation in PA.

The previous discussion points to the importance of preschools in relation to preschool children's PA levels. The current study aimed to elucidate whether the use of different videos showing children in PA influenced four- to six-year-old children's total PA levels compared to the preschool's ordinary activity. However, employees at preschools may also benefit from such a strategy: their health benefits from the PA and their PA level affects the children's PA levels (Lagestad & Kippe, 2016).

The purpose of the study is operationalised into two research questions:

1. Does the use of PA videos influence preschool children's PA (MVPA and CPM) during preschool time more than ordinary activity without the use of videos?
2. Does the use of PA videos influence preschool employees' PA levels (MVPA and CPM) during preschool time more than ordinary activity without the use of videos?

METHODS

PA was measured using accelerometers among preschool children and preschool employees for two weeks. Accelerometers were chosen because they can detect the intensity, frequency, and duration of both children's and preschool employees' PA (Evenson et al., 2008; Kolle et al., 2012; Plasqui & Westerterp, 2007). According to Phillips et al. (2021), the Actigraph has the greatest measurement properties for assessing common movement-related outcomes (MVPA) for free-living activity in preschool children and should be the tool of choice where resources allow and where it is logistically possible. In addition, the use of accelerometers makes it possible to compare data with a national population study of PA levels among preschoolers (Kolle et al., 2012).

PARTICIPANTS

This study was carried out in the northern part of Troendelag in central Norway. Out of 24 preschools, six were randomly selected to participate in the study. The preschools were randomly drawn from a list of all the preschools in the area. A condition for participating in the study was that the children were in preschool full-time. Based on power calculations (Cohen, 1988) related to a previous study with standard deviation (SD = 0.23) and expected differences between groups (1 = 0.39, α = 0.05, β = 0.8), at least 53 participants were needed to fulfil the criteria for observed power, and a sample of six preschools seemed preferable related to potential drop-out according to the SARS-CoV-2 pandemic. The six preschools included 110 full-time children, aged 4–6 years, and 31 preschool employees with valid accelerometer data. The employees represented an age range from 19–54 years. Six men and 25 women participated in the study. In addition, two preschools served as the control group (33 children and 8 preschool employees), while four preschools served as the intervention group (77 children and 23 employees). All the preschools are on the outskirts of the city. Furthermore, the preschools are located close to nature with several possibilities for trips in the neighbourhood.

The parents of the children and the employees were given written information about the procedures prior to the data collection. A lecture was also held in each preschool about why measuring PA is important and how the study would be carried out. This gave both parents and employees the opportunity to ask questions about the study. The written information and the lecture included information about the participants' right to decline to participate and their right to withdraw from the research at any time once it started. Furthermore, both the preschool employees and the parents of the children signed a written consent form. The first author was in the preschool when the children received the accelerometers. The employees explained to the children why they would be allowed to wear the accelerometers. The children were explained that the accelerometers would say something about their physical play, such as running, jumping or climbing. If the children did not want to wear the accelerometer immediately, they were given the opportunity to wear it later in the day. It was voluntary whether the children would wear the accelerometer or not.

Ethical research regulations for research on children were followed, and approval to use the data and conduct the study was granted by the Norwegian Centre for Research Data (NSD).

INTERVENTION – ACTIVITY VIDEOS

In the first week, both the control group and the intervention group carried out their ordinary activities. This was a normal week in the preschools, where they carried out the activities they usually did according to the daily schedule. In the second week, the four intervention preschools used the activity videos, while the two preschools in the control group continued their ordinary activities. Prior to the intervention, the employees were introduced to the content of the videos and trained in how to use them. As researchers, we were in the preschools at the start of the intervention to ensure that the display of the videos worked and to reduce the threshold for use of the videos in preschool. The activity videos included motion play, dance play, strength, and coordination exercises performed by children. "Active and Happy" is an online activity programme for schools and preschools. The use of the videos is simple and requires no training. The activities can be performed without equipment, except for a screen to view the videos. The children and employees were supposed to copy the activities on screen together by looking at the videos. Employees reported in a protocol which videos they used each day, to what extent they participated with the children, whether they used the videos beyond the agreed time, and what they did to motivate children who did not want to participate. The videos consisted of music and movement, including jumping, jumping jacks, high knee lifts, and activities including running, jumping, and crawling over and under obstacles. Each video session lasted four to five minutes, and the employees selected videos in line with the children's preferences. Some children were motivated to participate in dances that other children showed in the video, but some children became more interested in storytelling and movements, like several animals in the jungle. All videos are based on gross motor movements that children aged four to six years have developed. The preschools were encouraged to use videos that provided a high heart rate for 20 minutes every day, which corresponds to four video sessions each day. The difference between active video games presented in the introduction and the program "Active and Happy" is the varied selection of gross motor skills that children naturally develop.

