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Peer Influence and Physical Activity Behavior in Young Children: An Experimental Study

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Abstract

Background: There is evidence that the presence of a friend increases physical activity behavior in school-aged children (≥ 8 years old) and in young adolescents. Little is known about the developmental trajectory of the effects of peer influences on children's physical activity. Therefore, we sought to test the effect of the presence versus absence of a friend on physical activity in young children (≤ 6 years old).

Methods: Physical activity was assessed, via accelerometery, in 3- to 6-year-old children, during 2 social conditions: alone and in the presence of a friend. During each condition, children were taken to a gymnasium and had free access to physical and sedentary activities for 30 minutes. In one condition children were tested alone (solo play), whereas in the other they were tested in the presence of a friend who had access to the same activities.

Results: Children exhibited 54% greater ($P < .02$) average accelerometer counts during the friend condition (mean = 2629, SD = 1080 or 5.7 METs) than during the solo play condition (mean = 1707, SD = 1009 or 4.5 METs).

Conclusions: The presence of a friend contributes to increased physical activity behavior in young children.

Keywords

pediatrics; sedentary; obese; accelerometery

It is well established that physical activity skills and sport abilities are important determinants of social popularity in children. Specifically, children who are perceived as

having good athletic ability are more likely to have better peer relationships and peer acceptance.[1,2] Recently, several studies have provided evidence that positive social interactions may in turn promote physical activity behavior in school-aged children (≥ 8 years old) and young adolescents (12–14 years old).[3-16] The majority of this evidence, with the exception of 2 experimental studies, comes from nonexperimental studies, which limit causal inference. However, the 2 extant experimental studies are consistent with previous findings in indicating that children are more physically active in the presence of their peers than when alone.[12,16] All previous studies on the influence of peers and friends on children physical activity have been conducted in school-aged children and young adolescents, and it is unclear whether these findings extend to young children.

There are good reasons to expect that the presence of others impact children's physical activity differently across ages. During preschool years, children undergo rapid and significant cognitive, physiologic and social development.[17-19] During this period of development, children dramatically improve their motor skills and capacity for social interaction.[20,21] Preschoolers learn differently from school-age children and play is the main mode young children will learn to build the skills necessary for their critical thinking and social development.[22] However, the enjoyment and understanding of cooperative play required for physically active play are not readily developed in young children.[21] Between the ages of 2–3 years old, children begin to play alongside other children, and children less than 5 are not fully grasping the concepts of turn taking and following simple rules in games and sports.[23-25]

It is also the case that children less than 5 years old still have substantial difficulty inhibiting a prepotent response.[26] This ability to inhibit impulses plays a crucial role in everyday peer interactions in the classroom and in engaging in physical activity with others.[27,28]

This study assessed the effect of the presence of a friend (compared with being alone), on the intensity and amount of physical activity in 3- to 6-year-old children. The experiment was conducted in a gymnasium using physical activity and sedentary alternatives youth are likely to encounter in their natural environment. We hypothesized that the presence of a friend would increase the intensity and amount of physical activity in young children.

Methods

Participants

Twenty (N = 10 females) children between the ages of 3–6 years old participated in the current study. Recruitment of participants was accomplished via flyers posted in the local community and from a database of individuals who had previously contacted the Applied Physiology Laboratory at Kent State University to participate in separate, unrelated studies. Children were excluded from the study if they had any conditions (ie, orthopedic injury, illness) that could be considered contraindications to physical activity. Once a child was deemed to be eligible during a phone screen their parent/guardian indicated the name and contact information of a same-sex child that their child identified as a friend. Investigators then contacted the parent/guardian of the friend to determine their interest and eligibility for the study. To be eligible both children had to reciprocally identify each other as friends. If

the initial friend was not eligible for the study the participant indicated a second friend. Once a friend was deemed eligible for the study, both the initial participant and their friend then served as participants in all aspects of the study. All participants indicated verbal assent and their parent/guardian provided written consent. All procedures were approved by the University's Institutional Review Board.

Procedures

Children meeting the entry criteria were invited to the Applied Physiology Laboratory at Kent State University for 2 separate visits. Each of these visits was completed during a spring semester, on week days (Monday to Friday) between 3 PM and 7 PM. During the first visit, consent and assent were obtained and children's height and weight was assessed (procedure described below). Afterward, all children had the opportunity to sample physical and sedentary activities in a 4360 square foot gymnasium (gymnasium configuration described below).

