Parental Report of Outdoor Playtime as a Measure of Physical Activity in Preschool-aged Children

Hillary L. Burdette, MD, MS; Robert C. Whitaker, MD, MPH; Stephen R. Daniels, MD, PhD

Background: Keeping young children physically active is an important strategy to promote their health and well-being. To our knowledge, survey measures of physical activity in preschool-aged children are unavailable. Time spent playing outdoors is a potential surrogate measure of physical activity in preschoolers, but parental-report measures of outdoor playtime have not been evaluated.

Objective: To compare a direct measure of physical activity in preschool-aged children with 2 parental-report measures of children’s outdoor playtime.

Main Outcome Measures: Three days of recording with a 3-dimensional accelerometer were used to directly measure physical activity in 250 preschool-aged children. We calculated each child’s average vector magnitude per minute while awake. Parental report of outdoor playtime was measured in 2 ways: (1) the score from a checklist used to record outdoor playtime over 3 days and (2) a recall of the usual minutes of daily outdoor playtime during the prior month. We calculated Spearman rank correlation coefficients among these 3 measures.

Results: The mean age of the children was 44 months, 87.7% were white, and 12.3% were black. Parents reported that their children spent a mean (±SD) of 146 (±113) minutes playing outdoors each day. Physical activity as measured by the accelerometer was significantly correlated to the time spent playing outdoors, as measured by the checklist (r=0.33, P<.001) and recall (r=0.20, P=.003).

Conclusion: Parental-report measures of outdoor playtime were significantly correlated to a direct measure of physical activity in preschool-aged children, and are worthy of future evaluation as a survey measure.
knowledge, there are no validated parental-report measures of the time their preschool-aged child spends playing outdoors.

A validated surrogate measure of preschoolers’ physical activity, such as parent report of outdoor time, will assist future research efforts and may also be useful to health professionals who are increasingly concerned about obesity prevention counseling and who are in need of tools to assess physical activity levels in their young patients. This study develops and validates 2 parental-report measures of the time preschool-aged children spend playing outdoors—a 3-day record and a 1-month retrospective recall. These 2 measures were compared with a direct measure of physical activity obtained from accelerometers.

### METHODS

#### SUBJECTS

This cross-sectional study, conducted between July 2000 and June 2001, was performed on 250 preschool-aged children recruited from the Cincinnati metropolitan area. To be eligible for the study, children had to be free from any chronic medical condition that affected their growth and development. Subjects were recruited primarily through brochures that were distributed in pediatric offices and in day care centers in the Cincinnati metropolitan area. In addition, advertisements for the study were placed in community newspapers and parents of enrolled children also told their friends about the study. The Institutional Review Board at Cincinnati Children’s Hospital Medical Center approved the study.

#### STUDY MEASURES

##### Accelerometer

Direct measurement of physical activity was made for each child using a 3-dimensional accelerometer (RT3 Tri-axial Research Tracker; Stayhealthy, Inc, Monrovia, Calif). This small lightweight device (7.1 × 5.6 × 2.8 cm and weighing 65.2 g) was worn around the child’s waist like a beeper and collected data on acceleration in 3 planes of movement: mediolateral, anteroposterior, and vertical. It collected this motion data as minute-by-minute counts and then provided a composite score, termed the vector magnitude, that summarized movement in all 3 directions. These data were stored internally by the device and were downloaded to a computer after the monitoring period. The parents of the children in the study were instructed to have the child wear the activity monitor from morning awakening until bedtime on 2 weekdays and 1 weekend day, removing it only for swimming, bathing, and naps. Minutes of recording in which there was a value of 0 vector magnitudes on at least 2 of the 3 planes of movement were considered to be nap times, and these data were excluded.

##### Outdoor Time Checklist

A 2-question checklist that allowed parents to record the amount of time their child spent playing outdoors each day was developed (Figure). Each question focused on the location where outdoor play occurred. Responses to these questions were meant to be mutually exclusive and to include all of the children’s outdoor time. The day was divided into 3 separate periods—wake-up time until noon, noon until 6 PM, and 6 PM until bedtime. The amount of time spent playing outdoors during these 3 periods was divided into 5 response options: 0, 1 to 15, 16 to 30, 31 to 60, and over 60 minute intervals.