PROCEDURES

Accelerometer data were collected during February 2022. The Actigraph GT3X was utilized to objectively measure preschool employees' and four- to six-year-olds' PA over five consecutive days in week one, and five consecutive days in week two, which is more than the four days recommended by Migueles et al. (2017) and Ricardo et al. (2020), and the seven days recommended by several other researchers (Addy et al., 2014; Kolle et al., 2012; Penpraze et al., 2006). The participants were instructed to place the accelerometer on their sacrum at the right hip as recommended (Kolle et al., 2012; Ainsworth et al., 2015), and use it every day in preschool except while sleeping, showering, or other activities involving water. The accelerometers were put on at once the children came to the preschool and taken of just before they left, putting it into the actual children's box at the preschool, and were kept at the preschool at night. The employees helped the children place the accelerometers on their hips. With such a strategy, the accelerometers were only used during preschool time.

Raw data output produced from the accelerometers are expressed as counts per minute (CPM), which refers to all acceleration to which the accelerometer has been exposed, divided by the number of minutes the accelerometer has been used (Kolle et al., 2012). According to the test protocol by Kolle et al. (2012), counts were summed during 10-second intervals to capture data as precisely as possible among the children, and 60-second intervals among preschool employees. According to Migueles et al. (2017), short epochs of 3–15 seconds are recommended to register children's typical activity in intervals. Furthermore, the accelerometer data were classified as sedentary, light, moderate, and vigorous PA, according to the divisions used in a national population study of PA levels among preschoolers (Kolle et al., 2012). In this study, the limit value for physical activity in MVPA is 2000 counts. According to international health recommendations, moderate and vigorous PA (MVPA) per day is the most relevant and used measure of PA level.

Actilife v6.13.3 (ActiGraph, LLC, Pensacola, FL, U.S.A.) was used to initialise the accelerometers, download the accelerometer data, and to validate and create accelerometer data (MVPA). According to the test protocol, at least 480 minutes of daily recorded activity were required to obtain a valid day, and 20 minutes or more with consecutive zero counts were interpreted as non-wear time and removed (Kolle et al., 2012). Furthermore, the preschool children and the preschool employees were required to have at least two valid days each week to be included in the study (Kolle et al., 2012; Andersen et al., 2021; Hansen et al., 2015).

STATISTICS

The assumption of normality according to the two dependent variables (change in MVPA and CPM) was not met ($p < 0.05$) in a Kolmogorov-Smirnov test (O'Donoghue, 2012), and a parametric test could not be used. Wilcoxon nonparametric tests were used to examine differences in PA levels between the pre-test and post-test, and Mann-Whitney U tests were used to examine differences in PA levels between the control group and the intervention group. The level of significance was set at $p < .05$. Statistical analyses were performed with SPSS, version 26.0 (IBM, Armonk, NY, U.S.A.).

RESULTS

Table 1 shows the descriptive data of the children's and employees' activity levels at pre-test (before the intervention) and post-test (during the intervention).

	CONTROL GROUP PRE-TEST MEAN (SD)	INTERVENTION PRE-TEST MEAN (SD)	CONTROL GROUP POST-TEST MEAN (SD)	INTERVENTION POST-TEST MEAN (SD)
Children's MVPA	76.3 (21.8)	70 (25.6)	75.2 (26.2)	70.4 (25.6)
Employees' MVPA	17.1 (9.1)	11.9 (7.9)	17.4 (8.5)	16.1 (9.9)
Children's CPM	1106 (326)	922 (248)	1013 (257)	937 (207)
Employees' CPM	491 (102)	405 (133)	517 (197)	492 (207)

Table 1 Descriptive data of the participants' PA levels at pre-test and post-test.

