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John J Reilly, PhD, Professor of Physical Activity & Public Health Science, University of Strathclyde, Glasgow, G11XQ, Scotland. john.j.reilly@strath.ac.uk; tel 00441415484235

Grant Johnston, BSc, Undergraduate Researcher, University of Strathclyde, Glasgow G11XQ, Glasgow, Scotland. Johnston_@live.co.uk, tel 00441415484235

Stuart McIntosh, BSc, Undergraduate Researcher, University of Strathclyde, Glasgow G11XQ, Glasgow, Scotland. s_mc@hotmail.com. tel 00441415484235

Anne Martin, PhD, Research Fellow, Physical Activity for Health Research Centre, University of Edinburgh, Edinburgh, Scotland. anne.martin.ed.ac.uk. tel 00441316516138
Contribution of school recess to daily physical activity: systematic review and evidence appraisal

John J Reilly, BSc, PhD
Grant Johnston, BSc
Stuart McIntosh, BSc
Anne Martin, BSc, PhD

**Objective:** The present study aimed to estimate school recess moderate-vigorous intensity physical activity (MVPA). **Methods:** A systematic review was carried out in MEDLINE and SportDiscus to identify observational studies where MVPA had been measured objectively during school recess. Study quality was assessed formally.

**Results:** Twenty-four eligible studies in primary school pupils (N= 5,778 individuals), revealed a weighted mean of 12 minutes MVPA per school day. Only two eligible studies were identified in high school pupils (N= 399 individuals). The evidence was generally of moderately high quality. **Conclusions:** Recess makes a small contribution to daily MVPA. Substantial policy effort is likely to be needed if recess is to make a more useful contribution to MVPA among children and adolescents.

**Keywords:** school; physical activity; child; exercise; youth; systematic review; accelerometer

John J Reilly, Grant Johnston, Stuart McIntosh, University of Strathclyde School of Psychological Sciences & Health, Glasgow, Scotland. Anne Martin, University of Edinburgh Physical Activity for Health Research Centre, Edinburgh Scotland.

Correspondence Prof Reilly: john.j.reilly@strath.ac.uk
School recess has been the focus of a great deal of research in physical activity and health because it provides an opportunity every school day for children and adolescents to accumulate health-enhancing moderate-vigorous intensity physical activity (MVPA). Since the suggestion by Ridgers and Stratton in 2005 it has been accepted by researchers that at least 40% of recess time should be spent in MVPA. Systematic reviews have suggested that recess could make a meaningful contribution to physical activity and health of children and adolescents, by the accumulation of MVPA every school day. The contribution of school recess is considered important because of concerns that levels of MVPA are too low among children and adolescents, and because school reaches the entire child and adolescent population.

Recent systematic reviews on recess physical activity have focused on the determinants of physical activity during recess, and the efficacy of interventions aimed at increasing physical activity levels during recess. To date, no systematic review has focused on the amount of MVPA which is being accumulated by children and adolescents during school recess, and no systematic review has examined the extent to which MVPA meets the widely accepted recommendation of 40% of recess time in MVPA. At present it is unclear if school recess is making a meaningful contribution to overall daily MVPA during childhood and adolescence. The primary aim of the present study was therefore to systematically review and critically appraise the evidence on the amount of MVPA being accumulated by children and adolescents during school recess. A secondary aim was to identify gaps in the evidence base in this area, identifying future research questions.
METHODS

Literature searching and study inclusion criteria

The literature search was conducted using the two most relevant electronic databases: MEDLINE OVID from inception of the database to 8th December 2014; SportDiscus from inception of the database to 8th December 2014. The review was founded on the ‘population, exposure, comparison, outcome’ principle: population = school-age children and adolescents, age 5-18 years, or described as school-age in the original studies; exposure = school break time, ‘recess’, defined inclusively as any breaks outside class time, including lunchtime and school breaks in the morning and/or afternoon considered to be recess by the authors of the original studies; comparison was not applicable in the present study; outcome = objectively measured MVPA, with any acceptable objective measure. Full literature search details are available from the corresponding author on request.

