



Non-overweight and Overweight Children’s Physical Activity during School Recess

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Keywords:	Accelerometers, Playtime, Play and playthings, Schools , Youth
Abstract:	<p>Objective: Little research has investigated children’s physical activity levels during school recess and the contribution of recess to school day physical activity levels by weight status. The aims of this study were to examine non-overweight and overweight children’s physical activity levels during school recess, and examine the contribution of recess to school day physical activity.</p> <p>Design: Cross-sectional.</p> <p>Setting: Four elementary schools located in Nebraska, USA.</p> <p>Methods: Two hundred and seventeen children (99 boys, 118 girls; 47.9% overweight) wore a uni-axial accelerometer for 5 consecutive school days during Fall 2009. The proportion of time spent engaged in sedentary, light, moderate (MPA) and vigorous (VPA) intensity physical activity during recess was determined using age-specific accelerometer thresholds.</p> <p>Results: Overweight children engaged in more %MPA and less %VPA than non-overweight children, respectively. No differences were found between overweight and healthy weight children’s moderate- to-vigorous physical activity (MVPA). Recess contributed 16.9% and 16.3% towards non-overweight and overweight children’s school day %MVPA, respectively.</p> <p>Conclusion: Examining %MVPA as an outcome variable may mask differences in recess physical activity levels between non-overweight and overweight children. Future research is needed to establish why healthy weight and overweight children engage in differing levels of %MPA and %VPA during recess.</p>

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For Peer Review

Non-overweight and Overweight Children's Physical Activity during School Recess

For Peer Review

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Abstract

Objective: Little research has investigated children's physical activity levels during school recess and the contribution of recess to school day physical activity levels by weight status. The aims of this study were to examine non-overweight and overweight children's physical activity levels during school recess, and examine the contribution of recess to school day physical activity.

Design: Cross-sectional.

Setting: Four elementary schools located in Nebraska, USA.

Methods: Two hundred and seventeen children (99 boys, 118 girls; 47.9% overweight) wore a uni-axial accelerometer for 5 consecutive school days during Fall 2009. The proportion of time spent engaged in sedentary, light, moderate (MPA) and vigorous (VPA) intensity physical activity during recess was determined using age-specific accelerometer thresholds.

Results: Overweight children engaged in more %MPA and less %VPA than non-overweight children, respectively. No differences were found between overweight and healthy weight children's moderate- to-vigorous physical activity (MVPA). Recess contributed 16.9% and 16.3% towards non-overweight and overweight children's school day %MVPA, respectively.

Conclusion: Examining %MVPA as an outcome variable may mask differences in recess physical activity levels between non-overweight and overweight children. Future research is needed to establish why healthy weight and overweight children engage in differing levels of %MPA and %VPA during recess.

Key words: Accelerometers; Playtime; Play and playthings; Schools; Youth

Introduction

The high prevalence of overweight and obesity, both nationally¹ and internationally², has become a major public health priority. The negative health consequences of pediatric obesity are well documented.²⁻³ While the etiology of obesity is complex, behavioral factors such as increased sedentary recreation (e.g. TV viewing)⁴ and a lack of physical activity engagement⁵ clearly contribute to the problem.

To reverse or slow the progressing obesity epidemic it is necessary to intervene at all levels of the obesogenic environment.² Schools are one context that can be targeted to implement health policies and interventions.⁶ However, the structure of the school day can also a barrier to physical activity opportunities, as a large proportion of the day is spent in sedentary behaviors. One opportunity for engaging in physical activity during the school day is recess, which provides children a regular opportunity to engage in unstructured play and physical activity with their peers.^{7,8} However, regularly scheduled recess is not required by all states⁹ and in recent years there has been a trend to reduce the frequency and duration of school recess, often due to curricular pressures.^{7,10} This is of concern, as recess contributes to children's physical activity levels¹¹ and is important for children's social, cognitive, emotional, physical and social development.¹²⁻¹³