Figure 1 shows the activity level in MVPA among preschool children in the control group and the intervention group at both pre-test and post-test.

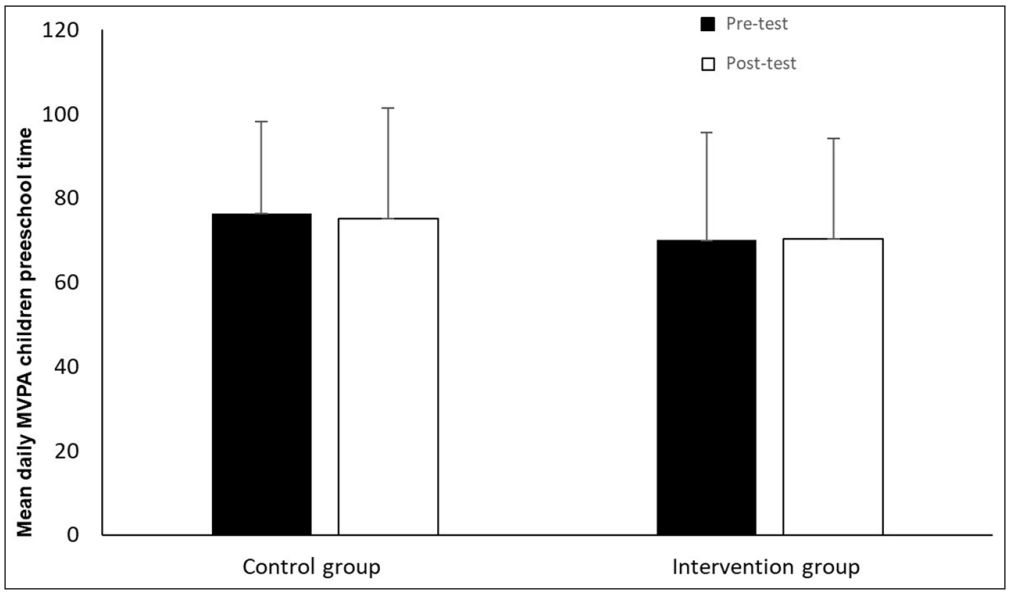

Figure 1 Activity level in MVPA among preschool children in the control group and the intervention group at both pre-test and post-test.

The statistical analyses in Figure 1 show that there was no significant change ($p > 0.05$) in MVPA from the pre-test to the post-test, in either the control group or the intervention group. Furthermore, the statistical analyses show that there was no significant difference ($p > 0.05$) in MVPA between the control group and the intervention group at both pre-test and post-test.

Figure 2 shows the activity level in CPM among preschool children in the control group and the intervention group at both pre-test and post-test.

