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Hollis, Jenna L.; Williams, Amanda J.; Sutherland, Rachel; Campbell, Elizabeth; Nathan, Nicole; Wolfenden, Luke; Morgan, Philip J.; Lubans, David R.; Wiggers, John; "A systematic review and meta-analysis of moderate-to-vigorous physical activity levels in elementary school physical education lessons". Published in Preventive Medicine Vol. 86, p. 34-54 (2016)

Available from: http://dx.doi.org/10.1016/j.ypmed.2015.11.018

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Accessed from: http://hdl.handle.net/1959.13/1316075

A systematic review and meta-analysis of moderate-to-vigorous physical activity
 levels in elementary school physical education lessons.
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- 35 **Word count:** abstract = 250, main text = 4500

36 Abstract

Objective: To examine elementary school students' moderate-to-vigorous physical activity
 (MVPA) levels during physical education (PE) lessons.

Methods: A systematic search of nine electronic databases was conducted (PROSPERO2014:CRD42014009649). Studies were eligible if they were in English; published between 2005-April 2014; assessed MVPA levels in PE lessons of elementary school children (aged four-12 years); and used an objective MVPA measure. Two reviewers retrieved articles, assessed risk of bias, and performed data extraction. The findings were synthesised using a meta-analysis.

45 Results: The search yielded 5132 articles. Thirteen studies from nine countries met the inclusion criteria. Eight studies measured MVPA through observational measures, five used 46 accelerometry and one used heart rate monitoring. The percentage of PE lesson time spent 47 48 in MVPA ranged between 11.4-88.5%. Meta-analysis of seven studies (4 direct observation; 4 accelerometers) found that children spent a mean (95%CI) 44.8 (28.2-61.4)% of PE lesson 49 time in MVPA. When measured using direct observation and accelerometers, children spent 50 57.6 (47.3-68.2) and 32.6 (5.9-59.3)% of PE lesson time in MVPA, respectively. The review 51 has limitations; the search strategy was restricted to studies in English; theses, dissertations 52 and conference abstracts were excluded; and six studies that provided insufficient data were 53 54 excluded from the meta-analysis.

55 *Conclusion:* MVPA levels during elementary school PE lessons do not meet the United 56 States Centre for Disease Control and Prevention and the United Kingdom's Association of 57 Physical Education recommendation (50% of lesson time), but is higher than estimated in 58 the previous review (34.2%). Interventions to increase MVPA in PE lessons are needed.

59

60 **Key words:** Schools, Physical education and training, Motor activity, Child.

61 Abbreviations

- 62 Accel Accelerometer
- 63 afPE Association of Physical Education
- 64 ASD Autistic Spectrum Disorders
- 65 BEACHES Behaviour of Eating and Activity for Children's Health: Evaluation System
- 66 BMI Body Mass Index
- 67 CDC Centre for Disease Control
- 68 CDOM Continuous Direct Observation Method
- 69 FI Fitness Infusion
- 70 FMS Fundamental Movement Skills
- 71 HR Heart Rate
- 72 Mins Minutes
- 73 MVPA Moderate-to-Vigorous Physical Activity
- 74 NR Not Reported
- 75 NSW New South Wales
- 76 PE Physical Education
- 77 PRISMA Preferred Reporting Items for Systematic Reviews and Meta-Analyses
- 78 RCT's Randomised Controlled Trials
- 79 SAM Simple Activity Measurement
- 80 SD Standard Deviation
- 81 SE Standard Error
- 82 SES Socioeconomic Status
- 83 UK United Kingdom
- 84 US United States
- 85 WHO World Health Organisation
- 86 SOFIT System for Observing Fitness Instruction Time
- 87 95% CI 95% Confidence Intervals

88 Introduction

Engaging children in physical activity during childhood is important as physical inactivity has been associated with cardiovascular risk factors and obesity in children.¹⁻³ International guidelines by the World Health Organisation (WHO) recommend that 5-17 year old children engage in 60 minutes of moderate-to-vigorous physical activity (MVPA) each day.⁴ However national data from the United States (US)⁵ collected using accelerometers, and self-report survey data from Australia⁶, have reported that less than half of children meet this recommendation.

96 Schools are a valuable setting to promote and engage children in physical activity.⁷ In 97 particular, physical education (PE) lessons provide an opportunity for children to engage in 98 MVPA and develop the fundamental movement skills (FMS), knowledge and attitudes 99 required for a lifetime of physical activity.⁸ The US Centre for Disease Control (CDC) and 100 Prevention⁹ and the United Kingdoms (UK) Association of Physical Education (afPE)¹⁰ have 101 recommended that both elementary and secondary school children engage in MVPA for at 102 least 50% of PE lesson time.