In order to inform physical activity programming and policy in schools in relation to attempting to combat childhood obesity, research identifying the activity levels of children during recess and the contribution of school recess to daily physical activity is warranted. A recent review identified six studies that have investigated the recess physical activity levels of

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3 non-overweight and overweight children; however no association was found between weight
4 status and physical activity levels.¹⁴ These studies primarily focused on moderate-to-vigorous
5 physical activity¹⁵⁻¹⁶ or steps taken.¹⁷⁻¹⁸ Identifying engagement in different physical activity
6 intensities is important, as this may inform interventions design and delivery in this context. It
7 should also be noted that only two studies have examined the contribution of recess to daily
8 physical activity.^{17,19} Such information is needed to contribute to the debate concerning the
9 role of recess in school,¹² and support calls for enhanced recess provision within the school
10 day.¹⁹

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24 The aims of this study, therefore, were to a) investigate the physical activity levels of non-
25 overweight and overweight children, and b) determine the contribution of recess to school
26 day physical activity levels by BMI group.

27 28 29 30 31 32 33 **Methods**

34 35 36 37 38 *Subjects*

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40 Two hundred and fifty-seven children (118 boys, 139 girls) aged 7-12 years (mean = 9.5 ± 1.2
41 yr) from 4 elementary schools located in Nebraska were recruited into this study. The
42 participants comprised of Caucasian (39.1%), Hispanic (29.2%), African-American (28.9%), and
43 Asian (1.6%) children. A small percentage of children (1.2%) classed their ethnicity as "Other".
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50 The percentage of children who received free or reduced school meals was 79.4%.

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3 The children were a sub-sample from a larger study called Ready for Recess, which is a recess
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5 intervention aimed at determining the effectiveness of staff training and playground
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7 environmental modifications on children's physical activity levels during recess.²⁰ Baseline
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9 data collected prior to the start of the intervention (Fall 2009) were used for analysis in this
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11 study. All procedures and measures were approved by the Institutional Review Board at the
12
13 University of Nebraska at Omaha. Children in Grades 3-6 (16 classes in total) were provided
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15 consent forms to give to their parents to sign and then return to their teachers. Children that
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17 returned written parental consent to their teacher before the data collection period began
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19 were eligible to participate in the study.
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24 25 26 *Instruments*

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29 *Demographic data:* The school nurse and/or school secretary reported demographic data that
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31 included race, gender, birthdates, and free or reduced lunch status for all children in Grades
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39 *Anthropometry:* The school nurse or health aid at each school measured the children's stature
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41 and body mass using standardized procedures. Graduate assistants entered information into
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43 an excel file which automatically calculated BMI according to stature, body mass, birth date,
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45 and date when measurement occurred. Age and gender specific BMI percentiles were
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47 calculated using the Centers for Disease Control and Prevention criteria²¹, and children were
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49 classified as non-overweight (BMI<85th percentile), overweight (BMI>85th - <95th percentile)
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51 or obese (BMI>95th percentile). In this sample, 52.1% were non-overweight, 24.4% were
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53 overweight, and 23.5% were obese. To balance the groups for data analysis in this study, the
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3 overweight and obese group were merged to form one group termed overweight (BMI>85th
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5 percentile).
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10 *Physical activity:* Physical activity was objectively assessed using a hip-mounted GT1M
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12 Actigraph accelerometer (Actigraph, Pensacola, FL). The Actigraph is a common tool in the
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14 assessment of children's volume and intensity of physical activity.²² The epoch length was set
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16 at 5 seconds to capture the intermittent and sporadic nature of children's physical activity.
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21 Accelerometers were initialized and downloaded using Actigraph software (version 4.2.0,
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23 Actigraph, Pensacola, FL). Data were initially screened for spurious data points and
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25 compliance with the protocol using a data reduction program (KineSoft 2.0.94, Kinesoft
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27 Software, New Brunswick, Canada). To be retained for analysis, children were required to
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29 have worn the monitor on a minimum of three complete school days (typically 8:15am to
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31 4:15pm). Days where children arrived late and/or left school early were coded as missing
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33 days. Forty children (19 boys, 21 girls; 50% overweight) did not meet the minimum inclusion
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35 criteria and were removed from the data set. The final sample consisted of 217 children (99
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37 boys, 118 girls; 47.9% overweight).
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46 Since children only wore the monitor at school, it was assumed that children complied with
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48 the protocol unless information logged by the research team indicated otherwise. Screening
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50 of data to check for non-wear time was not conducted but individual data files were checked
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52 for anomalies or aberrant data in the files. Age-specific cut points derived from the Freedson
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54 et al.²³ energy expenditure prediction equation were used to determine the time spent in
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3 light (LPA), moderate (MPA) and vigorous physical activity (VPA). Minutes with fewer than
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5 200 counts were coded as sedentary to avoid misclassifying the amount of light activity in the
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7 day.²⁴ For comparison with previous studies, moderate-to-vigorous (MVPA) was calculated by
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9 summing MPA and VPA.
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14 To control for varying times of school recess periods and to aid comparisons to previous
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16 studies, physical activity variables are reported as percent of time (%SED, %LPA, %MPA,
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18 %VPA, %MVPA). The mean percentage per day per intensity category was calculated and
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20 used in the statistical analyses. The mean daily recess length was 19.7 ± 6.5 min.
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24 25 26 *Procedure*

