

Physical Activity among Preschool Children

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The physical activity habits of children are established as early as the first year of life and have been suggested to follow many children through their school years into adulthood. We know that obesity and risks of cardiovascular diseases, for instance, are developed as early as the first few years of childhood. Studies show that blood vessel changes and other factors, which are the initial signs of incipient cardiovascular disease, are detected as early as in 3-year-olds, who have several risk factors, such as elevated body mass index (BMI), high blood pressure and elevated blood fat and cholesterol counts (1). A correlation between these risk factors and the amount of physical activity in 9-year-olds and 15-year-olds has been established in European Youth Heart Studies (EYHS) (2, 3). Very few studies, however, have examined how physical activity measures aimed at preschool children would affect various health parameters. Accordingly, only limited knowledge exists of whether insufficient physical exercise in early childhood is deleterious. Yet based on existing knowledge about the beneficial effect of physical activity among schoolchildren, our hypothesis is that a certain amount of physical activity as early as preschool age is important to the health of these preschoolers now and later on in life.

Statistics Denmark has noted that 95 per cent of all children aged 3 to 5 attend a kindergarten school or similar age-integrated institution. This means that almost all the children in this age group are involved in some sort of childcare scheme every day. Much of their day is spent at a kindergarten which, accordingly, should also provide an environment that promotes a substantial physical activity among the children. Our knowledge of children's patterns of physical activity at kindergarten is limited, as only a few valid studies have been carried out (primarily in the US), and few research groups have focused on this topic. Thus, a study of the extent of physical activity among children during the time spent at kindergarten that identifies the determinants of their activity patterns would be most relevant. For quite some time, we have wanted to study the effects of physical activity on the health of preschool children. Prior to embarking on this type of study, however, we needed a more extensive insight into the determinants of physical activity among children at kindergartens and, for this reason we recently carried out a pilot study.

Aims and methods

The pilot study had two primary aims:

- 1) to describe the level of physical activity by 3 to 6-year-olds during the time spent at the kindergarten;
- 2) to determine the demographic factors significant for the level of physical activity at the kindergarten, including the children's sex and age, the type of kindergarten, the area where the school is situated and the socio-demographic data of the parents.

We studied the level of physical activity among children at various types of kindergartens located in various areas. A total of 184 children from seven different kindergartens participated in the study. Three of the kindergartens were "traditional" and three were "Physical activity (PA) and play oriented" located in three different districts of Odense Municipality, and one was a "prototypical" kindergarten located in Ringe (The Four Seasons Kindergarten) that puts a high priority on outdoor play, as the children are outdoors for roughly 80 per cent of the time they attend this school. One

traditional and one PA and play kindergarten participated from each of the following three districts of Odense Municipality: the town centre, a suburb and a district with a high level of ethnic, religious and cultural diversity (Vollsmose). The physical activity among the children was objectively measured using an accelerometer (Actigraph, MTI 7164), one of the most valid methods for objectively measuring physical activity in large-scale studies (4). The children only wore the monitor while at the kindergarten, as the study exclusively focused on the time spent at the institution. The measurements were performed at two kindergartens at a time, over five consecutive days in the same week. The kindergartens were paired by district and type (cf. PA and play-oriented and traditional kindergarten), enabling us to consider weather-related differences, for instance. The children attending the The Four Seasons Kindergarten were measured at the same time as the children at schools in the centre of Odense. The children wore the activity monitor 6.5 hours a day for 4.6 days, on average. Previous studies show that a few days of physical activity measurements of preschoolers are sufficient for obtaining a credible picture of the preschoolers' daily activity patterns. Thus, we have good reason to believe in the validity of our observations in terms of whether the measurements reflect the children's actual daily level of activity at the kindergarten.

Physical activity determinants

Statistical analysis helps us to analyse the demographic factors of greatest significance for the level of physical activity among children attending kindergartens. The most obvious factor affecting the variation in activity was the individual kindergarten, which contributed 15 percent. The children's age and sex significantly explained some of the variance in physical activity, as well. By contrast the children's BMI and their parents' level of activity, BMI and financial income had no association with the level of physical activity at the kindergarten.

