Feasibility and Reliability of the System for Observing Play and Leisure Activity in Youth (SOPLAY) for Measuring Moderate to Vigorous Physical Activity in Children Visiting an Interactive Children’s Museum Exhibition

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Abstract
Purpose: To test the feasibility and reliability of a direct observation method for measuring moderate to vigorous physical activity (MVPA) in children visiting an interactive children’s museum exhibition.

Design: Direct observation was used to assess MVPA in children visiting an interactive children’s museum exhibition on 2 weekend days in winter 2013.


Participants: Children (group level) visiting the museum exhibition.

Measures: System for Observing Play and Leisure Activity in Youth (SOPLAY).

Analyses: Interobserver reliability was analyzed for MVPA and activity type. Two-group analyses were conducted using a series of Wilcoxon rank sum tests.

Results: A total of 545 children were observed over 288 observations. No significant differences were found between observers for MVPA (r = .91, P = .6804) or activity type (κ = .90, P = .6334). Children participated in MVPA during 35.2% of all observations. No significant differences were found for participation in MVPA between boys (37.6%) and girls (32.8%, P = .1589).

Conclusion: The SOPLAY may be a useful tool for measuring MVPA in interactive children’s museum exhibitions. Research with multiple museum settings and diverse groups of children over longer periods of time is warranted to further establish the feasibility and reliability of the SOPLAY for measuring MVPA in this novel setting.

Keywords
direct observation, feasibility, motor activity, museums, physical activity assessment, SOPLAY

Purpose
First Lady Michelle Obama’s Let’s Move: Museums and Gardens initiative tasked children’s museums across the United States to develop interactive exhibitions where children and families can be physically active.¹ However, accurate measurement of child physical activity (PA) in open settings remains challenging; self-report measures are prone to recall bias and overestimation of activity, whereas objective measures are prone to underestimation of certain activities.² Direct observation techniques may provide accurate measure of group-level PA within environmental contexts,² such as

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children’s museums. The purpose of this pilot study was to assess the feasibility of using the System for Observing Play and Leisure Activity in Youth (SOPLAY) for measuring moderate to vigorous physical activity (MVPA) in children visiting an interactive children’s museum exhibition.

**Methods**

**Design**

Direct observation was used to assess MVPA in children visiting an interactive children’s museum exhibition on 2 weekend days in winter 2013.

**Sample**

Group-level PA was assessed for all children visiting the Children’s Museum of Manhattan’s EatSleepPlay™: Building Health Every Day exhibition.

**Measures**

**System for Observing Play and Leisure Activity in Youth.** Child MVPA was assessed by direct observation using a modified version of the SOPLAY.4

**Target area mapping.** EatSleepPlay™: Building Health Every Day (3500 sq ft; 325 m²) stood on the first floor of the Children’s Museum of Manhattan, located in New York City’s Upper West Side. The museum was open to the public and entrance to the exhibition by museum visitors was completely voluntary. A total of 6 potential areas for PA were identified prior to data collection, based on exhibition design blueprints. Target areas that presented a high density of visitors during pilot testing were divided into smaller scan spaces. Defined target areas ranged from having 1 to 5 scan spaces for a total of 18 scan spaces in the entire exhibition. Figure 1 presents the target area mapping for this study.

**Observer training.** Eight research assistants underwent rigorous training for the SOPLAY and met the acceptable criteria for reliability assessment (observer agreement with gold standard >80%) before progressing to field-based training. By the completion of training, 1 female and 1 male observer were chosen as criterion and reliability coders, respectively.

