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Contribution of school recess to daily physical activity: systematic review and evidence appraisal

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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

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1

2 School recess has been the focus of a great deal of research in physical activity
3 and health because it provides an opportunity every school day for children and
4 adolescents to accumulate health-enhancing moderate-vigorous intensity physical
5 activity (MVPA). Since the suggestion by Ridgers and Stratton in 2005¹ it has been
6 accepted by researchers that at least 40% of recess time should be spent in MVPA.
7 Systematic reviews have suggested that recess could make a meaningful contribution
8 to physical activity and health of children and adolescents, by the accumulation of
9 MVPA every school day.^{2,3} The contribution of school recess is considered important
10 because of concerns that levels of MVPA are too low among children and
11 adolescents, and because school reaches the entire child and adolescent population.¹⁻³

12

13 Recent systematic reviews on recess physical activity have focused on the
14 determinants of physical activity during recess,² and the efficacy of interventions
15 aimed at increasing physical activity levels during recess.³ To date, no systematic
16 review has focused on the amount of MVPA which is being accumulated by children
17 and adolescents during school recess, and no systematic review has examined the
18 extent to which MVPA meets the widely accepted recommendation of 40% of recess
19 time in MVPA. At present it is unclear if school recess is making a meaningful
20 contribution to overall daily MVPA during childhood and adolescence. The primary
21 aim of the present study was therefore to systematically review and critically appraise
22 the evidence on the amount of MVPA being accumulated by children and adolescents
23 during school recess. A secondary aim was to identify gaps in the evidence base in
24 this area, identifying future research questions.

25

26 **METHODS**

27 **Literature searching and study inclusion criteria**

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

39

40 To be eligible for inclusion in the review papers had to: report information on
41 school-age children and adolescents as defined above; use objective methods for
42 measuring MVPA, which consisted of accelerometry, heart rate monitoring,
43 combined accelerometry and heart rate monitoring, and direct observation; report
44 minutes of MVPA and/or the % of time spent in MVPA during the school recess
45 period along with the duration of recess; be original research, published in a peer
46 reviewed journal; be observational in design, though intervention studies were
47 considered for inclusion if pre-intervention data and/or control group data were given
48 separately; be published in the English language. Studies were excluded if they were
49 based on other populations, exposures, outcomes, or provided intervention group data
50 only.

51

52 Two authors independently considered the Titles/Abstracts of all papers
53 identified by the search for eligibility using the inclusion criteria described above,
54 referring to a third author for discussion and mediation where required. Two authors
55 also examined the papers identified for full-text screening, and this was confirmed by
56 a third author. Searching two databases was acknowledged as a study limitation, and
57 in an effort to reduce the probability that relevant studies would be excluded we
58 carried out two additional search procedures: reference lists of all eligible studies
59 were examined for potentially eligible studies; studies which cited other studies
60 identified as eligible were identified and screened for eligibility using the process
61 described above.

62

63 **Data extraction and analysis/interpretation**

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

71

72 Where studies provided recess period data separately, eg morning plus
73 afternoon recess, these periods were combined to produce a summary daily MVPA
74 recess estimate. A weighted mean estimate of recess MVPA from the eligible studies
75 was calculated, weighted by sample size. The eligible studies fell logically into two

76 categories: studies of primary school pupils (elementary and middle school); studies
77 of secondary school (high school) pupils, and so data were synthesised for these two
78 age groups separately, summarised as the absolute mean or median minutes of
79 MVPA accumulated during recess time, and the mean or median % of recess time as
80 MVPA.