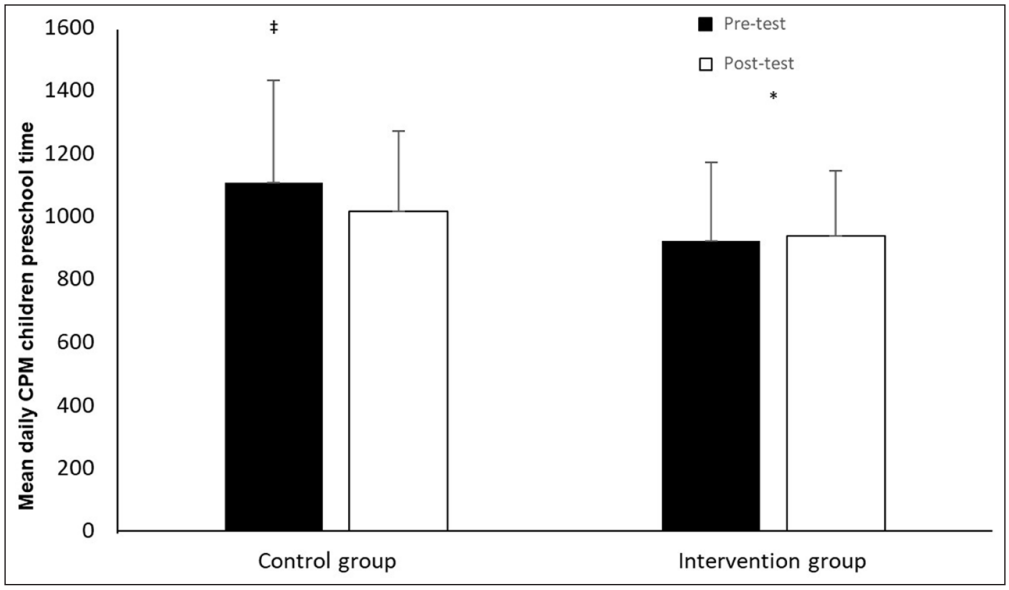

Figure 2 Activity level in CPM among preschool children in the control group and in the intervention group at both pre-test and post-test. *Significantly higher CPM at post-test compared to pre-test in the intervention group ($p < 0.05$). †Significantly higher CPM in the control group compared to the intervention group.

The statistical analyses in Figure 2 show that there was a significant change in CPM from pre-test to post-test in the intervention group ($Z = -2$, $p = 0.041$), but not in the control group ($p > 0.05$). The intervention group increased their CPM from 922 to 936. Furthermore, the statistical analyses show that there was a significant difference ($p > 0.05$) in CPM between the control group and the intervention group at the pre-test ($Z = -2.9$, $p = 0.004$). The control group had a significantly higher CPM at the pre-test than the intervention group (1106 compared to 922), but not at the post-test ($p > 0.05$).

Figure 3 shows the activity level in MVPA among preschool employees in the control group and the intervention group at both pre-test and post-test.

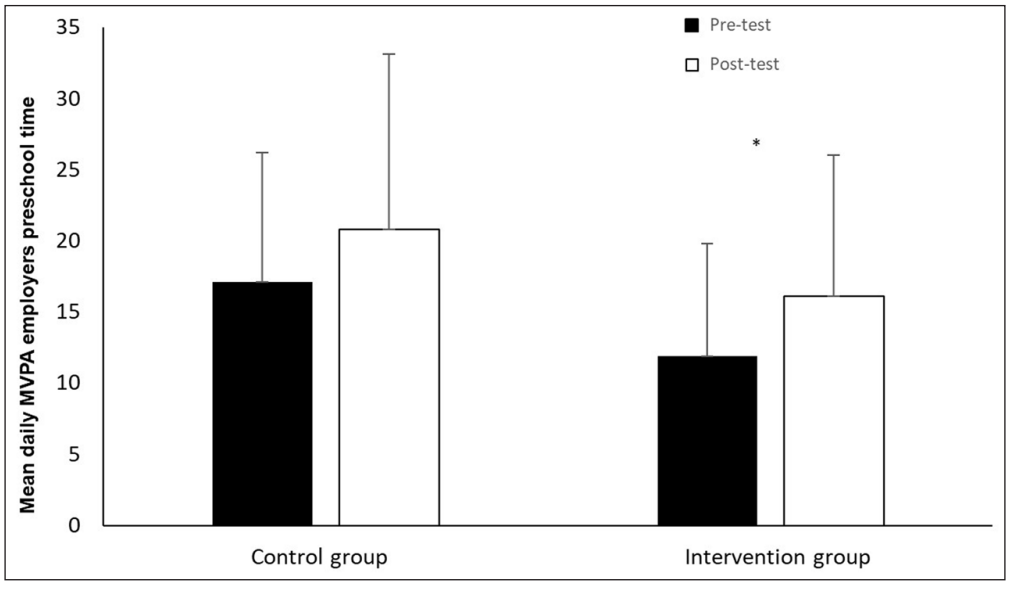

Figure 3 Activity level in MVPA among employees in the control group and the intervention group at both pre-test and post-test.

The statistical analyses in Figure 3 did not show a significant change in MVPA from the pre-test to the post-test, in either the intervention group or the control group ($p > 0.05$). However, the intervention group increased their MVPA from 11.9 to 16.1. Furthermore, the statistical analyses show that there was no significant difference ($p > 0.05$) in MVPA between the control group and the intervention group at both pre-test and post-test.

Figure 4 shows the activity level in CPM among preschool employees in the control group and the intervention group at both pre-test and post-test.