To be eligible for inclusion in the review papers had to: report information on school-age children and adolescents as defined above; use objective methods for measuring MVPA, which consisted of accelerometry, heart rate monitoring, combined accelerometry and heart rate monitoring, and direct observation; report minutes of MVPA and/or the % of time spent in MVPA during the school recess period along with the duration of recess; be original research, published in a peer reviewed journal; be observational in design, though intervention studies were considered for inclusion if pre-intervention data and/or control group data were given separately; be published in the English language. Studies were excluded if they were based on other populations, exposures, outcomes, or provided intervention group data only.
Two authors independently considered the Titles/Abstracts of all papers identified by the search for eligibility using the inclusion criteria described above, referring to a third author for discussion and mediation where required. Two authors also examined the papers identified for full-text screening, and this was confirmed by a third author. Searching two databases was acknowledged as a study limitation, and in an effort to reduce the probability that relevant studies would be excluded we carried out two additional search procedures: reference lists of all eligible studies were examined for potentially eligible studies; studies which cited other studies identified as eligible were identified and screened for eligibility using the process described above.

**Data extraction and analysis/interpretation**

Three researchers used a standard data extraction form in order to populate the evidence tables and to cross check for agreement and accuracy. The aim was to extract summary MVPA data expressed in minutes/day during school recess. Since the time scheduled for recess varied between -and sometimes within- eligible studies, the mean or median % of recess time which was spent in MVPA was also extracted, or calculated if absolute time in MVPA and recess duration were both provided, in an attempt to make the studies more comparable.

Where studies provided recess period data separately, eg morning plus afternoon recess, these periods were combined to produce a summary daily MVPA recess estimate. A weighted mean estimate of recess MVPA from the eligible studies was calculated, weighted by sample size. The eligible studies fell logically into two
categories: studies of primary school pupils (elementary and middle school); studies of secondary school (high school) pupils, and so data were synthesised for these two age groups separately, summarised as the absolute mean or median minutes of MVPA accumulated during recess time, and the mean or median % of recess time as MVPA.

Assessment of quality of the eligible studies

Eligible studies were assessed independently for quality by three of the four authors, resolving disagreements by discussion. The Tooth et al tool\textsuperscript{4} for assessing the quality of observational studies was considered initially—it consists of over 30 items, but some items of particular importance to the quality of accelerometry studies are not included. The Tooth et al tool has been used previously, in substantially reduced form, in recent systematic reviews of physical activity studies\textsuperscript{5,6} with an 11-item, or 8-item checklist. In the present study the Tooth et al tool\textsuperscript{4} was modified for use as a 17-item checklist, but scored out of 6, as shown in Table 1. Each eligible study therefore received a score out of 6, with higher scores reflecting higher study quality. The review did not set a priori quality criteria for inclusion of studies, but had planned a sensitivity analysis, comparing conclusions based on higher quality studies only versus conclusions based on all studies, in the event that study results varied markedly by study quality.

Experience and expertise of the authors in conducting and reporting systematic reviews
The last author has published 11 peer-reviewed systematic reviews since 2002, 10 as first or last author: this includes reviews and appraisals for two evidence-based guidelines for the Scottish Intercollegiate Guidelines Network, and one for the Canadian Society for Exercise Physiology. The first author completed a PhD which was based on systematic reviewing in 2014, and has published 6 peer-reviewed systematic reviews since 2014, all as first author, including one Cochrane review. The other two authors undertook the study as final year BSc research projects over the course of academic year 2014-2015: they were trained in review methodology by the two more senior authors.

RESULTS

Characteristics of eligible studies

The study flow diagram is provided in Figure 1. Of 542 papers identified in the initial review of the two databases, 150 were selected for full text screening and of these, 24 studies were eligible for inclusion. A further 2 eligible studies were identified from manual reference searching of included studies. Almost all (23/26) eligible studies used the ActiGraph accelerometer to measure recess MVPA, though with a variety of different ActiGraph models and approaches to data collection and reduction. The remaining three studies used heart rate monitoring (2 studies), and direct observation (1 study).

Primary (elementary, middle) school pupils
Twenty four eligible studies involved primary school pupils (Table 2), with a total sample size of 5,778 children, all from high-income nations. The weighted mean recess MVPA across the 24 studies was 12 minutes per school day.

Secondary (High) school pupils

Only two eligible studies involved high school pupils (Table 3), with a total sample size of 399 adolescents from two nations, Denmark and Spain. Weighted mean recess MVPA per school day was 7 minutes.

Study quality assessment

Study quality assessment (Tables 2 and 3) suggested that study quality was generally high. For the 24 eligible primary school studies: one scored 3/6; five scored 4/6; eight scored 5/6; 10 scored 6/6. Both of the eligible secondary school studies scored 5/6 on study quality.