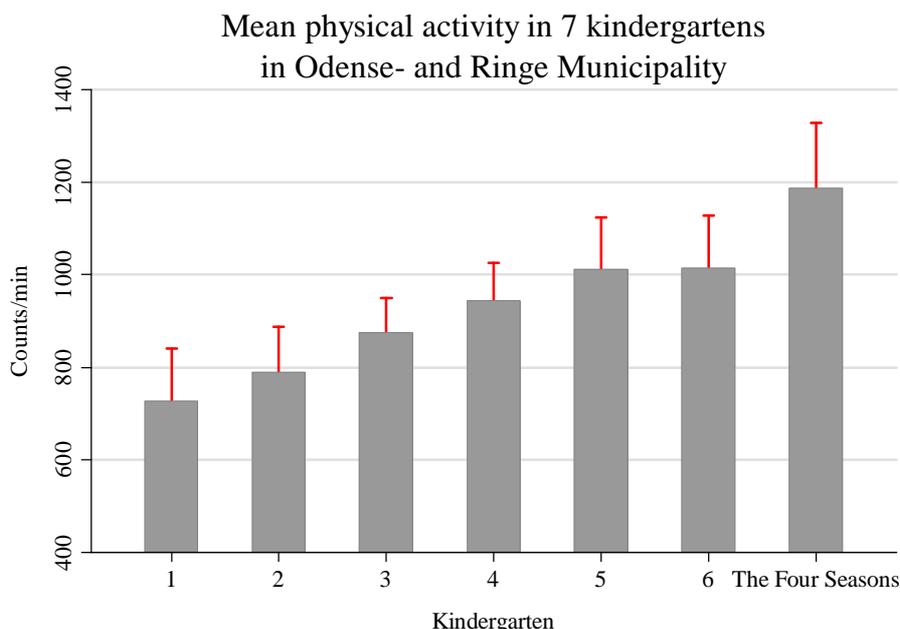


Figure 1. Mean level of physical activity (counts/min.) during time spent in kindergarten at 7 kindergartens in Odense and Ringe municipalities. The individual kindergarten had the greatest impact on the variation in level of physical activity (15%) of all the demographic factors studied. The bars are average values \pm 95% CI (I).

The mean level of physical activity, inactivity and moderate-to-vigorous physical exercise varied significantly from one kindergarten to another. Generally speaking, the children at the most active kindergarten were 39 per cent more physically active, spent 10 minutes less per hour on sedentary activities and 4 minutes more per hour on moderate/vigorous physical exercise at the kindergarten than the children at the least active kindergarten. On average, the children at the most active kindergarten were involved in moderate or vigorous physical exercise for 62 minutes of the time spent at

the kindergarten, compared to only 35 minutes for children at the least active kindergarten – or a little more than half that at the most active kindergarten. We observed a significant difference in children’s level of activity between the kindergartens representative of the Municipality of Odense, and the children attending The Four Seasons Kindergarten who were considerable more physically active in all levels of physical activity independent of all demographic factors explored. Despite the fact that we did not measure the amount of time spent outdoors, this finding supports the importance of free outdoor play on the level of physical activity as earlier studies have reported (5, 6).

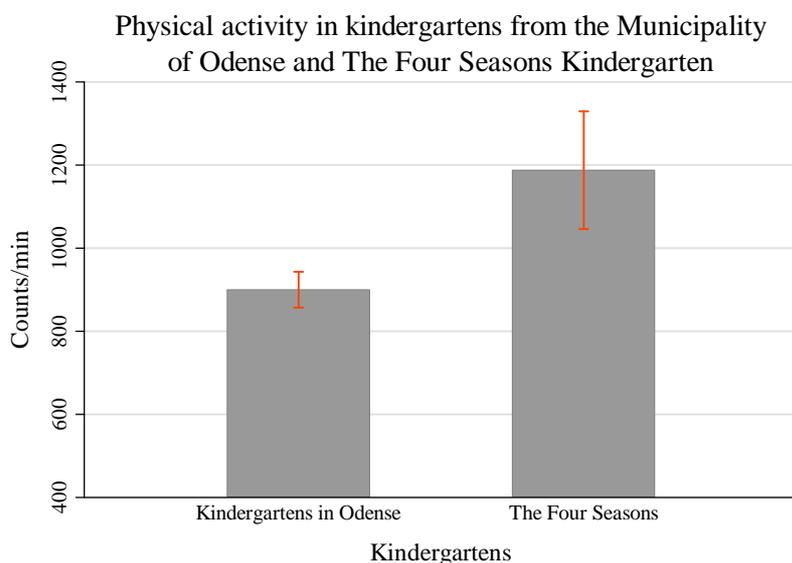


Figure 2. Mean level of physical activity (counts/min.) of children attending kindergartens representative of the Municipality of Odense, and The Four Seasons. The bars are mean values \pm 95 % CI (I). The children at The Four Seasons were significantly more physically active than children attending kindergartens in Odense, independent of all other demographic factors.