<table>
<thead>
<tr>
<th>Wake-up Time Until Noon</th>
<th>Noon Until 6 PM</th>
<th>6 PM Until Bedtime</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 min</td>
<td>0 min</td>
<td>0 min</td>
</tr>
<tr>
<td>1-15 min</td>
<td>1-15 min</td>
<td>1-15 min</td>
</tr>
<tr>
<td>16-30 min</td>
<td>16-30 min</td>
<td>16-30 min</td>
</tr>
<tr>
<td>31-60 min</td>
<td>31-60 min</td>
<td>31-60 min</td>
</tr>
<tr>
<td>Over 60 min</td>
<td>Over 60 min</td>
<td>Over 60 min</td>
</tr>
</tbody>
</table>

Downloaded from www.archpediatrics.com at Children's Hospital, Boston, on March 16, 2010 ©2004 American Medical Association. All rights reserved.
30, 31 to 60, and more than 60 minutes. The checklist was
completed by the parent on 2 weekdays and 1 weekend day,
corresponding to the days on which the accelerometer was
worn. The parents were not informed that a specific question
in the study was to compare the checklist and accelerometer
measures.

Outdoor Time Recall Questions
Two questions asked parents to recall the amount of time their
child “typically” spent playing outdoors each day in the last
month—one question about weekdays and the other about
weekend days (Figure). The parents recorded how many hours
and minutes their child spent playing outdoors. These 2 out-
door time recall questions were adapted from similar ques-
tions in the National Longitudinal Survey of Youth7 that ask
parents to recall how much time their child spent viewing tele-
vision (TV). The parents completed these questions when they
returned the accelerometer. Therefore, the time frame of these
recall questions (the last month) included the 3 days on which
the accelerometer was worn by the child and on which the par-
ents recorded outdoor playtime on the checklist.

We conducted cognitive interviews on these 2 questions
using a 60-minute focus group with 6 mothers of preschool-
aged children. These mothers reported that their children’s gross
motor play occurred primarily outdoors and that it was easier
to quantify outdoor time than to quantify the amount of time
their child spent in active gross motor play. We then at-
ttempted to understand how these mothers interpreted out-
door time and to identify the most appropriate time frame for
recording responses (hours, minutes, or fractions of hours). The
outdoor time recall questions were then pilot tested with 15
additional mothers. During the pilot testing, there was an-
other opportunity to probe respondents about how they un-
derstood the questions.

ADDITIONAL VARIABLES
Television viewing time was also measured because it has been
used in other studies as an indirect measure of physical activity
and as a proxy measure for sedentary activities. The mea-
sure of TV viewing time was obtained from 2 TV time recall
questions that were used in the National Longitudinal Survey
of Youth.7 They asked about the amount of time the child spends
watching TV or videotapes on a typical weekday and on a typi-
cal weekend day. The parent also provided demographic in-
formation, such as the age, sex, and race of the child.

COMPUTING STUDY VARIABLES
The accelerometer data were used to derive a single summary
measure of physical activity—average vector magnitude per
minute while awake. To derive this measure, we first ex-
cluded raw data from the accelerometer that corresponded to
the time the children were napping. We then calculated the av-
erage vector magnitude per minute while awake on each moni-
toring day. No day was included for an assessment unless there
were 8 or more waking hours of monitoring. To analyze the 2
questions on the outdoor time checklist, responses from the 3
time interval categories were coded as 0 through 4 (0 for 0 min-
utes, 1 for 1–15 minutes, 2 for 16–30 minutes, 3 for 31–60 min-
utes, and 4 for >60 minutes). Using these ordered categorical
responses and summing the responses across both questions
gave a maximum score of 24. The responses to the 2 outdoor
time recall questions were converted to minutes. For all 3 mea-
sures, there were no significant differences between weekday
and weekend values, so the mean of these 2 values was com-
puted for each measure.

In summary, we had 3 variables for the data analysis: (1)
from the accelerometer, the average amount of activity (vector
magnitude per minute) while awake; (2) from the outdoor time
checklist, the average daily score (possible range, 0–24); and
(3) from the outdoor time recall questions, the average daily
time (in minutes) spent playing outdoors. All 230 children had
data available from the accelerometer and the outdoor time
checklist, but only 214 of the children had data available from
the outdoor time recall questions.

DATA ANALYSIS
The association between each of these 3 measures was as-
signed using Spearman rank correlation coefficients because the
checklist data were rank scores. As another method of evalu-
at ing the association between the 3 measures, we divided
the children into quartiles based on their level of physical activity,
as assessed by the accelerometer, and compared the 2 outdoor
playtime measures across each quartile of children. We also de-
termined whether our 3 measures differed by season or child
sex. For the seasonal analysis, spring was defined as the months
of March, April, and May; summer as June, July, and August;
autumn as September, October, and November; and winter as
December, January, and February. Finally, the 3 primary study
variables were compared with TV viewing time. Data from the
TV viewing time questions were handled in a similar manner
as data from the outdoor time recall questions, generating the
average daily time (in minutes) spent watching TV.