**Observation protocol.** Data collection procedures were approved by the Hunter College institutional review board. Direct observation was conducted on 2 consecutive Saturdays in winter 2013. Two observations per hour were conducted between...
At 12:30 pm and 6 pm with 30-minute breaks between every hour. No observations were performed prior to 12:30 pm due to low visitor volume during pilot testing. During data collection, observers made simultaneous but independent observations of child PA across all 18 scan spaces standing 1 meter apart. Observers recorded the number of boys and girls across 3 activity levels (sedentary, walking, or very active). Boys and girls were also separately coded for their predominant activity type (eg, running), according to a list of 20 predefined activities compiled during pilot testing. Museum equipment was also evaluated for functionality (broken vs working) on 4 occasions each day.

Analysis

Data processing. Count data that represented the number of boys and girls engaged in each of the 3 activity levels were summed by day and zeroes were converted to missing values. Two variables were generated to represent the fraction of boys and girls participating in MVPA by observation. The “very active” category of the SOPLAY was regarded as MVPA, as suggested by Saint-Maurice and colleagues.

Data analysis. Interobserver reliability was calculated using a series of Spearman rank correlation coefficients, Cohen kappa coefficients, and percentage agreement. Two-group analyses were conducted with Wilcoxon rank sum tests. All statistical tests were conducted with Stata 12.0 (StataCorp, 2011, College Station, Texas) with a significance level set a priori at \( P < .05 \).

Results

System for Observing Play and Leisure Activity in Youth

A total of 545 children (50.3\% girls) were identified over 288 observations. Observations consisted of 0 to 11 children, with 94\% of observations consisting of 5 children or less. A majority of sex- and activity level-specific observations (eg, sedentary boys or very active girls) were missing (71.1\%) and 31.6\% of observations in a single-scan space had no children. Eighteen of 20 predetermined activity types appeared as predominant activity types during observation. Lack of variation in equipment functionality (eg, broken) prevented analysis of these data.

Reliability. No significant differences appeared for interobserver coding for MVPA (Wilcoxon rank sum, \( P = .6804 \)), including for girls (\( P = .9030 \)) and boys (\( P = .6874 \)). Correlation coefficients were very strong for interobserver coding of MVPA (\( r = .91 \)) and slightly higher for boys (\( r = .96 \)) compared to girls (\( r = .89 \)). Correlation coefficients for boys and girls combined remained above .90 with variation in visitor density (low vs high) by scan space. Differences also did not appear when designating MVPA as “walking” or “very active,” but the correlation coefficient improved for girls (\( r = .96 \)). For coding of activity type, no significant differences appeared between observers (Wilcoxon rank sum, \( P = .6334 \)), including for girls (\( P = .5314 \)) and boys (\( P = .9630 \)). Kappa coefficient was within acceptable range for observer coding of activity type (90.6\%, \( \kappa = .90 \)).

Moderate to vigorous physical activity. Children participated in MVPA for 35.2\% of observations. No significant difference was found in the percentage of boys (37.6\%) and girls (32.8\%) in MVPA (Wilcoxon rank sum test, \( P = .1589 \)). Table 1 presents data for participation of boys and girls in MVPA.

Activity type. Majority of activities were of active (70.7\%) and nonlocomotive (60.7\%) type. Participation in nonlocomotive activities was similar between girls (60.0\%) and boys (63.7\%), but notable differences appeared between girls (18.5\%) and boys (9.7\%) for stationary bicycling. Similarly, participation in locomotive activities was similar between girls (41.9\%) and boys (36.3\%), but girls were more frequently coded as climbing stairs (37.0\%) than boys (24.4\%), and boys were more frequently reported as running (19.5\%) than girls (5.6\%).

Discussion

In their evaluation of the GoKids Project at the Boston Children’s Museum, Kuross and Folta highlighted the development of in-house exhibitions in children’s museums to promote healthy lifestyles for children and families. However, the authors of this study are not aware of attempts to examine

Table 1. Participation in MVPA and Interobserver Reliability for Estimates of MVPA and Activity Type in Children Visiting the Interactive Children’s Museum Exhibition, Using the SOPLAY.