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28 Each school was visited for one school week (Monday to Friday) in September 2009 (Fall).
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30 Each morning, children were provided with a specific numbered accelerometer to wear whilst
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32 at school. Children wore the same monitor each day. A familiarization session was provided
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34 on the first morning to explain to children about the correct wearing of the monitors, and to
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36 explain the study protocol. Children were encouraged to wear the accelerometers during the
37
38 entire school day and to follow their normal daily school routine. Graduate students removed
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40 the accelerometers at the end of the school day. Records of attendance were kept each day
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42 to identify the children who wore the monitors for the full school day, and identify those who
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44 did not comply with the monitoring protocol for at least one of the following reasons:
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46 absenteeism, arrived at school late, left school early, or decided to not wear the monitor on a
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48 given day. One teacher from each grade (Grades 3-6) was provided with a log and a
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50 stopwatch to record what time the recess periods occurred and length of the recess periods
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3 during the school day. At the end of each week, the teachers returned the logs to the
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5 investigators.
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10 *Data Analysis*

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12 Descriptive statistics (mean \pm SD) were initially calculated for all variables. Differences
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14 between children with complete and incomplete data were compared. To examine BMI group
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16 and sex differences in the different physical activity intensities, data were initially analyzed
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18 using a 2 (sex) x 2 (BMI group) analysis of variance. Post-hoc analyses were used to identify
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20 where significant differences lay in the event of a significant interaction.
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27 The relative contribution of recess to school day physical activity was calculated as a
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29 proportion using ((time in activity intensity/total time in activity intensity during the school
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31 day) \times 100), and averaged over valid days. Differences in the contribution of recess to school
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33 day physical activity by BMI group and sex were assessed using analyses of variance.
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35 Significant p-values were established at $p \leq 0.05$. All data were analyzed using SPSS v17.
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41 **Results**

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43 Table 1 reports the descriptive characteristics of this sample. No significant differences were
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45 found between included and excluded children on the descriptive data ($p > 0.05$).
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3 BMI group main effects were revealed for %LPA, %MPA and %VPA. Overweight children
4 engaged in significantly more %LPA and %MPA and significantly less %VPA than their non-
5 overweight peers. Sex main effects were found for all physical activity variables (Table 1).
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8 Boys engaged in significantly more %MPA, %VPA and %MVPA than girls, while girls engaged
9 in significantly more sedentary and %LPA than boys. A significant gender x BMI group
10 interaction was found for %VPA. Post-hoc analyses revealed that non-overweight boys were
11 significantly more active than overweight boys ($p < 0.01$), non-overweight girls ($p < 0.001$) and
12 overweight girls ($p < 0.001$). No other significant interactions were found.
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29 Figure 1 shows the contribution of recess to non-overweight and overweight boy's and girls'
30 school day physical activity. Recess contributed significantly more %VPA to non-overweight
31 boys' school day physical activity compared to non-overweight girls and overweight boys and
32 girls. No differences were found between groups for %LPA, %MPA or %MVPA. Overall, recess
33 contributed 16.9% and 16.3% towards non-overweight and overweight children's school day
34 %MVPA, respectively.
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45 Discussion