The mean age of the 250 children was 44 months (range,
29–52 months). Of the children, 57% were boys, 87.7% were
non-Hispanic white, and 12.3% were non-
Hispanic black. Data on outdoor playtime (in minutes)
and on physical activity (in vector magnitude per minute)
had a normal distribution (data not shown). Children
spent a mean (±SD) of 146 (±113) minutes of TV or videotapes a
day. The average outdoor playtime, as assessed by the recall
and checklist measures, differed by season. The highest levels of outdoor playtime occurred in the
summer; and the lowest, in the winter. The tendency for
greater outdoor playtime in the fall than in the spring is
consistent with the lower amount of precipitation and
higher temperatures in the Cincinnati fall. Seasonal
differences in physical activity levels, as measured by the
accelerometer, were less pronounced than for the other
2 measures of physical activity. Boys had significantly
higher physical activity levels than girls, but scores for
the 2 outdoor playtime measures did not differ signifi-
cantly between boys and girls.

The time spent playing outdoors, as measured by
the checklist, was significantly correlated to the direct
measure of physical activity from the accelerometer
(r = 0.33, P < .001), as was outdoor playtime measured by
recall (r = 0.20, P = .003). The 2 measures of outdoor play-
time were also significantly correlated to each other
(r = 0.57, P < .001). We also compared outdoor playtime
in 4 groups of children categorized by quartile of physi-
ical activity level (Table 2).

These preschool-aged children watched a mean
(±SD) of 133 (±79) minutes of TV or videotapes a day.
The average TV time was significantly inversely corre-
lated to the direct measure of physical activity by accel-
Our goal was to conduct a study comparing 2 parental-report measures of outdoor playtime in preschool-aged children—a 2-question checklist and 2 recall questions—with a more objective measure of physical activity in children obtained by a 3-dimensional accelerometer. Both measures of outdoor playtime were significantly correlated to the accelerometer measure, with the checklist having the higher correlation. There are 2 potential explanations for the higher correlation with the checklist. First, the checklist may have allowed mothers to provide a better assessment of total outdoor time because of its prompts for time of day, place, and duration of activity. Second, the checklist was completed on the same days as the accelerometer was worn.

The correlation coefficients in this study are of similar magnitude to those obtained in the only other study in which outdoor time was correlated to a measure of physical activity in preschoolers. Klesges et al\(^5\) measured outdoor time and physical activity in preschoolers by direct observation, and showed higher activity levels outdoors than indoors. However, they did not report the correlation between these 2 measures.

In older children, other investigators have assessed the correlation between direct measures of physical activity from accelerometers and the scores derived from longer physical activity questionnaires that attempt to assess specific activities. If either a parent completes the physical activity questionnaire\(^8\) or the child completes it\(^9,10\), the correlation between the questionnaire scores and the accelerometer measure is also in the range of 0.3 to 0.4.

There are several reasons why the correlations between the outdoor playtime measures and the measure of physical activity from the accelerometer may not have been higher. First, we attempted to quantify a behavioral correlate of physical activity, outdoor playtime, rather than physical activity itself. We did so with the assumption that not all the physical activity of preschool-aged children occurs outdoors and that not all time spent outdoors involves active play. Second, despite the high levels of summer outdoor time, there were relatively low levels of physical activity in the summer, as measured by the accelerometer. This may be because the accelerometers, which were not waterproof, were taken off for swimming and play around water. Finally, the time frame for recalling outdoor play was the past month and the few months prior to the study.

### Table 1. Study Measures by Season and Sex

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. of Subjects</th>
<th>Outdoor Playtime by Recall, min*</th>
<th>No. of Subjects</th>
<th>Outdoor Playtime, Score by Checklist*</th>
<th>Physical Activity by Accelerometer, vpm*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>214</td>
<td>146 (± 113)</td>
<td>250</td>
<td>4.6 (± 3.5)</td>
<td>667 (± 186)</td>
</tr>
<tr>
<td>Season</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter (Dec-Feb)</td>
<td>58</td>
<td>79 (± 58)</td>
<td>70</td>
<td>2.2 (± 2.0)</td>
<td>619 (± 155)</td>
</tr>
<tr>
<td>Spring (Mar-May)</td>
<td>28</td>
<td>88 (± 79)</td>
<td>43</td>
<td>4.1 (± 3.4)</td>
<td>681 (± 192)</td>
</tr>
<tr>
<td>Summer (Jun-Aug)</td>
<td>39</td>
<td>243 (± 145)</td>
<td>39</td>
<td>7.4 (± 3.9)</td>
<td>659 (± 182)</td>
</tr>
<tr>
<td>Autumn (Sep-Nov)</td>
<td>89</td>
<td>167 (± 94)</td>
<td>98</td>
<td>5.3 (± 3.0)</td>
<td>698 (± 200)</td>
</tr>
<tr>
<td>P value†</td>
<td>NA</td>
<td>&lt;.001</td>
<td>NA</td>
<td>&lt;.001</td>
<td>.05</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>132</td>
<td>148 (± 123)</td>
<td>147</td>
<td>4.8 (± 3.7)</td>
<td>693 (± 184)</td>
</tr>
<tr>
<td>Female</td>
<td>82</td>
<td>145 (± 94)</td>
<td>103</td>
<td>4.3 (± 3.2)</td>
<td>630 (± 183)</td>
</tr>
<tr>
<td>P value‡</td>
<td>NA</td>
<td>.84</td>
<td>NA</td>
<td>.21</td>
<td>.01</td>
</tr>
</tbody>
</table>

**Abbreviations:** NA, data not applicable; vpm, vector magnitude per minute.

*Data are given as mean (± SD).