<table>
<thead>
<tr>
<th>Activity Type</th>
<th>Boys</th>
<th>Girls</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVPA, n</td>
<td>271</td>
<td>274</td>
<td>545</td>
</tr>
<tr>
<td>MVPA, %</td>
<td>37.6</td>
<td>32.8</td>
<td>35.2</td>
</tr>
<tr>
<td>Reliability (( r ))</td>
<td>.96</td>
<td>.89</td>
<td>.91</td>
</tr>
<tr>
<td>( P )</td>
<td>.6874</td>
<td>.6804</td>
<td>.6334</td>
</tr>
<tr>
<td>Reliability (( k ))</td>
<td>.92</td>
<td>.87</td>
<td>.90</td>
</tr>
<tr>
<td>( P )</td>
<td>.9630</td>
<td>.5314</td>
<td>.6334</td>
</tr>
</tbody>
</table>

Abbreviations: MVPA, moderate to vigorous physical activity (defined according to the “very active” activity level of the SOPLAY); SOPLAY, System for Observing Play and Leisure Activity in Youth.

*Observation of the museum exhibition was conducted twice per hour, 4 times per day, on 2 weekend days by 2 trained observers. Observers made simultaneous independent recordings of the number (n) of boys and girls who were sedentary, walking, or very active. Boys and girls were also separately coded for their predominant activity type (eg, running).
MVPA in children visiting such museum settings. The purpose of this study was to assess the feasibility and reliability of using direct observation to measure MVPA in children visiting an interactive children’s museum exhibition.

According to McKenzie and colleagues, a minimum of 4 measurement days is necessary to achieve an interobserver reliability greater than 0.8. The present study found no significant difference for interobserver coding of MVPA and reached an adequate level of interobserver reliability for MVPA and activity type in only 2 days of observation. Target area mapping assisted in dividing the exhibition into manageable scan spaces and reducing the number of children per scan. This was further evident by strong interobserver coding of MVPA, despite variation in visitor density. However, this strategy may vary by museum, and researchers studying children’s PA in these settings are encouraged to work closely with museum staff to agree on feasible ways to map areas to reduce visitor density. Studies also suggest that a 30-minute time period requires 2 to 3 scans to provide valid estimates of children in MVPA. For feasibility purposes, the present study invested resources to train 2 observers, so a 30-minute time period resulted in only a single scan of the exhibit. Provided these changes to improve study feasibility, future studies are encouraged to increase the sample of days and settings, as well as observation frequency, to determine whether this meaningfully alters the reliability of the SOPLAY.

Despite evidence of strong reliability, the generalizability of findings in this study is limited to a single museum exhibition on 2 weekend days during the winter season. For example, studies suggest that winter may promote greater indoor and fewer outdoor activities in children, especially girls, which may positively bias findings from this study. Moreover, due to limited number of days and settings sampled, this study was unable to observe differences in MVPA according to functionality of museum equipment. Studies of greater duration are needed to capture MVPA in museum exhibits that may vary by day, season, and museum conditions.

Finally, in the present study, no differences appeared for participation in MVPA between boys and girls. This is in contrast to previous studies using direct observation that found boys engaged in significantly more MVPA than girls. The authors of this study took precaution in reducing instances of misclassifying PA by defining MVPA according to the “very active” category of the SOPLAY. Thus, discrepancies between the present and previous studies may be more due to factors associated with the children’s museum exhibition that favored PA in girls. For example, girls in this study were more engaged in stationary bicycling, compared to boys. Studies have shown that girls are more likely to engage in activities in zones with equipment, whereas boys are more likely to engage in activities in open spaces. Interestingly, girls in this study were also more engaged in climbing stairs. The use of direct observation in this study proved useful, given that certain activities, such as stationary bicycling, are poorly detected by accelerometers. However, this study was unable to match visitor MVPA with activity type. Future studies may wish to use direct observation strategies that track individual children, such as the System for Observing Children’s Activity and Relationships During Play, to match visitor activity with museum location to assess activity-specific MVPA.

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