46 This is the first study to explore non-overweight and overweight children's engagement in
47 different physical activity intensities, and determine the contribution of recess to school day
48 physical activity levels. Small but significant differences in %LPA, %MPA and %VPA
49 engagement during school recess were observed. Whilst no studies have examined
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3 engagement in %LPA or %MPA separately, making comparisons to the current literature
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5 difficult, previous research has reported that overweight children engage in less %VPA during
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7 school recess.^{15,25} This is consistent with the findings from this study. Whilst the reasons for
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9 these findings are not widely known, previous research examining the context of school
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11 recess reported no significant differences between non-overweight and overweight children's
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13 social play behaviors.¹⁶ It is possible that while social play behaviors are similar between non-
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15 overweight and overweight children, overweight children may not be able to engage at
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17 higher intensities due to fitness¹⁵ or differences in fundamental movement skills.²⁶ Different
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19 intervention strategies may be required for non-overweight and overweight children during
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21 school recess to increase their physical activity levels, and a range of options should be
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23 provided for children to engage in physical activity levels of different intensities.
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31 It should be noted, however, that no differences were found between non-overweight and
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33 overweight children's %MVPA, which supports previous research conducted in elementary
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35 school age children.^{15-16,18} Previously research has suggested that overweight children are less
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37 active during their discretionary time,¹⁸ yet the results of the current study suggest that these
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39 differences occur at higher intensities. Overall, these findings suggest that assessing %MVPA
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41 may mask differences in recess physical activity levels between BMI groups, and may explain
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43 the lack of association found in a recent correlates review.¹⁴
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50 In this study, recess contributed 16.9% and 16.3% towards non-overweight and overweight
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52 children's school day %MVPA, respectively. This is lower than the contribution of recess to
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54 the number of steps taken by non-overweight (29.6%) and overweight (31.1%) children
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3 during the school day reported by Erwin and colleagues.¹⁹ Interestingly, recess contributed
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5 between a quarter to a third of children's school day VPA, despite accounting for 4% of the
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7 whole school day. This highlights the importance of recess as an opportunity for children to
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9 engage in physical activity which may benefit health outcomes such as weight status.²⁷
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11 Furthermore, this finding lends further support to recommendations that recess should occur
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13 on a daily basis,^{8,28} as it contributed a significant proportion to their school day physical
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22 School recess contributed significantly more to non-overweight boys' school day VPA than
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24 overweight boys and girls in general. This latter finding is difficult to explain, as it suggests
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26 that girls and overweight boys engage in more VPA in other parts of the school day. It is
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28 possible that non-overweight boys compensate for their engagement in VPA during recess by
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30 reducing their VPA in other parts of the day,²⁹ though further research is needed to
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32 determine where these reductions may occur. Overall, however, these results lend support to
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34 the concerns reported by Ramstetter et al.¹² who highlighted that reducing or removing
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36 recess from the school day may be counterproductive. Indeed, reductions in recess duration
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38 and frequency may have a negative impact on both non-overweight and overweight
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40 children's physical activity engagement.
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47 *Limitations*