DISCUSSION

Main findings and study implications

The present study found a large and fairly consistent body of moderately high or high quality evidence on the contribution which recess makes to objectively measured schoolday MVPA in children attending primary school (elementary school/middle school). There was apparently very little evidence on recess MVPA among those attending secondary school- only two eligible high-school studies were found.
The present review focused on MVPA accumulated during recess. To consider the impact of recess MVPA to overall population MVPA over the whole year, recess data can usefully be seen against a background of the number of school days actually attended per year.\textsuperscript{32} This approach approximately halves the contribution of recess MVPA to total ‘population attributable MVPA’, because in most high-income countries children attend school on only around half of all days per year, once the length of school-terms, weekends, and school absences are taken into account.\textsuperscript{32,33}

The present study adds to previous reviews by answering a different research question, and adds to previous individual studies of the topic by providing an assessment of the quantity, quality, and consistency of the evidence base which answers the question.

\textbf{Comparisons with other studies}

Since previous systematic reviews on school recess physical activity have focused on issues distinct from the present study, notably interventions to increase physical activity and correlates/determinants of physical activity during recess, there are no directly comparable reviews. The systematic review by Parrish et al\textsuperscript{3} on interventions to increase physical activity during recess\textsuperscript{3} found only nine eligible studies –with none from high schools- and reported that the quality of these studies was low. The limited quality and quantity of evidence precluded firm conclusions, but Parrish et al. suggested that two strategies –playground markings, and the provision of non-fixed play equipment- could be considered promising.\textsuperscript{3}
There are currently no evidence-based, systematically reviewed and critically appraised, guidelines on the number of minutes per school day which children or adolescents should accumulate during recess, or the percentage of recess time which should be spent in MVPA. However, a number of studies, including 9 of the 26 studies eligible for the present review, have compared their findings with a threshold of 40% of recess time in MVPA as an indicator of the adequacy of MVPA during recess. In the present review only 3/26 eligible studies met or exceeded this 40% threshold.\textsuperscript{22,28,29}

**Review and evidence strengths and weaknesses**

The present study had several weaknesses. First, studies eligible had to be published in peer reviewed journals in English, and this may have excluded relevant evidence. Literature searching was restricted by the use of two databases, a result of time/resource constraints as this was an unfunded project. However, the two most relevant databases were searched, reference lists of eligible studies were searched manually for additional eligible studies, papers which cited the eligible studies were also checked for eligibility, and a very large body of fairly consistent evidence -24 primary school studies-was found. The limited evidence on high school recess may reflect a real gap in the literature, as suggested by the systematic review on interventions to promote recess physical activity by Parrish et al,\textsuperscript{3} or might reflect the reality that in some parts of the world high-school students do not have opportunities for recess.

There is no standard or accepted definition of ‘recess’ in the literature, and the way in which recess time was operationalised in the eligible studies varied. For
example, some studies included only specified breaks as recess, excluding lunchtime. Other studies included lunchtime, on the grounds that this usually has an element of time for eating and an element of recess. A more standardised approach to defining recess would be helpful in future research, though difficult to achieve given the variety of recess scheduling across the world. The MVPA content of recess, when expressed as a percentage of recess time, is more comparable between studies.

We excluded studies where an intervention had been applied to increase physical activity during recess, or where recess was defined as being part of physical education. In the absence of a standard definition we interpreted recess as school breaks in the present review, but the absolute amount of MVPA accumulated was relatively small however it was operationalised, particularly when considered as a contribution to ‘population attributable MVPA’ as noted above. The small contribution of school recess to overall MVPA is a combination of the fact that some non-physically active activities must take place during recess, recess time is generally short, and only around half of all days are schooldays in western countries.

While the present study used a 17-item checklist to assess study quality, and applied it using three researchers as a check, collapsing the checklist to 6 items for scoring might have reduced the sensitivity of the resulting instrument.

The evidence considered by the present review had a number of strengths too. In particular, most eligible studies were generally rated as being of moderately high or high quality. All studies also provided estimates of MVPA using objective methods, a notable strength.
The evidence considered by the present study also had a number of weaknesses. There was probably substantial heterogeneity in recess MVPA between and within studies. Some of the heterogeneity was probably real, the result of differences between samples which systematic reviews have shown influence MVPA during recess such as gender,\textsuperscript{2,3} and environmental differences such as season or weather,\textsuperscript{2,3} or facilities available to encourage play during recess.\textsuperscript{2} Between-study sources of variation in the MVPA content of recess also include ActiGraph model differences, and accelerometry data collection and reduction differences.\textsuperscript{34} Between-study differences in methodology for measurement of MVPA, in time allocated to recess, and in differences between samples which are relevant to MVPA during recess, such as gender, meant that a meta-analysis was not appropriate.