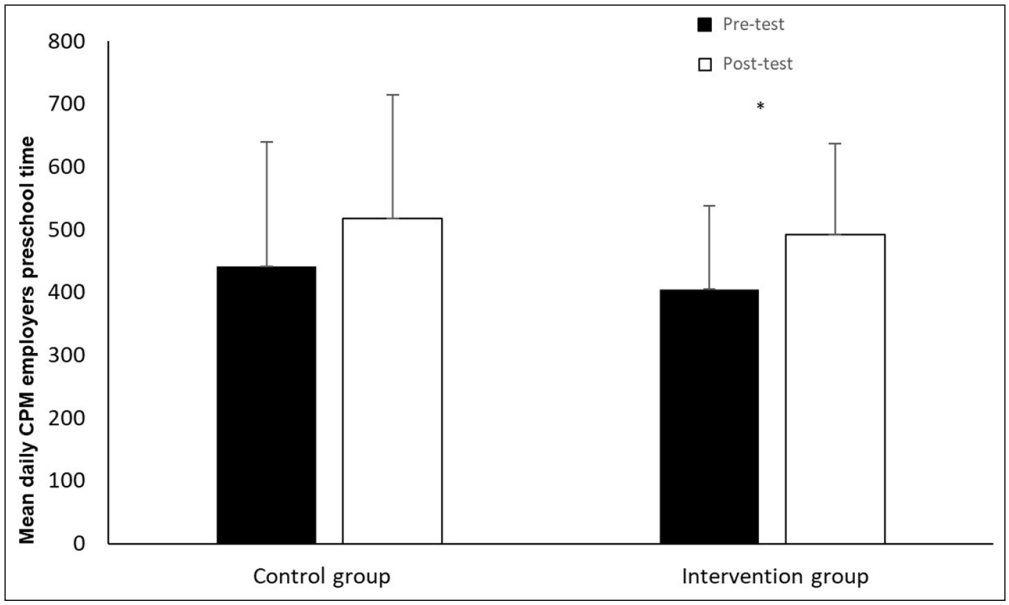

Figure 4 Activity level in CPM among employees in the control group and the intervention group at both pre-test and post-test. *Significantly higher CPM at post-test compared to pre-test in the intervention group ($p < 0.001$).

The statistical analyses in Figure 4 show that there was a significant change in CPM from the pre-test to the post-test in the intervention group ($Z = -3.4$, $p < 0.001$), but not in the control group ($p > 0.05$). The intervention group increased their CPM from 405 to 492. Furthermore, the statistical analyses show that there was a significant difference in CPM between the control group and the intervention group at the pre-test ($Z = -2.6$, $p < 0.01$), but not at the post-test ($p > 0.05$).

DISCUSSION

The first main finding was that the activity videos significantly increased CPM in preschool time among children; however, this was a borderline level close to 0.05. This difference is also small (see Figure 2). The control group had a significantly higher CPM at the pre-test, and we argue that it was easier to increase CPM in the intervention group than in the control group. However, this difference disappeared during the intervention. Our findings indicate that the use of activity videos created an increased general PA level. Furthermore, the activity videos did not significantly increase the MVPA (activity with moderate to vigorous levels of intensity) in preschool time among the children. Our findings (increase in CPM and no significant increase in MVPA) are in line with Peng et al. (2012), who found that playing activity video games generate light-to-moderate PA among children. Furthermore, our findings are also in line with Ramirez-Granizo et al. (2020), who found that activity videos cannot replace PA in MVPA. It is possible that the requirements for coordinating the movements in the videos were too complicated, and that the children were unable to fully participate due to a lack of coordinative skills. This despite the fact that the employees chose videos in line with the children's preferences. It could also be that the children did not find the activity videos interesting enough, and that they could not play bodily enough, as highlighted in the findings of Cooper et al. (2015). The dialectical relationship between children and employees is an important part of socio-cultural thinking (Berger & Luckman, 1967). The child's level of PA thus becomes a function of the dialectical relationship between the child as an individual engaged in PA and the social world communicated through significant others who are responsible for it. Even though the videos were easily organized and based on gross motor movements the children should have developed, it may also be that the movements were too fast or that the transition between each movement was too complicated for some children. It may also be relevant to discuss whether an adaption of the employee's role could contribute to more PA among the children. In this study, there was a focus on the employees participating in the PA together with the children. An opportunity to increase the children's level of physical activity in MVPA could be if employees focused more on adapting the movements to the children's level instead of carrying out the activity themselves. When all the children are helped to master movements, this can increase both the PA level and motivation for participating in the activity. Nevertheless, our findings indicate that the use of activity videos can be an important contribution to more physically