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49 Few studies have investigated the physical activity levels of different intensities of non-
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51 overweight and overweight children in contexts where there are opportunities for physical
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53 activity and limited opportunities for engaging in screen-based sedentary leisure activities.
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3 This is a strength of this current study. Some limitations, however, warrant attention. First,
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5 all children with a BMI greater than the 85th percentile were grouped together in this study to
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7 add power to the analyses. Future studies should determine whether differences occur
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9 between normal weight, overweight and obese children's physical activity levels during
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11 recess. Second, no habitual physical activity were collected. It was not possible, therefore, to
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13 determine the extent to which recess contributes to non-overweight and overweight
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15 children's daily activity levels, and whether activity compensation occurs during the day.
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17 Third, it is not known what behaviors non-overweight and overweight children engaged in
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19 during recess. Further research is needed to identify the activities they choose to engage in
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21 during this time, which will help to inform future intervention strategies.
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29 *Conclusion*

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31 Overweight children engage in more %MPA and less %VPA than non-overweight children
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33 during school recess. Moreover, recess contributed between a quarter and a third to
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35 children's school-day VPA engagement. Interventions that aim to increase both non-
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37 overweight and overweight children's physical activity levels during school recess are
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39 warranted.
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Table 1: Anthropometric characteristics and Physical activity levels of non-overweight and overweight boys and girls during school recess (mean ± SD)

	Boys		Girls		ANOVA (p-values)		
	Non-overweight (n=55)	Overweight (n=44)	Non-overweight (n=58)	Overweight (n=60)	Gender effect	BMI Group effect	Gender x BMI Group
Age (yrs)	9.4 ± 1.2	9.6 ± 1.2	9.6 ± 1.2	9.7 ± 1.1	NS	NS	NS
Stature (inches)	54.8 ± 3.3	56.8 ± 4.3	54.1 ± 3.7	56.5 ± 3.8	NS	<0.001	NS
Body Mass (lbs)	72.2 ± 13.4	111.5 ± 30.6	72.1 ± 13.8	109.9 ± 24.0	NS	<0.001	NS
Body Mass Index	16.8 ± 1.6	24.0 ± 3.7	17.2 ± 1.6	24.2 ± 3.8	NS	<0.001	NS
<i>Physical Activity</i>							
%Sedentary	35.5 ± 18.2	34.3 ± 14.4	48.2 ± 14.8	46.4 ± 14.4	<0.001	NS	NS
%LPA	15.0 ± 4.5	17.6 ± 4.9	17.1 ± 4.4	18.4 ± 4.7	0.03	<0.01	NS
%MPA	28.4 ± 9.2	33.9 ± 11.6	23.2 ± 8.3	24.9 ± 8.5	<0.001	<0.01	NS
%VPA	21.0 ± 11.2	14.2 ± 8.7	11.6 ± 7.2	10.3 ± 7.2	<0.001	<0.001	0.02
%MVPA	49.5 ± 18.1	48.1 ± 16.0	34.8 ± 13.5	35.3 ± 13.8	<0.001	NS	NS

Abbreviations: %LPA= Light physical activity; %MPA= Moderate physical activity; %VPA= Vigorous physical activity; %MVPA = Moderate-to-vigorous physical activity; NS = not significant

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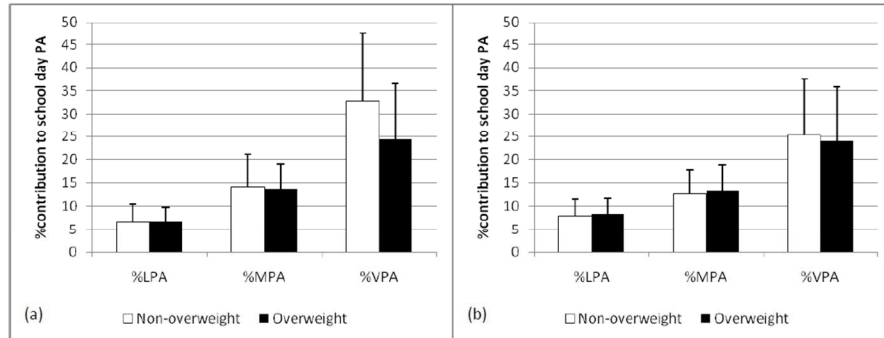


Figure 1: Contribution of recess to school day physical activity for (a) boys and (b) girls by weight status

322x188mm (96 x 96 DPI)

Peer Review