The Childcare Environment and Children’s Physical Activity

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Background: With increased numbers of children attending child care, this setting presents an ideal opportunity to promote physical activity and the early development of healthy behaviors. The purpose of this study was to examine the relationships between the childcare environment and physical activity behavior of preschool children.

Methods: Aspects of the environment hypothesized to influence children’s physical activity were assessed in 20 childcare centers using the Environment and Policy Assessment and Observation (EPAO) instrument. Physical activity behavior was assessed over 2 days using direct observation.

Results: Children in centers with supportive environments achieved more moderate-to-vigorous physical activity (15% of observations vs 9%; effect size [ES] = 1.17), spent less time in sedentary activities (50% vs 61%; ES = -1.52), and had higher mean physical activity levels (2.68 vs 2.43; ES = 1.41) compared to centers with less supportive environments. Facets of the physical and social environment related to physical activity behavior included active opportunities, portable play equipment, fixed play equipment, sedentary environment, and physical activity training and education.

Conclusions: Previous research indicates that the childcare center that children attend significantly affects physical activity behavior. The current findings extend this evidence by identifying aspects of the childcare environment that relate to the physical activity behavior of children. These factors should be considered when identifying determinants of physical activity and designing interventions.

Introduction

Fifty-seven percent of children aged 3 to 5 years were enrolled in center-based child care in 2005. With a large proportion of young children spending all or part of their day outside of home, the childcare environment presents an ideal opportunity to promote physical activity and aid in the early development of healthy behaviors. The increasing prevalence and earlier onset of childhood overweight further underscores the importance of intervening at the preschool level.

Despite growing evidence supporting environmental determinants of physical activity behavior and studies suggesting that nearly 50% of the variation in physical activity during preschool hours can be attributed to the childcare center, research focused on understanding the unique aspects of the childcare environment that influence physical activity behavior is lacking. This may be due, in part, to the need for appropriate measures to assess the healthy-weight environment in the childcare setting. The unique social and physical aspects of childcare settings that may influence weight status are not adequately covered by instruments designed to assess the home, school, and built environments.

Recently, a new instrument has been developed that attempts to quantify both social and physical environmental factors thought to affect dietary and physical activity behaviors of children in child care. The Environment and Policy Assessment and Observation (EPAO) was created to evaluate the Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC) program, an environmental nutrition and physical activity intervention in child care. The EPAO is an expansion of the self-assessment component of the NAP SACC program created following an extensive review of the nutrition and physical activity literature, recommendations and standards from credible organizations, as well as input from a number of experts in the field.
fields of measurement, nutrition, physical activity, and child care. Details of the literature review and documentation of the components used for the self-assessment and the EPAO can be found elsewhere.\(^{15,16}\)

Improving our understanding of physical activity determinants in the childcare setting will ultimately lead to the development of more effective strategies for promoting physical activity among preschool children. Therefore, the purpose of this study was to determine the relationship between the social and physical activity environment in childcare centers, measured by the physical activity component of the EPAO, and physical activity behavior of children while in child care. The findings are also presented as validity evidence for the EPAO physical activity subscales.

### METHODS

Each childcare center received a 1-day assessment of the physical and social environmental factors hypothesized to influence healthy weight. In addition, an evaluation of the physical activity behavior of children attending centers was conducted on 2 additional days. During the 3-day assessment, children aged 3 to 5 years were observed. In centers with more than one eligible classroom, a single class was randomly selected for observation. Additional data were gathered through interviews and a document review. Data were collected between July 2005 and January 2006. All procedures were approved by the University of North Carolina at Chapel Hill Institutional Review Board and written informed consent was obtained from all childcare center directors.

### Sample

The childcare centers (N=20) were randomly selected from 96 facilities recruited for the NAP SACC project from across North Carolina. On average, the childcare centers had been in operation for 19 years. Most participated in the Child and Adult Care Food Program (CACFP), and 20% were accredited by the National Association for the Education of Young Children (NAEYC). All had outdoor play areas, while half had an indoor area sufficient for active play. The average racial/ethnic distribution of the childcare centers reported by center directors was 33% black, 59% white, 4% Hispanic, and 4% other. Additional demographic information is presented in Table 1.