81

82 **Assessment of quality of the eligible studies**

83 Eligible studies were assessed independently for quality by three of the four
84 authors, resolving disagreements by discussion. The Tooth et al tool⁴ for assessing the
85 quality of observational studies was considered initially-it consists of over 30 items,
86 but some items of particular importance to the quality of accelerometry studies are not
87 included. The Tooth et al tool has been used previously, in substantially reduced form,
88 in recent systematic reviews of physical activity studies^{5,6} with an 11-item, or 8-item
89 checklist. In the present study the Tooth et al tool⁴ was modified for use as a 17-item
90 checklist, but scored out of 6, as shown in **Table 1**. Each eligible study therefore
91 received a score out of 6, with higher scores reflecting higher study quality. The
92 review did not set a priori quality criteria for inclusion of studies, but had planned a
93 sensitivity analysis, comparing conclusions based on higher quality studies only
94 versus conclusions based on all studies, in the event that study results varied markedly
95 by study quality.

96

97 **Experience and expertise of the authors in conducting and reporting systematic** 98 **reviews**

99 The last author has published 11 peer-reviewed systematic reviews since 2002,
100 10 as first or last author: this includes reviews and appraisals for two evidence-based
101 guidelines for the Scottish Intercollegiate Guidelines Network, and one for the
102 Canadian Society for Exercise Physiology. The first author completed a PhD which
103 was based on systematic reviewing in 2014, and has published 6 peer-reviewed
104 systematic reviews since 2014, all as first author, including one Cochrane review. The
105 other two authors undertook the study as final year BSc research projects over the
106 course of academic year 2014-2015: they were trained in review methodology by the
107 two more senior authors.

108

109 **RESULTS**

110 **Characteristics of eligible studies**

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

119

120 **Primary (elementary, middle) school pupils**

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

124

125 **Secondary (High) school pupils**

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

129

130 **Study quality assessment**

131 Study quality assessment (Tables 2 and 3) suggested that study quality was
132 generally high. For the 24 eligible primary school studies: one scored 3/6; five scored
133 4/6; eight scored 5/6; 10 scored 6/6. Both of the eligible secondary school studies
134 scored 5/6 on study quality.

135

136 **DISCUSSION**

137 **Main findings and study implications**

138 The present study found a large and fairly consistent body of moderately high
139 or high quality evidence on the contribution which recess makes to objectively
140 measured schoolday MVPA in children attending primary school (elementary school/
141 middle school). There was apparently very little evidence on recess MVPA among
142 those attending secondary school- only two eligible high-school studies were found.

143

144 The present review focused on MVPA accumulated during recess. To consider the
145 impact of recess MVPA to overall population MVPA over the whole year, recess data
146 can usefully be seen against a background of the number of school days actually
147 attended per year.³² This approach approximately halves the contribution of recess
148 MVPA to total ‘population attributable MVPA’, because in most high-income
149 countries children attend school on only around half of all days per year, once the
150 length of school-terms, weekends, and school absences are taken into account.^{32,33}
151 The present study adds to previous reviews by answering a different research
152 question, and adds to previous individual studies of the topic by providing an
153 assessment of the quantity, quality, and consistency of the evidence base which
154 answers the question.

155

156 **Comparisons with other studies**

157 Since previous systematic reviews on school recess physical activity have
158 focused on issues distinct from the present study, notably interventions to increase
159 physical activity and correlates/determinants of physical activity during recess, there
160 are no directly comparable reviews. The systematic review by Parrish et al³ on
161 interventions to increase physical activity during recess³ found only nine eligible
162 studies –with none from high schools- and reported that the quality of these studies
163 was low. The limited quality and quantity of evidence precluded firm conclusions, but
164 Parrish et al. suggested that two strategies –playground markings, and the provision of
165 non-fixed play equipment- could be considered promising.³

166

167 There are currently no evidence-based, systematically reviewed and critically
168 appraised, guidelines on the number of minutes per school day which children or
169 adolescents should accumulate during recess, or the percentage of recess time which
170 should be spent in MVPA. However, a number of studies, including 9 of the 26
171 studies eligible for the present review, have compared their findings with a threshold
172 of 40% of recess time in MVPA as an indicator of the adequacy of MVPA during
173 recess. In the present review only 3/26 eligible studies met or exceeded this 40%
174 threshold.^{22,28,29}