After sampling the physical and sedentary activities for 5 minutes, children participated in their first of 2 condition trials, either solo play or with their friend. The order of these sessions was counterbalanced. During each session children had free access to all of the previously sampled physical and sedentary activities for a period of 30 minutes and were free to use the equipment, in any pattern, for the entire session. A member of the research team was present in the gymnasium to monitor the children's behavior. Children were informed that the observer was there simply to ensure their safety while they were playing in the gymnasium. Apart from the participant (or 2 participants during the with-friend condition) and the member of the research team observing, there were no other individuals present in the gymnasium during the 30-minute activity sessions. At the conclusion of each 30-minute activity session, children were asked by the research team member whether they wished to participate in an additional 10 minutes of activity in the gymnasium or if they wished to be done for the day. If children chose to participate in an additional 10 minutes of activity they were provided with immediate, free-access to the same physical and sedentary activity equipment as the 30-minute session. If children chose to not participate in the additional 10-minute activity session they were sent home for the day. During the friend session, both children had to agree to participate in the additional 10-minute activity session, otherwise they were sent home for the day. Friends were asked together and informed that if they did not both agree, they would be done for the day. This was done to maintain consistency (eg, presence or absence of a friend during play). The decision to or not to participate in the additional 10-minute activity session was recorded as a potential estimate of how motivating the child found that particular condition. After completing the first social session children were scheduled to return to the laboratory for the remaining session, on a separate day. After completing the second session, children were asked which session they preferred (solo play or with a friend). Research personnel assessed preference via the following question: "Which day did you like more: the day when you played with your friend or the day when you played alone?" Children were privately asked which session they preferred and their responses were kept confidential from their friend. Children were then compensated with a $20.00 gift card to a local store for their participation.

Gymnasium Configuration

Physical Activity Equipment.—Physical activities/ equipment included a jump rope, modified hurdles, several Nerf footballs, and flying discs with targets and goals (Hasbro, Pawtucket, RI), standing long jump, kicking a soccer ball around a series of 7 cones, and navigating 2 obstacle courses made up of gymnastic/soft-play equipment (UCS Inc., Lincolnton, NC). Detailed descriptions of the obstacle courses are available upon request.

Sedentary Activity Equipment.—The sedentary activity area was equipped with a table and 2 chairs. Children were informed that if they wished to play with the sedentary activities they needed to be seated in 1 of the 2 chairs. The sedentary alternative available included: toys (Thomas the Tank Engine Wooden Railways trains and track, Learning Curve, Oak Brooke, IL), age appropriate books, crayons and blank paper for drawing, coloring sheets, and the matching game Perfection (Milton Bradley Company, East Longmeadow, MA).

Measurements

Anthropometrics.—Weight was assessed to the nearest 0.2 kg and height to the nearest 1.0 mm using a balance beam scale and calibrated stadiometer respectively (Health O Meter, Alsip, IL). BMI Percentile was then calculated using the Centers for Disease Control BMI ($m \cdot kg^{-2}$) Percentile Calculator for Child and Teen.[29]

Accelerometry.—Physical activity intensity was assessed via accelerometry during each 30-minute activity session. Children wore an ActiGraph GT1M Monitor (ActiGraph, Pensacola, Florida) on their hip, snug against the body. Epoch length was set to 60 seconds and per-minute accelerometer counts were averaged over each 30-minute session. For children choosing to participate in the optional, additional 10-minute activity session the same accelerometer was also worn throughout that activity session. Epoch length remained at 60 seconds and per-minute counts were averaged over the 10-minute session. Accelerometer data were also converted to metabolic equivalents (METs, 1 MET = 3.5 $ml \cdot kg^{-1} \cdot min^{-1}$ of oxygen consumption) based on each child's age.[30] The ActiGraph is a valid and reliable tool for objectively assessing physical activity in children.[31]

Sedentary Activity Observation.—During each 30-minute activity session, the amount of time children allocated to the sedentary activities was monitored with a stop watch (Traceable Stopwatch, Fisher Scientific, Waltham, Massachusetts) by a member of the research team discretely observing the session. Research personnel started the stop watch when children came to the table of sedentary behaviors and sat at the chair to play. The stop watch was stopped when children left the table to return to the physical activities. If a child returned to the table multiple times, identical procedures were followed and the time allocated to sedentary activity during the 30-minute activity session was summed.