### Physical Activity Environment

The physical activity environment of each childcare center was assessed using the EPAO instrument. The physical activity portion of the EPAO consists of eight subscales derived from key physical activity areas identified during the extensive literature review and development of the NAP SACC program.\(^{15}\) These include: Active Opportunities, Sedentary Opportunities, Sedentary Environment, Portable Play Environment, Fixed Play Environment, Staff Behaviors, Physical Activity Training and Education, and Physical Activity Policy. The content of each subscale can be found in Table 2.

The EPAO protocol consists of a day-long observation of the nutrition and physical activity environment of the childcare center and a document review. During the observation day, a trained data collector observed all activities of a randomly selected classroom. During nap time, general information about the center was collected. The assessment began as children arrived in the morning and concluded when the last child in the observation classroom left for the day. Observational data for the physical activity subscales were
Table 2. Content of the physical activity environment subscales from the EPAO

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Opportunities</td>
<td>Daily opportunities that may result in more MVPA; includes structured physical activity (# of occasions), outdoor play (# of occasions), and total minutes of active opportunity (any time play that could be rated as MVPA was an option or part of a structured lesson).</td>
</tr>
<tr>
<td>Sedentary Opportunities</td>
<td>Daily opportunities that may result in little or no MVPA; includes seated for 30 or more minutes (Y/N), TV viewing (minutes TV on), video game playing (Y/N)</td>
</tr>
<tr>
<td>Portable Play Environment</td>
<td>Presence of several types of play equipment that can be transported and used in various locations; includes jumping or twirling equipment, balls, hula hoops, and riding toys (all Y/N)</td>
</tr>
<tr>
<td>Fixed Play Environment</td>
<td>Equipment and space that is anchored or fixed within the center environment; includes climbing structures (Y/N), balancing surfaces (Y/N), running space (Y/N), and indoor play space (4-point rating)</td>
</tr>
<tr>
<td>Sedentary Environment</td>
<td>Items in the physical environment that may promote or discourage physical activity behavior; includes TV in room, computer in room, physical activity displays, posters, and books (all Y/N)</td>
</tr>
<tr>
<td>Staff Behaviors</td>
<td>Interactions between staff and children that may promote or discourage physical activity behavior; includes restricting active play, joining in activity, positive statements about physical activity (all Y/N)</td>
</tr>
<tr>
<td>Physical Activity Training and Education</td>
<td>Training and education for children, staff, and/or parents that may increase participation or knowledge related to physical activity behavior; includes physical education curriculum, physical education observed, physical activity training for staff, physical activity education for parents (all Y/N)</td>
</tr>
<tr>
<td>Physical Activity Policies</td>
<td>Child care center written policies (all Y/N) related to: active and inactive time, TV use/viewing, play environment, supporting physical activity, physical activity education.</td>
</tr>
</tbody>
</table>

EPAO, Environment and Policy Assessment and Observation; MVPA, moderate and vigorous physical activity; Y/N, Yes/No.

The data were collected in a tally format continuously throughout the observation period. The document review involved examination of lesson plans, parent and staff handbooks, physical activity and nutrition training documents and curricula, and written physical activity policy documents. Items from the observation and document review were used to score the physical activity subscales of the EPAO.

Because response options for EPAO items vary, criteria based on established recommendations and expert opinion were used to convert item responses to a 3-point scale (0, 1, 2). Scores were then calculated as the average rating for items within a given subscale (items per scale range from 3 to 6) and multiplied by 10. The Sedentary Opportunities and Sedentary Environment subscales were reverse-scored, therefore higher values represent lower levels (i.e., less TV time). A total physical activity environment score was also calculated as the average of all physical activity subscale scores (possible range 0 to 20). Each center was categorized as having a high or low EPAO physical activity environment score based on a median split of the total physical activity environment score.