Despite the potential for PE lessons to play a role in promoting physical activity in children 103 104 from a young age, only one review has examined MVPA during elementary school PE lessons.¹¹ The narrative review was based on 44 studies published until 2005, and included 105 cross sectional, longitudinal and intervention studies (baseline and follow-up data of all 106 control and intervention groups).¹¹ The majority of studies used observational methods to 107 measure MVPA (n=26), while 15 studies used heart rate monitoring and nine used monitor 108 109 sensors (accelerometers and pedometers).¹¹ Six studies used a combination of physical 110 activity measurements methods.¹¹ The mean lesson length was 33.7 minutes.¹¹ The review found that when data from PE lessons under both intervention and non-intervention 111 conditions were combined (n=44), students participated in MVPA for 37.4% of PE lesson 112 time, with a mean of 34.2% based on non-intervention condition studies only (n=15).¹¹ Sub-113 114 group analyses showed that activity tended to increase with school grade, particularly between grades three and five. MVPA differed according to measurement type, with heart 115 rate monitors reporting the highest percentage MVPA (40.4%), followed by motion sensors 116 such as accelerometers and pedometers (36.8%), and observation methods (32.5%).¹¹ The 117 review did not undertake an assessment of risk of bias to aid the interpretation of findings. 118

Given the absence of a subsequent updated review, the primary aim of this systematic review was to examine elementary school students' MVPA levels during PE lessons in studies published between 2005 and 2014. The secondary aims were to evaluate student participation in MVPA during PE lessons by: i) measurement type (accelerometer, heart rate monitoring, pedometry or observational measure); ii) PE activities; and iii) student (e.g. sex,
socioeconomic status (SES)), teacher (e.g. training) and environmental factors (e.g.
country).

126 Methods

For the purpose of this review, the term 'elementary school' (i.e. catering for children aged 4-127 12 years) will be used throughout. The systematic review protocol was registered with 128 7/5/2014 129 Prospero on the (PROSPERO2014:CRD42014009649): http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42014009649. 130 The review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-analysis 131 (PRISMA) statement.¹² 132

A two-step search strategy was used. First, a systematic search of nine electronic scientific 133 databases was performed in May 2014: Medline, Sport Discus, CINAHL, The Central 134 Cochrane database, ERIC, Proquest, EMBASE, Scopus, and PsycINFO. Key search terms 135 and their synonyms were searched using four filters identifying the i) setting (e.g. physical 136 137 education), ii) target population (e.g. child), iii) measurement (e.g. MVPA), and iv) study design (e.g. prospective studies). Search terms within each filter were combined using the 138 Boolean operator 'or', and all four filters were combined to form one search using the 139 Boolean operator 'and'. See Appendix A for the full list of search terms and a record of the 140 141 search strategy. Secondly, the reference lists of all included studies were manually searched 142 for additional papers not already identified.

143 Inclusion and exclusion criteria

The title and abstracts of the studies identified during the search were retrieved and examined by two reviewers (J.H., A.W.) to determine if the study met the inclusion criteria. The full texts of potentially eligible studies were retrieved and independently assessed by the two reviewers to determine eligibility. If there was disagreement on whether a study should be included in the review and a consensus could not be reached through discussion, a third independent reviewer was consulted (R.S.).

This review examined studies that: i) assessed the MVPA levels of elementary school 150 children (aged four-12 years) during PE lessons; ii) used a quantitative measure of physical 151 activity such as accelerometers, heart rate monitors, pedometers or systematic 152 observational measures (e.g. the System for Observing Fitness Instruction time (SOFIT)); iii) 153 studies published in English between January 2005 and April 2014; and iv) used cross-154 sectional and prospective longitudinal quantitative study designs. For intervention studies 155 (e.g. Randomised Controlled Trials (RCT's), non-RCT's and pre-post studies), baseline data 156 from both intervention and control groups were included. If baseline data were not provided, 157

the control group follow-up data were used if no intervention was delivered to that group. Follow-up data from intervention studies were excluded as the aim was to assess MVPA in usual PE lessons rather than under intervention conditions. Studies that reported findings in abstracts, theses, dissertations, and unpublished literature were excluded from the review. The 'cut-off' date for this review was 2005 as the searches for the previous review¹¹ took place in January 2005, and this current systematic review aimed to include all relevant studies published since the prior review.

165 Risk of bias assessment

An 11-item tool to assess the methodological quality of the studies was developed (Appendix 166 B). A new tool was created as no other risk of bias tool that assessed bias relevant to this 167 systematic review context was identified. Existing tools¹³⁻¹⁵ assessed criteria such as 168 participant recall bias, interviewer bias (e.g. assessor blinding), the randomisation 169 procedure, and attrition. The existing tools also lacked detailed criteria on selection and 170 171 instrument bias relevant to the school context, PE lessons and MVPA measures, which were 172 more likely to influence the findings of this review. The tool comprised seven domains (Table 173 1) covering selection bias across the school, class and student level, plus selection and 174 instrument bias related to the PE lessons and MVPA measures.