Analytic Plan

Independent samples *t* tests were performed comparing differences in physical characteristics (age, height, weight, and BMI percentile) and activity data (accelerometer counts and sedentary time) between boys and girls.

Mixed effects models were used to analyze the relationship between the dependent variables (accelerometer counts and minutes allocated to sedentary activity) and the time variant (social condition) predictor variable from each 30-minute activity session. Sex was initially included in the models as a time invariant predictor however it was removed as there were no significant ($P \geq .10$ for all) main or interaction effects of sex for either of the dependent variables nor were there any sex differences in any of the subject physical characteristics. Mixed-effects models were used due to the multiple observations and interdependence of the observations within participants.[32,33] For such analyses the individual outcomes are modeled taking into consideration the dependence of observations within individuals.

Social conditions were dummy-coded as either 0 (solo play) or 1 (with friend). The models for accelerometer counts and time allocated to sedentary activities during each 30-minute activity session are illustrated below:

$$\text{Accelerometer counts} = \alpha + \beta_1 \text{ (social condition)}$$

$$\text{Sedentary time} = \alpha + \beta_1 \text{ (social condition)}.$$

It is important to note that the accelerometer counts and minutes allocated to sedentary activity were analyzed using the 30-minute activity sessions only. Any additional activity performed during the optional 10-minute bonus periods were not added to the initial 30-minute activity session totals.

A Wilcoxon signed rank test was used to determine the differences in children's decision to choose to participate in the optional 10-minute bonus period of activity in the solo play versus the with-friend conditions. Finally, a chi-square analysis was performed to assess any differences in the number of children indicating their preference of the 2 social conditions.

Results

Physical Characteristics

Physical characteristics are shown in Table 1. There were no significant differences ($P \geq .13$) between boys and girls for any variable.

Accelerometer Counts

The model testing the effects of social condition on average per-minute accelerometer counts revealed a significant main effect of social condition for accelerometer counts ($F = 7.8$, $P = .008$). Average per-minute accelerometer counts were greater in the friend condition (mean = 2629, SD = 1080 or 5.7 METs) than the solo play condition (mean = 1707, SD = 1009 or 4.5 METs).

Minutes of Sedentary Activity

The model testing the effects of social condition on the amount of sedentary activity time children participated in revealed a trend toward a significant main effect of social condition

for sedentary time ($F = 3.4$, $P = .07$). Children accumulated 16.0 (SD = 8.3) minutes of sedentary activity in the solo play condition and 11.7 (SD = 6.4) minutes in the friend condition.

Bonus Period of Activity

A significantly greater ($z = 3.3$, $P < .001$) proportion of children chose to participate in the optional, 10-minute bonus period of activity in the friend condition (100%) than the solo play condition (45%).

Social Condition Preference

A significantly greater [χ^2 (1, N = 20) = 5.0, $P < .03$] number of children indicated that they preferred the with-friend social condition (N = 15) versus the solo play condition (N = 5).

Discussion

This is the first study to experimentally assess the effect of the presence of a friend on the amount of physical activity in pre- or early-elementary school age children (≤ 6 years old). Children exhibited 54% greater average accelerometer counts in the friend session then in the solo play condition. While children reduced time allocated to sedentary behavior by 25% in the presence of a friend versus the solo play condition, this was not a statistically significant reduction. All (100%) of the children chose to participate in the optional, 10-minute bonus period of activity in the with-friend condition versus only 45% in the solo play condition and 75% of the children stated that they preferred the with-friend condition to the solo play condition. This suggests that children preferred the with-friend condition and the presence of a friend not only increased physical activity intensity, but also increased the likelihood that children would choose to allocate additional time to the gymnasium activities.

The current 54% increase in physical activity intensity in the with-friend condition is greater than what has been noted previously in the 2 experimental studies assessing the effect of the presence of peers on physical activity behavior in older children and adolescents.[12,16] The greater effect noted presently indicates that these younger children may be more responsive to the presence of their friends than older children. Therefore, while additional research is needed, interventions designed to increase socialization in an effort to increase physical activity may have great efficacy in young children.