All field observers were trained during an intensive day-long workshop that included a review of EPAO items and criteria, lessons on observational techniques, and a mock observation in a childcare center. The average agreement between observers at the same center on the same day was 87.3% and 79.3% for the observation and document review portions of the EPAO. In addition, mean physical activity subscales scores did not differ significantly among observers. The EPAO is available on request from the corresponding author.

Physical Activity

A modified version of the Observation System for Recording Activity in Preschools (OSRAP) was utilized to estimate the proportion of time children spent at different intensities of physical activity. A momentary time-sampling procedure was used to record physical activity intensity, type, location, context, prompts, and interactions every 15 seconds using a handheld Dell Axim Pocket PC (Austin TX). Among field observers, intraclass correlations for mean activity rating using the OSRAP are generally greater than 0.90, while percent agreement ranged from 75% to 99%. Children at each center were observed during eight 32-minute periods over 2 consecutive days. Observation periods were distributed evenly across morning and afternoon hours, but did not include meal or nap times. During each observation period, data were collected on four randomly selected children. Each child was observed for two nonconsecutive 4-minute blocks during the period. Through each 4-minute block, eight individual observations were recorded for each child (15 seconds observe/15 seconds record cycle). A total of 10,240 individual observations were completed (20 centers×2 days×4 periods/day×4 children/period×2 blocks/child×8 observations/block).

For this analysis, the ratings of intensity level from the modified OSRAP were used to calculate the primary outcome variables. Intensity level was measured on a 5-point scale and was recorded as the highest level of intensity achieved by the child during each 15-second observation. The five intensity levels included: (1) stationary/motionless, (2) stationary with movement of limbs or trunk, (3) slow/easy movement, (4) moderate movement, and (5) fast movement. Significant differences in energy expenditure and accelerometer counts have been reported across these intensity categories, supporting inferences made about physical activity from the 5-point scale. For the purposes of this study, data were...
collapsed to obtain center-level indices of average physical activity intensity, proportion of time in moderate and vigorous physical activity (MVPA; intensity level 4 or 5), and proportion of time in sedentary activity (intensity level 1 or 2). Mean physical activity intensity level was calculated by averaging all intensity ratings for each center. Time in sedentary activity and MVPA were derived by calculating the proportion of observations at each center that were at the intensity levels of interest.

Statistical Analysis

All statistical analyses were performed with SAS, version 9.1, during the fall of 2006. Means, standard deviations, and Pearson product moment correlations were calculated to describe the sample and illustrate group differences and relationships among physical activity and EPAO subscales. Differences in center characteristics (e.g., racial distribution, years in operation) were tested using T-tests and chi-square statistics. A one-way ANOVA was used to examine physical activity behavior. An alpha level of 0.05 was used to judge statistical significance.

Results

Data from the EPAO and modified OSRAP are summarized in Table 3. Overall, 12% of physical activity observations were classified as MVPA (rated 4 or 5), while 55% were classified as sedentary activity (rated 1 or 2). The mean activity rating over all observation periods was 2.55, indicating that the average intensity across all centers was between seated play and slow/easy movement.

The average EPAO physical activity environment total score (±SD) was 10.15±2.80 (median=10.59). Mean subscale scores ranged from 1.25 (Physical Activity Training and Education) to 16.25 (Fixed Play Environment). Correlations among the physical activity environment subscales were small to moderate (r=-0.164 to 0.521). The most highly related subscales were Physical Activity Policy and Sedentary Opportunities (r=0.521) and Physical Activity Training and Education and Staff Behavior (r=0.481).

Correlations between physical activity environment subscales and mean activity level, sedentary activity, and MVPA also can be found in Table 3. Active Opportunities subscale had the strongest correlations with mean physical activity intensity (r=0.513) and %MVPA (r=0.504), while Physical Activity Policy was related weakly to all estimates of physical activity (r=-0.076 to 0.157).