Two independent reviewers (J.H., A.W.) used the tool to examine the risk of bias of all studies that were considered eligible. Any difference in ratings was resolved through discussion between the two reviewers. If a consensus could not be reached, a third reviewer was consulted (R.S.). Each criteria was coded as 'clearly described and present' (yes), 'absent' (no), or 'unclear or inadequately described' (unclear) rating for each of the 11 items. Each domain was considered independently as recommended by PRISMA.¹²

181 Data collection

A pre-piloted standardised data extraction table was used by one independent reviewer 182 (A.W.) to extract study data from the included studies. A second independent reviewer (J.H.) 183 184 examined the completed data extraction table and added any missing data, corrected any errors and highlighted information that was unclear. The two reviewers discussed all 185 discrepancies and consulted a third reviewer (R.S.) where a consensus could not be 186 reached. Missing data were requested from study authors if it would determine study 187 188 eligibility and/or if insufficient data was provided for inclusion in a meta-analysis. The 189 extracted information provided details regarding: study design, setting (region/country, 190 school year), participants (school and student sample size, student age, sex, SES, ethnicity), 191 teacher training, aim, recruitment, response rate, measurement type, lesson delivery, number of lessons, lesson duration, activities engaged in during the lesson, and MVPA in PE 192

193 lessons. MVPA in PE lesson time was included if it was provided as either: i) mean 194 percentage of lesson time spent in MVPA, or ii) minutes of MVPA per lesson and length of 195 the PE lesson so that percentage MVPA per lesson could be manually calculated.

196 Data synthesis

The characteristics and findings of all included studies were synthesised narratively. 197 Summaries of the MVPA levels in each study were presented as mean (SD/SE/95%CI) 198 percentage of lesson time and actual minutes, where available. The findings for percentage 199 200 time spent in MVPA were pooled into a meta-analysis using Comprehensive Meta-analysis Software (version 2.2.064, July 2011) for studies that provided mean percentage of time in 201 202 MVPA, a standard deviation, and number of PE lessons observed. Moderator analyses, according to the pre-specified subgroups, were planned to address the secondary aims of 203 the review including; type of measurement instrument (accelerometry, heart rate monitoring, 204 observation), type of physical activity, student sex, student SES, teacher training, and study 205 206 country. Statistical heterogeneity was assessed through Cochran's Q and the l^2 Index tests. As a guide to interpreting the l^2 Index; 0-40% may represent low heterogeneity; 30-60% 207 moderate heterogeneity; 50-90% substantial heterogeneity; and 75%-100% considerable 208 209 heterogeneity.¹⁶ Methodological heterogeneity was also examined through the subgroup meta-analysis that examined the method of assessing MVPA. 210

211 Results

212 Study selection

The initial database search yielded 5132 articles once duplicates were removed (Figure 1). 213 Following title and abstract review, 74 full-text papers were retrieved and reviewed for 214 eligibility. Fourteen papers representing 13 studies met the inclusion criteria.¹⁷⁻³⁰ Seven 215 studies^{17, 18, 20, 21, 23, 29, 30} provided sufficient data to be pooled into a meta-analysis. All study 216 selection discrepancies between the two reviewers were resolved through discussion, and 217 the third reviewer was not consulted. The two reviewers initially disagreed on 6.6% of the 218 219 risk of bias criteria; however a consensus was reached on all criteria through discussion. There were 10 discrepancies in data collection between the two reviewers, which were all 220 resolved by discussion. 221

222 Study characteristics

The characteristics and outcomes of the studies are shown in Tables 2 and 3. Publication dates ranged from 2005²² to 2014.²¹ The studies were conducted in the US (n=2)^{21, 23}, UK (n=2)^{24, 30}, Belgium (n=1)²⁹, Switzerland (n=1)¹⁹, Mexico (n=1)²⁶, Canada (n=1)²⁰, Brazil (n=1)¹⁸, Australia (n=1)^{27, 28} and Hong Kong (n=1).¹⁷ Two studies did not report the study location.^{22, 25} The majority of studies were of cross-sectional design (n=8)¹⁷⁻²⁴ and the remaining five studies were RCT's.²⁵⁻³⁰ Baseline intervention and control group data were included in the review for two of the five RCT studies^{26, 29}, whereas only control group data could be obtained for the remaining three studies.^{25, 27, 28, 30} The number of student participants in the individual studies ranged from 13²² to 830²⁶, and the number of schools included in studies ranged from one²⁵ to 42¹⁷. All 13 studies monitored both male and female students, and only one study reported results by sex.²⁰