175

176 **Review and evidence strengths and weaknesses**

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

189

190 There is no standard or accepted definition of ‘recess’ in the literature, and the
191 way in which recess time was operationalised in the eligible studies varied. For

192 example, some studies included only specified breaks as recess, excluding lunchtime.
193 Other studies included lunchtime, on the grounds that this usually has an element of
194 time for eating and an element of recess. A more standardised approach to defining
195 recess would be helpful in future research, though difficult to achieve given the
196 variety of recess scheduling across the world. The MVPA content of recess, when
197 expressed as a percentage of recess time, is more comparable between studies.

198

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

208

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

212

213 The evidence considered by the present review had a number of strengths too.
214 In particular, most eligible studies were generally rated as being of moderately high or
215 high quality. All studies also provided estimates of MVPA using objective methods, a
216 notable strength.³⁴

217

218 The evidence considered by the present study also had a number of
219 weaknesses. There was probably substantial heterogeneity in recess MVPA between
220 and within studies. Some of the heterogeneity was probably real, the result of
221 differences between samples which systematic reviews have shown influence MVPA
222 during recess such as gender,^{2,3} and environmental differences such as season or
223 weather,^{2,3} or facilities available to encourage play during recess.² Between-study
224 sources of variation in the MVPA content of recess also include ActiGraph model
225 differences, and accelerometry data collection and reduction differences.³⁴ Between-
226 study differences in methodology for measurement of MVPA, in time allocated to
227 recess, and in differences between samples which are relevant to MVPA during
228 recess, such as gender, meant that a meta-analysis was not appropriate.

229

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

236

237 **IMPLICATIONS FOR HEALTH BEHAVIOR AND POLICY**

238 The present study suggests that school recess makes a small contribution to
239 overall population MVPA in high-income countries. Our findings have a number of
240 implications for school policy. First, the emphasis on recess as an opportunity for
241 MVPA should arguably receive less emphasis in future, with greater focus on other

242 school-based domains of physical activity such as physical education, or greater
243 policy effort should perhaps be directed at domains of physical activity outside
244 school. Alternatively, school recess requires a renewed and massive effort if the
245 potential it appears to offer as a means of providing MVPA is to be realised. One
246 element of the greater policy effort could be increased surveillance: if school recess is
247 an important public health opportunity which is being missed, then it should be
248 monitored using local and national surveillance. Monitoring of the MVPA content of
249 school recess is rare. The implementation of any existing policy in relation to school
250 recess MVPA should also be considered critically- even where appropriate policy is in
251 place, policy *implementation* may be limited, and policy *evaluation* even more
252 limited. Evidence-based policy requires evidence, and the limited amount of evidence
253 from high school pupils identified by the present review suggests that more research
254 will be required.

255

256 Recent systematic reviews have established some correlates or determinants of
257 physical activity during school recess for primary school pupils,² and have identified
258 lessons which can be learned from previous interventions, but with only a small
259 evidence base of low quality,³ so policy in this area could not be very evidence-based
260 at present. The frequency and duration of recess is sensitive to policy and practice,
261 and apparently simple school practices such as holding recess indoors during
262 inclement weather probably influence MVPA¹⁴. Tentative evidence-based
263 recommendations at present would therefore include policies aimed at increased use
264 of markings in the school playground, increased availability of non-fixed play
265 equipment, and increased use of outdoor space for recess. Being indoors constrains

266 MVPA in children, favoring sedentary behavior and light intensity physical activity:
267 being outdoors creates greater opportunity for MVPA.³⁷

268

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

280

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

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Table 1 Study Quality Assessment Checklist

Criterion number	Item(s) and number of items required for 1 point
	for scoring
1	List at least 3 of the following 4 items: sampling; how the sample was recruited; time; place
2	Adequate description of the sample, all 3 items (number, age, gender)
3	Attrition- description of number of children recruited and the number measured
4	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)
5	Methods of MVPA definition given (1 item), e.g. a cut point used to define MVPA given if appropriate
6	Adequate description of the following two items: numbers analysed; summary data for MVPA during recess