Other observations

We found a distinct difference in activity patterns between boys and girls regardless of age. Thus, boys were 20 per cent more physically active than girls on average (figure 3), which corresponds with the results of our previous findings among 6 to 7-year-old boys and girls in the Copenhagen School Child Intervention Study and 9-year-olds and 15-year-olds in EYHS-I and EYHS-II (7, 8). Accordingly, our results indicate a distinct gender-related difference in physical activity starting as early as the age of 3 to the age of 15 when the gender-related differences apparently disappear. The latest results involving 3 to 6-year-olds are based solely on the time spent at the kindergarten, however. We still have little knowledge of the underlying reasons for the substantial gender-related difference in activity levels which starts even among preschoolers. Thus, we do not know whether these differences are primarily caused by socio-cultural or biological factors. A few previous studies have shown for instance that, generally speaking, the play of preschool boys usually involves a higher level of activity and that preschool boys tend to play in larger groups, take greater risks and have more bodily contact than preschool girls (9). Based on our results, however, we recommend that an extra effort are to be made to encourage physical activity among girls at a very early age. Our observations regarding gender-related differences are consistent with observations from a group of US researchers who have also used accelerometers to measure children’s physical activity during the time spent at kindergarten (10).

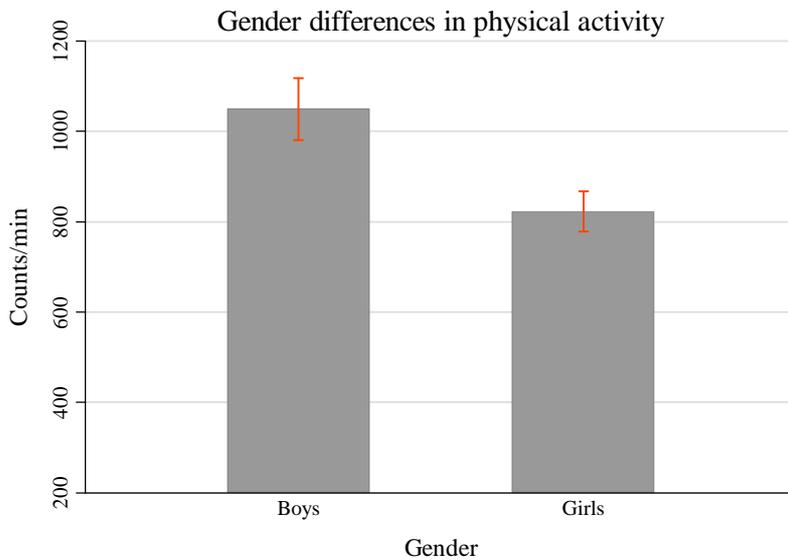


Figure 3. Mean level of physical activity (counts/min.) at the kindergarten, stratified by gender. The bars are mean values \pm 95% CI (I). Boys are significantly more active than girls while at kindergarten, independent of age, BMI and type of kindergarten.

The results of our study also show that the level of activity increases with age, where the 5 to 6-year-olds were 20 per cent more active on average than 3 to 4-year-olds, regardless of sex or of which kindergarten the children attended (figure 4). Compared to our results from the Copenhagen School Child Intervention Study and EYHS studies, this indicates that the level of activity is highest until the children start attending school, after which the level probably stabilises until the mid-school years when it declines toward the final school years among boys and girls alike. This overall assessment is primarily based on cross-sectional studies, however, which should be interpreted with caution.

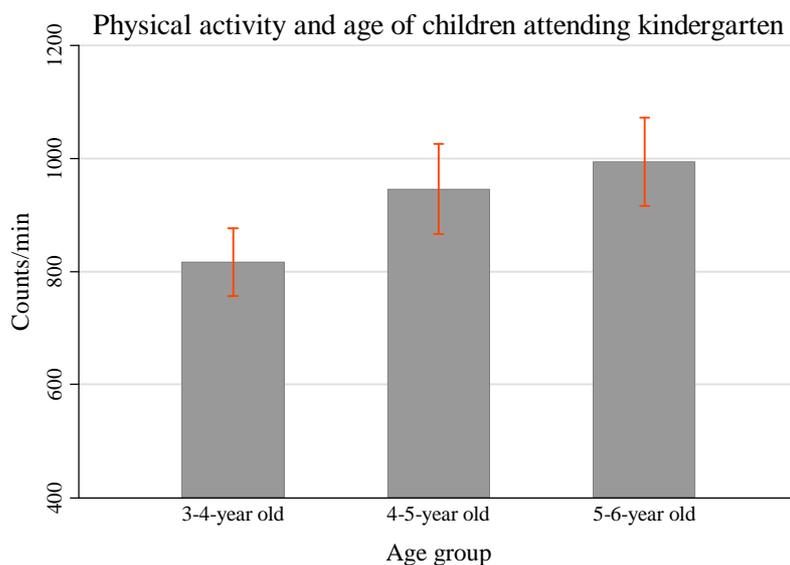


Figure 4. Mean level of physical activity (counts/min.) among children attending kindergarten, stratified by age groups: 3 to 4-year-olds, 4 to 5-year-olds and 5 to 6-year-olds. The bars are mean values \pm 95% CI (I). 5 to 6-year-olds are significantly more physically active than 3 to 4-year-olds.