Previous studies examining the effects of peer/friends on physical activity included assessments of psychological variables that are predictive of actual physical activity behavior in children.[34,35] Salvy et al[12] assessed relative reinforcing value (motivation) of physical versus sedentary activity and Rittenhouse et al[16] assessed liking of physical activity. Because the children in the current study were considerably younger, it was not possible to accurately assess these constructs herein. Therefore, we simply asked children which condition they preferred and if they wanted to spend 10 more minutes playing while we continued to monitor the intensity of their activity. When in the presence of their friend, children increased physical activity intensity according to accelerometer counts and were more likely (100% with-friend versus 45% solo play) to choose to participate the 10-minute

bonus activity. During the 10-minute bonus activity periods average accelerometer counts were not lower in both the solo play (mean = 2180, SD = 1588 counts·min^{-1} or 5.1 METs) and with-friend (mean = 3003, SD = 1274 counts·min^{-1} or 6.2 METs) conditions than the corresponding 30-minute period (mean = 1707, SD = 1009 counts·min^{-1} or 4.5 METs solo play, mean = 2629, SD = 1080 counts·min^{-1} or 5.7 METs with-friend). This suggests that when children chose to perform the additional 10-minute bonus activity they used that time to participate in additional physical activity and did not decrease their activity intensity. A greater number of children (75% of participants) also indicated that they preferred the with-friend condition over the solo play condition and some provided unsolicited, anecdotal comments including "I liked playing with my friend more than (being) alone," "it (time) went faster with my friend," and "we want to play longer (after the conclusion of the 10-minute bonus in the with-friend condition)" that further indicated their preference for the with-friend condition. Because children chose the bonus activity, during which they maintained the intensity of their physical activity, far more frequently when with a friend than during solo play it is possible that children in the current study were more motivated to be physically active when with a friend than during solo play. The greater preference for the friend condition and the unsolicited comments from the children supports the contention that children had a greater liking (ie, enjoyment) of these activities in the presence of a friend.

While the results of the current study add to the literature, there are some limitations that we must acknowledge. The sample size was relatively small (N = 20) and homogeneous (N = 18 Caucasian, 2 African American). This small sample size did not allow for the analysis of possible moderators of physical activity behavior in the 2 social conditions such as age and bodyweight. Children were also paired only with same-sex friends. It is not known if the effects would be comparable if children were paired with members of the opposite sex. In addition, while examining a younger group of children was novel, future research should examine this age group relative to older children and/or adolescents to assess developmental differences. In the current study children were paired only with friends. Therefore, future studies may want to consider including a condition in which younger children interact with unknown peers. Finally, during the with-friend condition both children had to agree to participate in the bonus 10-minute session or neither would be permitted to do so. It is therefore possible that some children agreed only because their friend chose to participate in the bonus session and not because they themselves were motivated to do so.

Conclusion

This was the first study to assess the effect of the presence of a friend on physical activity behavior in pre- or early-elementary school age children. This was the second experimental study to examine the effect of the presence of a friend on physical activity behavior in individuals of any age. This single previous study used cycle ergometry as the sole form of physical activity whereas the activities used in the current study were likely more similar to the types of activities children of this age typically participate in.[12] Relative to a solo play condition, the presence of a friend increased the intensity of physical activity and resulted in more than twice as many children choosing to spend additional time in this highly physically active environment. These results agree with the survey research and limited experimental studies that have assessed the influence of the presence of peers and friends on physical

activity behavior in older children. Interestingly, the presence of a friend did not significantly decrease sedentary behavior. This was contrary to our hypothesis and future research is warranted to clarify this result. However, because children increased physical activity intensity and elected to spend more time in this active environment when in the presence of a friend it appears that the presence of a friend has a strong positive influence on physical activity behavior in young children.

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Table 1

Physical Characteristics

	Boys (N = 10)	Girls (N = 10)
Age (years)	5.3 ± 1.2	5.3 ± 1.0
Age range (years)	3.3–6.9	3.8–6.6
Height (cm)	112.4 ± 6.4	110.7 ± 7.9
Weight (kg)	19.7 ± 2.9	20.7 ± 4.6
BMI percentile	49.8 ± 32.8	68.2 ± 31.4
Counts per-minute solo play	1892 ± 1063	1522 ± 972
Counts per-minute friend	2478 ± 1276	2780 ± 884
Sedentary time solo play (min)	13.1 ± 9.0	18.9 ± 6.9
Sedentary time friend (min)	12.0 ± 7.5	11.3 ± 5.4

Note. Data are mean ± standard deviation unless otherwise noted. There were no differences between groups ($P \geq .13$).

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