†Obtained using an analysis of variance.

‡Obtained using the t test.

### Table 2. Outdoor Time Values by Quartile of Physical Activity (From the Accelerometer)

<table>
<thead>
<tr>
<th>Quartile of Physical Activity by Accelerometer</th>
<th>Rank by Checklist, Mean</th>
<th>Minutes by Parent Recall, Mean (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (&lt;539 vpm)</td>
<td>98</td>
<td>127 (96-157)</td>
</tr>
<tr>
<td>2 (539-641 vpm)</td>
<td>107</td>
<td>133 (106-160)</td>
</tr>
<tr>
<td>3 (642-773 vpm)</td>
<td>139</td>
<td>150 (122-178)</td>
</tr>
<tr>
<td>4 (&gt;773 vpm)</td>
<td>158</td>
<td>177 (141-213)</td>
</tr>
<tr>
<td>P value*</td>
<td>&lt;.001</td>
<td>.09†</td>
</tr>
</tbody>
</table>

**Abbreviation:** vpm, vector magnitude per minute.

*Obtained using the Kruskal-Wallis test.

†Obtained using a 1-way analysis of variance.
Physical activity in preschool-aged children is important for their health and well-being, but, to our knowledge, there are no parent-report measures of physical activity available for this age group. Such measures are needed for use in research and clinical practice. This study compares 2 parental-report measures of outdoor playtime with a more direct measure of physical activity by accelerometer.

Both parental-report measures of outdoor playtime—a 2-question checklist and 2 recall questions—were significantly correlated to physical activity. This study presents a surrogate measure of physical activity in preschoolers that can be used when direct measurement is not feasible.

days that month on which the accelerometer was worn may not have been representative of the month’s outdoor playtime.

Despite finding only a moderate correlation between parental-report measures of outdoor playtime and direct measures of physical activity in preschoolers, we believe that the measurement of outdoor play in preschool-aged children is worthy of future evaluation as a research and a clinical tool. Where research is concerned, to our knowledge, there is no alternative questionnaire measure of physical activity in preschoolers. If researchers are to evaluate population-level trends in physical activity in preschool-aged children or to conduct large-scale interventions in children this age, then there needs to be a way to measure physical activity in large groups. This study presented a possible new method.

Because of the epidemic of childhood obesity, health care professionals are making increasing efforts to counsel children and families about physical activity. All the challenges faced by researchers in characterizing physical activity in preschoolers are also faced by clinicians in trying to assess physical activity levels in preschoolers as part of a health behavior inventory. This study shows that asking parents about outdoor playtime is an acceptable surrogate measure of activity in preschoolers given that few alternative interview questions have been suggested for clinical practice and that none, to our knowledge, have been compared with a direct measure of physical activity. Furthermore, asking parents about outdoor playtime may be useful in achieving the twin goals, recently recommended by the American Academy of Pediatrics, of reducing TV viewing time and increasing unstructured play. In this study, outdoor playtime measured by the checklist was inversely correlated to TV viewing time. Reallocation children’s time from TV viewing to outdoor play may not only protect against obesity but may also lead to other beneficial effects on children’s well-being, including increased opportunities for enhanced cognitive stimulation through social interaction and imaginative play.

Accepted for publication December 1, 2003.

This study was supported by grant R01HL/DK64022 from the National Institutes of Health, Bethesda, Md.

This study was presented in part at the Pediatric Academic Societies Annual Meeting, May 5, 2003; Seattle, Wash; and at the American College of Sports Medicine Annual Meeting: May 31, 2003; San Francisco, Calif.

We thank Karen Munson, RN, Marcia Schmidt, MS, RD, LD, and Marcia Gavin, RD, LD, for executing the data collection; and Phil Khoury, MS, for his assistance with the data management.

Corresponding author and reprints: Hillary L. Burdette, MD, MS, Division of Gastroenterology and Nutrition, The Children’s Hospital of Philadelphia, 34th St and Civic Center Blvd, CHOP-North (Room 1578), Philadelphia, PA 19104 (e-mail: burdette@email.chop.edu).

REFERENCES