active play in preschool. This is in line with Popeska et al. (2018), who found an effect of the application of Brain Break video exercises on children's attitudes toward PA, motivation for PA, and good internalization of movement habits. This was found even though Brain Break videos are intended to be a shorter break activity from cognitive work. In this study, the activity videos aimed to increase the children's PA in MVPA to a greater extent than in Brain Break videos. The study of Kooiman et al. (2016), highlight that video PA involves PA games in which children play remotely with other children over the internet. In this study, children and employees perform the PA together in the same room. Preschool children need employees present to support their development and learning. This is in line with the proximal development zone of Vygotsky (1978), which states that children can perform some PA alone, but children can do even more with help and support. Using activity videos, the preschool employees can create and offer the children simpler variations of the movements in the videos to give the children mastery of the motor challenges. This emphasizes the importance of the employees being active and supportive in children's physical play. Some of the activities were a combination of different movements with both arms and legs. Preschool children are not yet in the phase where they coordinate movements beyond basic movements (Hansen & Jagtøien, 2019). It may also be argued that physically active adults are good role models for children by encouraging a physically active lifestyle (Bjørgen & Svendsen, 2015). Studies have emphasized the importance of preschool employees as facilitators and supporters of PA (Kippe & Lyngstad, 2021; Brown et al., 2009). Furthermore, it seems to be of general agreement among several researchers (Brown et al., 2009; Gubbels et al., 2011) that positive adult encouragement is especially important when preschool employees participate in children's PA. One study of Fossdal et al. (2018) demonstrated that a significant association exists between preschool employees' aggregated PA levels and four- to six-year-old children's individual activity levels in preschool. These findings are supported by Sørensen (2012), who suggests that preschool employees should engage in PA with children, whereby PA is expressed verbally as fun, rather than a duty. The preschool employees are responsible for providing activities that give the children positive mastering experiences (Norwegian Directorate for Education and Training, 2017). Positive adult encouragement might increase children's PA through perceived sporting competence (Gubbels et al., 2011). A consequence of preschool employees' participation in children`s PA could be that more children will fulfil the recommendation of 60 minutes of MVPA per day.

The second main finding was that the activity videos increased the CPM level among preschool employees during preschool time. In fact, the percentage of relative increase from the pre-test to the post-test was substantially higher among employees, than children. The increased CPM may be related to the fact that the employees had to participate in the PA while using the activity videos to support the children in the activity. Furthermore, our finding of an increased CPM from 405 to 492 is also an important contribution to the preschool employees' total daily PA. Our findings are higher than in a study by Kippe and Lagestad (2020), who found that preschool employees working with four- to six-year-old children had 428 CPM during preschool time in a traditional week. The present study found an increased MVPA from 11.9 to 16.1 in the intervention group. This is substantially lower than the 30 minutes of MVPA among preschool employees mainly working with four- to five-year-old children in a study by Kippe and Lagestad (2020). This difference may be related to a period with Covid-19 and absence due to illness among the preschool employees. The preschool employees may have had busy days with extraordinary tasks to do due to fewer preschool employees at work, which may have influenced the opportunity to be physically active. Furthermore, the results indicate that PA videos are important for the preschool employees' PA in preschool. Furthermore, among the children, the statistical analyses (Figure 1) show no significant change in MVPA from the pre-test to the post-test, in either the control group or the intervention group. According to Peng et al. (2012), a consistent finding is that playing activity video games is generally equivalent to light-to-moderate PA among children. In addition, children rate the perceived exertion of playing activity video games to be like an activity with lower intensity (Peng et al., 2012). This is in line with Ramirez-Granizo et al. (2020), who found that activity videos are not able to replace PA in MVPA. This may indicate that activity videos may be a good starting point for creating PA among sedentary or low-active children. This is in line with a study by Ramirez-Granizo et al. (2020) that shows that activity videos can counteract sedentary behaviour and increase participation in PA. Furthermore, Pipsa et al. (2017) found that over two weeks (baseline and intervention), the mothers and children who used a movement-to-music video program (i.e., the intervention