Recommended level of physical activity

Even though the National Board of Health recommends that all children and adolescents (under 18 years of age) should participate in moderate physical activity for at least 60 minutes a day, our recent research shows that this figure should be at least 90 minutes (3). Children attending the most active kindergarten probably get an additional 30 minutes of exercise before or after attending kindergarten. On the other hand, it is doubtful whether children at the least active kindergarten get 55 minutes of moderate physical exercise before or after attending kindergarten. Overall, the children in the study obtained, on average, slightly more than half their recommended 90 minutes of exercise a day at the kindergarten. It is doubtful whether children achieve the other half before or after attending kindergarten and, thus, it is likely that a large percentage of 3 to 6-year-olds probably do not achieve the recommended daily level of physical activity. Table 1 shows the level and varying intensity of physical activity among children while they are at kindergarten, broken down by age and sex. At present, we do not know the required level of physical activity at a kindergarten to achieve a sufficient health-related effect. It is our hope that future studies analysing the effect of physical activity of preschool children may provide some answers to this.

Physical activity patterns recorded among children at 7 kindergartens in Odense and Ringe (number of minutes and hours a day)						
	N	Recorded time at kindergarten	Sedentary activities	Light to moderate intensity	Moderate to vigorous intensity	Time lacking in moderate-vigorous intensity
Total	184	6 hrs, 33 min.	4 hrs, 21 min.	1 hr, 23 min.	49 min.	41 min.
Boys	88	6 hrs, 33 min.	4 hrs, 9 min.	1 hr, 28 min.	56 min.	34 min.
Girls	96	6 hrs, 33 min.	4 hrs, 33 min.	1 hr, 18 min.	42 min.	48 min.
3-4-year-olds	56	6 hrs, 20 min.	4 hrs, 21 min.	1 hr, 20 min.	39 min.	51 min.
4-5-year-olds	63	6 hrs, 42 min.	4 hrs, 23 min.	1 hr, 28 min.	51 min.	39 min.
5-6-year-olds	65	6 hrs, 39 min.	4 hrs, 20 min.	1 hr, 23 min.	56 min.	34 min.
<u>The Four Seasons</u>						
Total	21	6 hrs, 45 min.	3 hrs, 59 min.	1 hr, 44 min.	1 hr, 2 min.	28 min.
Boys	14	6 hrs, 53 min.	3 hrs, 48 min.	1 hr, 54 min.	1 hr, 11 min.	19 min.
Girls	7	6 hrs, 30 min.	4 hrs, 20 min.	1 hr, 24 min.	46 min.	44 min.

Table 1. Data are the average time spent at the kindergarten. The last column shows the time needed to achieve 90 minutes of daily moderately intense physical activity.

Conclusions

The results of this pilot study indicate that children's level of physical activity varies significantly from one kindergarten to another and that the individual kindergarten has far greater influence on a child's level of activity than other demographic factors, such as type of school, the children's sex, age or BMI or the parents' BMI, level of activity and income factors. Nevertheless, we must point out that the results are merely based on measurements taken at three traditional and three sport-oriented kindergartens and one kindergarten in the village of Ringe, and that these observations should be interpreted with this in mind. However, we have verified a number of factors, such as district and measurement timeframe, by which traditional and sport-oriented kindergartens were

paired, which adds to the validity of the study as a result. Nevertheless, we found that the individual kindergarten clearly explained the greatest degree of the variation in children's levels of physical activity. This has also been observed in a US study of nine kindergartens (10). Thus, we assume our results to be valid in terms of the individual kindergarten's contribution to the children's physical activity. In the near future, therefore, we would like to study the precise factors at the individual kindergartens that help to determine the level of physical activity among the children. We will study the following determinants, among others, which, on the basis of our own observations and a few previous studies, we believe are the factors that determine the level of physical activity at a kindergarten:

- the amount of time spent outdoors;
- possibilities for playing in a playground and the size of the playground;
- the number of trips outside the kindergarten;
- the furnishings, layout and size of the kindergarten;
- the kindergarten's policy relating to physical activity;
- the employees' approach to physical activity at the kindergarten;
- the sex and age dispersion of kindergarten employees;
- the number of employees per child at the kindergarten;
- the educational background of the kindergarten employees;
- the employees' level of physical activity at the kindergarten.

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