One striking evidence gap was the absence of data from low-middle income countries. The decision to restrict the search to studies in English language may have contributed to this. Developing countries are undergoing a ‘physical activity transition’ through,\textsuperscript{35,36} and future research on recess MVPA should attempt to include populations from low-middle income countries if the published literature is to become more representative globally.

**IMPLICATIONS FOR HEALTH BEHAVIOR AND POLICY**

The present study suggests that school recess makes a small contribution to overall population MVPA in high-income countries. Our findings have a number of implications for school policy. First, the emphasis on recess as an opportunity for MVPA should arguably receive less emphasis in future, with greater focus on other
school-based domains of physical activity such as physical education, or greater
policy effort should perhaps be directed at domains of physical activity outside
school. Alternatively, school recess requires a renewed and massive effort if the
potential it appears to offer as a means of providing MVPA is to be realised. One
element of the greater policy effort could be increased surveillance: if school recess is
an important public health opportunity which is being missed, then it should be
monitored using local and national surveillance. Monitoring of the MVPA content of
school recess is rare. The implementation of any existing policy in relation to school
recess MVPA should also be considered critically— even where appropriate policy is in
place, policy implementation may be limited, and policy evaluation even more
limited. Evidence-based policy requires evidence, and the limited amount of evidence
from high school pupils identified by the present review suggests that more research
will be required.

Recent systematic reviews have established some correlates or determinants of
physical activity during school recess for primary school pupils, and have identified
lessons which can be learned from previous interventions, but with only a small
evidence base of low quality, so policy in this area could not be very evidence-based
at present. The frequency and duration of recess is sensitive to policy and practice,
and apparently simple school practices such as holding recess indoors during
inclement weather probably influence MVPA. Tentative evidence-based
recommendations at present would therefore include policies aimed at increased use
of markings in the school playground, increased availability of non-fixed play
equipment, and increased use of outdoor space for recess. Being indoors constrains
MVPA in children, favoring sedentary behavior and light intensity physical activity: being outdoors creates greater opportunity for MVPA.\textsuperscript{37}

Other policy considerations in the future could include a comparative analysis of the likely gain in population MVPA from policies targeting different domains of physical activity: active commuting to school; school recess; school physical education; active/outdoor play. In such a recent comparative analysis for Canada, Janssen,\textsuperscript{32} using a modelling exercise, suggested that the greatest potential for population MVPA gain might be from the promotion of active and outdoor play, with the implication that recess should have a lower priority in future policy. Bassett et al,\textsuperscript{38} with a comparative analysis based on US data, also suggested that recess policy change might have less scope for public health gain than some other school-based policy targets, notably physical education. This type of evidence should help inform priorities for MVPA policy in children and adolescents in future.

Finally, the focus of school policy around MVPA in future might usefully incorporate some of the latest evidence on the non-health impact of variation in MVPA. It is becoming clear that higher levels of MVPA among children and adolescents are associated with increased academic attainment and improved pupil behavior in class, including greater focus on school tasks.\textsuperscript{39,40} This relatively recent emphasis on the potential learning gain, rather than health gain, from MVPA\textsuperscript{40,41} might be a useful lever for policymakers to promote MVPA during recess in future, by arguing that it should have educational benefits of direct and short-term relevance to schools.
References


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<td>List at least 3 of the following 4 items: sampling; how the sample was recruited; time; place</td>
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<td>2</td>
<td>Adequate description of the sample, all 3 items (number, age, gender)</td>
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<td>3</td>
<td>Attrition- description of number of children recruited and the number measured</td>
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<td>4</td>
<td>Methods of MVPA measurement. If any of the following 3 items are described 1 point: type of device; epoch, number of days of recess specified as a minimum; duration of monitoring of recess given; monitor placement; data reduction (e.g. exclusion of zeros/non wear time decisions)</td>
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<td>5</td>
<td>Methods of MVPA definition given (1 item), e.g. a cut point used to define MVPA given if appropriate</td>
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<td>6</td>
<td>Adequate description of the following two items: numbers analysed; summary data for MVPA during recess</td>
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Figure 1: Study Flow Diagram

542 records retrieved from 2 database searches

2 studies identified from manual reference searching

103 duplicates removed

Titles screened from 439 records

144 records excluded based on title

Abstracts screened from 295 records

145 records excluded based on abstract

150 records for full-text screening

126 records excluded based on full-text screening, 2 added from citation searching

26 eligible studies included; 2 from high schools; 24 from primary schools