group) demonstrated less sedentary time during the intervention week, compared to the baseline week. Peng et al. (2012) highlighted that videos can be useful for children who are not interested in physically active play. Outdoor play, taking trips, and being in nature have a long tradition in Norwegian preschools (Bjørgen & Svendsen, 2015). For children who do not prefer to be physically active outdoors, such as "catch and run" games, climbing trees, or trips in nature, the activity videos can be considered as a good supplement to other physical play in preschool to ensure varied gross motor PA for the children. Finally, in the context of exercise, music may promote behavioural change through increased exercise adherence and participation (Peng et al., 2012). Moreover, Peng et al. (2012) point out that although studies found that activity video games are liked or enjoyed more than traditional exercise over a shorter period, the use of activity videos over time decreases the success of such interventions.

Studies show that inclusion of all employees, adaption to context and breaking down barriers was an important factor in the successful implementation of interventions with the aim of increasing children's PA level (Øvreås et al., 2020; Hnatiuk et al., 2019; Finch et al., 2016). In addition, in order to have long-term effects of interventions, it is appropriate to link the employee's competence, professional responsibility and professional development to an intervention design that aims to strengthen physically active play in preschool (Øvreås et al., 2020). Furthermore, interventions should not only focus on direct action, but also aim at increasing parents' awareness of their role model function in promoting their children's healthy lifestyle, especially at early years (Ruedl et al., 2022). This shows the complexity of the work to increase children's PA level and highlights the importance of the sociocultural perspective in promoting a healthy lifestyle among preschool children.

STRENGTHS AND LIMITATIONS OF THE STUDY

The present study possesses several advantages. One strength is that it included many participants. Furthermore, different types and sizes of kindergartens were also included in the study due to random selection, which yielded a representative sample. Accelerometers, as an objective measurement, decrease subjectivity (Sirard & Pate, 2001) and eliminate bias like social desirability, and recall problems (Evenson et al., 2008). Furthermore, several researchers identified accelerometers as the optimal method to capture PA in free-living situations (Phillips et al., 2021; Plasqui & Westerterp, 2007; Brage et al., 2015). The Actigraph GT3X is validated and reliability-tested for measuring PA levels for children aged zero to five years old (Brage et al., 2015; Butte et al., 2014; Hänggi et al., 2013; Jimmy et al., 2012; Evenson et al., 2008; Corder et al., 2007; Pate et al., 2006). Furthermore, the effects of using music in activity videos have previously been studied mostly in adults (Peng et al., 2012). The present study also includes music activity videos among children, e.g., videos in which children were encouraged to dance and move to music.

Nevertheless, the present study is not without limitations. The study was carried out during the Covid-19 pandemic, which led to some dropouts among the control group. One out of two preschools in the control group had many children affected by Covid-19. Furthermore, the control group consists of only eight preschool employees, and even though the sample size was large in general, it would have been preferable to have a larger control group. Finally, the study does not address potential confounding variables, such as teachers' work experience, familiarity with technology (like activity videos), and PA during leisure time, which could have influenced the data.

In order to increase children's PA in a long-term perspective, further research should focus on the importance of intervention designs that are linked to the employee's competence, professional responsibility and professional development. In addition, it is important to adapt the intervention to the participating preschools.

CONCLUSION

The results show that the use of activity videos increased CPM among children during preschool time significantly, with no change in the MVPA level. Considering the findings, we argue that the activity videos did not offer the children enough intensity to increase PA in MVPA. However, the activity videos can be an important contribution to more general PA among four- to six-year-

old children in preschool. Furthermore, this study shows that the activity videos substantially increased the CPM level among the preschool employees. The results point towards PA videos as a contributor to increasing preschool employees' general PA level, and important in helping the preschool employees fulfil the weekly health recommendation for PA. In addition, this study shows that the employees physically active participation is not sufficient to increase children's physical activity in MVPA, and that providing activity videos alone are not enough to increase children's PA level substantially in preschools. This finding contributes to advancing knowledge in the field about how the use of activity videos impact both the children's and employees PA level at preschool, but also highlights the importance of future research focused on the employee's role in children's physical activity with the use of activity videos. To address gaps in existing research future studies should also examine how different types of activity videos increase children PA level at preschools.

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COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

KK contributed to the design and writing of the introduction, methods, discussion and conclusion sections. PL contributed to the methods, statistical analyses, discussion and conclusion sections.

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