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Table 3. Means, standard deviations, and correlations for physical activity environment subscales and physical activity behavior

<table>
<thead>
<tr>
<th>Subscales</th>
<th>Mean (SD)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Portable Play Environment</td>
<td>7.33 (6.45)</td>
<td>7.33</td>
<td>7.33</td>
<td>7.33</td>
<td>7.33</td>
<td>7.33</td>
<td>7.33</td>
<td>7.33</td>
<td>7.33</td>
<td>7.33</td>
<td>7.33</td>
<td>7.33</td>
</tr>
<tr>
<td>6. Staff Behaviors</td>
<td>11.00 (4.97)</td>
<td>11.00</td>
<td>11.00</td>
<td>11.00</td>
<td>11.00</td>
<td>11.00</td>
<td>11.00</td>
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<td>11.00</td>
<td>11.00</td>
<td>11.00</td>
<td>11.00</td>
</tr>
<tr>
<td>7. PA Training and Education</td>
<td>1.25 (2.75)</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>9. PA Environment Total Score</td>
<td>10.15 (2.80)</td>
<td>10.15</td>
<td>10.15</td>
<td>10.15</td>
<td>10.15</td>
<td>10.15</td>
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</table>

*aPossible range for all subscales is 0–20.

*bReverse coded (i.e., higher score means fewer sedentary opportunities or a less sedentary environment).

MVPA, moderate and vigorous physical activity.
Estimates for the differences in mean physical activity level ($F[1,18]=9.61, p=0.006$), proportion MVPA ($F[1,18]=6.37, p=0.021$), and proportion sedentary ($F[1,18]=11.61, p=0.003$) across high and low physical activity environment groups are presented in Table 4. The effect size estimates indicate that centers with higher total physical activity environment scores have mean physical activity and MVPA levels that are 1.2 to 1.4 standard deviations higher than low scoring centers.

Comparisons of EPAO subscale scores between centers with high and low physical activity environment scores are displayed in Table 4. While not statistically significant, moderate effect sizes were observed for the Sedentary Environment, Fixed Play Environment, and Physical Activity Policy subscales. All other effect size estimates were large and most mean differences were statistically significant.

Standardized parameter estimates and $R^2$ values from the regression analysis can be found in Table 5. Active Opportunities was the most important predictor of all physical activity variables. Models for percent sedentary activity time and mean activity intensity also included scores for Sedentary Environment and Physical Activity Training and Education. Variation in percent MVPA time was best accounted for by Active Opportunities, Portable Play Environment and Fixed Play Environment scores.

Because the amount of time provided for active opportunities (when active play is an option or part of a structured lesson) is strongly correlated with average physical activity level, post-hoc analyses were conducted to determine if accounting for this would affect the relationship between EPAO physical activity environment scores and physical activity behavior. Two methods were selected to examine this effect. First, an ANCOVA was conducted with the EPAO item “active opportunity minutes” included as a covariate. Next, this item, “active opportunity minutes,” was removed from EPAO total score and group comparisons were reevaluated. With this variable included as a covariate, estimates of effect size for differences in physical activity between high and low environment groups were reduced to 0.631 (mean intensity), 0.637 (% MVPA), and −0.832 (% sedentary activity). While not statistically significant, these effects were still considered moderate to large. With active opportunity minutes removed from the physical activity environment scale, scores for...
high (12.06±1.03) and low (7.96±2.61) environment groups decreased slightly, but classification (high or low) did not change.

Discussion

The purpose of the present study was to examine associations between physical activity behavior and the physical activity environment in childcare centers. A key finding was that centers with higher physical activity environment scores had children who were more physically active and less inactive while in child care. Previous research indicates that the childcare center accounts for a significant proportion of the variability in physical activity behavior of children while in care.8–10,12,22 The present study extends this body of evidence by identifying specific aspects of the environment associated with physical activity behavior.