Table 2 School Recess MVPA: Primary (Elementary, Middle) School Studies

First Author, Setting	Method of MVPA measurement	Sample Size, Mean Age (y)	MVPA (mean; minutes/day)	Study Quality Rating (out of 6)
Blaes, ⁷ France	ActiGraph GT1M, cut-point not clear	427; 8.7	9	6
Cohen, ⁸ Australia	ActiGraph GT3X and GT3X+, Evenson cut-point	325; 8.5	11	5
D'Haese, ⁹ Belgium	ActiGraph GT3X+, Evenson cut-point	184; 10.4	4	5
Dessing, ¹⁰ Netherlands	ActiGraph GT1M, Evenson cut-point	76; 8.6	5	6
Efrat, ¹¹ USA	ActiGraph 7164, cut-point not clear	47; elementary school	6	5
Engelen, ¹² Australia	ActiGraph GT3X, Evenson cut-point	221; 6.0	11	4
Fairclough, ¹³ England	ActiGraph GT1M >2000 counts/minute	223; 10.6	10	6
Harrison, ¹⁴ England	ActiGraph GT1M,	1794; 10.3	15	6

	cut point >2000 counts/minute			
Huberty 2011, ¹⁵ USA	ActiGraph GT1M, ≥ 2000 counts per minute cut-point	93; 9.6 age	6	5
Huberty, 2014 ¹⁶ USA	ActiGraph GT1M, Freedson equation	667; 9.7	5	4
Kelly, ¹⁷ Australia	ActiGraph GT1M, Evenson cut-point, >2297 counts/minute	97;6.5	11	4
Mota, ¹⁸ Portugal	ActiGraph CSA Freedson equation	22; 8.9	10	5
Pan, ¹⁹ Taiwan	ActiGraph GT1M, Freedson equation	24; 9.1	34	6
Pollard, ²⁰ England	ActiGraph GT3X >2000 counts/minute	166 (girls only); 9.8	13	6
Ridgers et al 2005, ²¹ England	ActiGraph 7164 >163 counts per 5s cut-off	228; 8.1	25	6

Ridgers & Stratton 2005, ¹ England	Time spent at >50% of heart rate reserve, maximum heart rate set at 200 beats/m	244; 8.0	32	6
Ridgers, ²² England	Direct observation (SOCARP)	114; at elementary school	not given	3
Nettlefold, ²³ Canada	ActiGraph GT1M, Trost 2002 cut-points	279; 10	5	6
McGall, ²⁴ New Zealand	ActiGraph GT1M >3000 counts/minute	60; 8.3	8	6
Saint-Maurice, ²⁵ USA	ActiGraph GT1M, Freedson equation	100, 3 rd -5 th graders	not given	5
Sandt & Frey, ²⁶ USA	ActiGraph 7164, cut-point not clear	13; 8.9	23	5
Scruggs, ²⁷ USA	Heart rate > 1.5 max heart rate reserve	27; 11.0	13	4

Wickel, ²⁸ USA	Actigraph GT1M, cut-points not given	113; 9.8, boys	20	4
		only		
Verstraete, ²⁹	ActiGraph 7164	235; 10.8	not given	5
Belgium	cut point unclear			

Table 3 School Recess MVPA (minutes/day): Secondary (High) School Studies

First Author, Setting	Method and Cut-point	Sample Size; Mean Age (y)	Mean MVPA (minutes/day)	Study Quality Rating (out of 6)
Klinker, ³⁰ Denmark	ActiGraph GT3X, Evenson cut point	367; 11-16	7	5
Martinez- Gomez, ³¹ Spain	ActiGraph GT1M; Ekelund cut point	32; 13.1	13	5

Figure 1: Study Flow Diagram