The Active Opportunities subscale (occasions of structured physical activity, occasions of outdoor play, and minutes of active opportunities) was related most strongly to all measures of physical activity. Not surprisingly, the item “active opportunity minutes” was an important contributor to this relationship. However, controlling for this item reduced, but did not fully account for, the relationship between physical activity environment and physical activity behavior. This suggests that while minutes of active opportunities are important, other environmental factors also affect physical activity of children while in child care.

The Portable and Fixed Environment subscales were significantly related to the proportion of time in MVPA, while Sedentary Environment and Physical Activity Training and Education helped explain the variability in the proportion of sedentary time and mean activity intensity. To our knowledge these are the first research findings suggesting differential impact of portable and fixed environmental factors on physical activity levels. Others have reported no relationship between active toys at home and physical activity,23 or that centers with more money to buy media equipment may promote physical activity, attract more educated staff, and have resources to provide supplemental training and education. Regrettably, this hypothesis could not be adequately tested because information about center funding/budget and staff education levels were not collected. Future research should attempt to model these potential mediators and moderators of physical activity in child care.

While the emphasis during early childhood should be on adequate amounts of active free play,11,24,25 current recommendations also suggest that preschool-aged children accumulate 60 minutes of structured physical activity each day.26 There is no doubt that active free play is important to cognitive, social, emotional, and motor development,11,27 but structured activities have been shown to produce higher levels of physical activity in young children.28,29 Inclusion of short play-based activities led by trained and knowledgeable staff could be used to enhance childcare programs and increase activity levels of children. Unfortunately, only about 25% of the 96 centers evaluated for the NAP SACC project provided physical activity education or training for staff (unpublished data). Center-level training and educational support may be an important first step in providing a rich, active environment for all children in child care, but future study will be needed to determine the impact of structured physical activity in the childcare setting.

Several limitations of the study should be acknowledged. The inclusion of only 20 centers may have limited our ability to detect statistical significance of some outcomes; however, the estimates of effect size and adjusted R² values support the practical significance of the findings. Secondly, the measurement of physical activity intensity did not allow for a precise estimate of total minutes of MVPA, but research supports its use as an acceptable surrogate.19,30,31 Third, physical activity was only assessed at the center level, which does not allow for an evaluation of how physical activity in child care affects overall activity levels for individual children. Inclusion of both home and childcare environments would allow for a more detailed examination of the interactions and influences of physical activity in young children. Finally, with cross-sectional data, no specific conclusions about causality can be drawn.

Few measurement tools exist that can be used to evaluate the physical activity environment, policies, and practices of childcare centers. The EPAO advances this
area considerably. The group comparisons and correlations presented provide validity evidence for the EPAO, suggesting that the physical activity subscales and total physical activity environment score differentiate childcare centers across observed physical activity levels. More widespread use and improvement of this tool could significantly advance knowledge related to how specific aspects of the childcare environment influence physical activity.

Based on the proportion of MVPA and sedentary time in the sample and national averages for the amount of time children aged 3 to 5 years spend in child care (22.5 hours per week), children in centers with high physical activity environment scores receive approximately 80 more minutes of MVPA and 140 fewer minutes of sedentary activity time per week compared to centers classified as having low physical activity environments. These findings emphasize the need for further systematic study aimed at understanding specific aspects of the childcare environment that influence physical activity behavior and how changing these factors alters physical activity. The easiest and least expensive means of increasing physical activity may be as simple as providing more active play time, but other aspects of a supportive environment also appear to promote physical activity. Therefore, policies, staff and center-level practices, and the play environment are important characteristics to consider when identifying determinants of physical activity or designing interventions in this setting.

We would like to thank the childcare center directors who participated in this study and the excellent field work conducted by Christina McWilliams, Katie Haverly, and the staff at the Center for Health Promotion and Disease Prevention. This study was support by a PEP grant from the Centers for Disease Control and Prevention/Associations of Schools of Public Health.

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References