- 234 Eight studies^{17, 21-24, 26-29} measured MVPA through direct observational measures, five used
- accelerometry^{18-20, 29, 30} and one used heart rate monitoring.²⁵ One study used both
- accelerometry and direct observation.²⁹ The number of PE lessons observed in each study
- ranged from two²³ to 374.²⁴ PE lesson length varied between 24²¹ and 50 minutes.^{23, 26, 29}
- 238 Seven studies employed specialist PE teachers to deliver the PE lesson^{17, 19, 20, 23, 25, 26, 29},
- one study used classroom teachers with little or no PE training^{27, 28}, and two studies
- 240 employed both specialist PE teachers and classroom teachers.^{21, 30} Three studies did not
- specify the teacher delivering the lessons.^{18, 22, 24} Only five^{17, 19, 23-25} of the 13 studies
- specified the types of activities the children were engaged in during the lesson. The activitieswithin each study varied and included ball games, fitness activities and movement activities
- 244 (e.g. dance and gymnastics). The random effects models were used for all analyses as there
- was considerable heterogeneity among the studies (G = 1043, df = 6 (p \le 0.01); l^2 = 99%).
- 246 The subgroup analysis consisting of four studies that measured MVPA by accelerometry
- was also found to be highly heterogeneous (G = 704, df = 3 (p \leq 0.01); l^2 = 100%), as was
- 248 the analysis for the four studies that measured MVPA through observational methods (G =

249 71, df = 3 (p = <0.01); l^2 = 96%).

250 Risk of bias

Table 4 shows the risk of bias assessment for all included studies. For many studies, it was unclear if the school sample was representative (n=8) and whether the classes selected to be measured were representative of all classes (n=8). The nature of the physical activities observed was not reported in eight studies and the number of PE lessons observed was not described in seven studies. All studies adequately described the student eligibility criteria and the demographic characteristics of the class sample. The majority of studies used an objective measure of physical activity or cited validation studies (n=10/13) and stated

reliability data (n=11/13), reducing the risk of instrument bias.

259 MVPA in elementary school PE lessons

260 Of the 13 studies included in the systematic review, the percentage of PE lesson time spent

- in MVPA ranged between 11.4% and 88.5%. The mean percentage of PE lesson spent in
- 262 MVPA was greater than 50% in five of the 13 studies. In one study²⁹, children met the CDC

- and afPE recommendation when accelerometers were used to measure MVPA, but not
- when SOFIT observations were used. Seven studies provided sufficient data for inclusion in meta-analysis. The pooled analysis of these seven studies found that children spent a mean
- 266 (95%CI) of 44.8 (28.2-61.4)% of PE lesson time in MVPA (Figure 2).

267 Moderator analyses

268 i) Measurement type: accelerometer or observational measure

- 269 Of the seven studies that were included in the meta-analysis, four studies measured MVPA
- with accelerometers^{18, 20, 29, 30} and four using observational measures (three used SOFIT,
- and one used Simple Activity Measurement (SAM)).^{17, 21, 23, 29} One study measured MVPA
- 272 using both accelerometers and SOFIT.²⁹ When measured using accelerometers and
- observational measures, children spent a mean (95%CI) 32.6 (5.9-59.3)% (Figure 3) and
- 57.6 (47.3-68.2)% (Figure 4) of PE lesson time in MVPA, respectively.

275 *ii) PE activities*

Moderator analyses to assess the percentage of PE lesson time spent in MVPA according to different activities could not be conducted due to the lack of information on the PE activities performed. Only two studies^{17, 23} in the meta-analysis provided information on the physical activities performed, and the activities performed varied greatly (i.e. ball games, fitness activities, and movement activities e.g. dance and gymnastics).

- 281 iii) Student, teacher and environmental factors
- Moderator analyses to examine the percentage of PE lesson time spent in MVPA according
 to student, teacher and environmental factors were not conducted due to the lack of
 information provided on these factors. Few studies in the meta-analysis provided information
 on the SES of school communities (n=3/7), and only one study reported results separately
 by student sex. In terms of teacher PE training, four studies employed specialist PE
 teachers^{17, 20, 23, 29}, two studies employed both specialist PE teachers and classroom
 teachers^{21, 30}, and one study did not specify the teacher delivering the lessons.¹⁸ The seven
- studies in the meta-analysis were conducted across seven different countries.

290 Discussion

291 Summary of the evidence

- 292 This study sought to examine elementary school students' MVPA levels during PE lessons in
- studies published between 2005 and 2014. Of the 13 studies included in the systematic
- review, percentage time spent in MVPA varied, ranging from 11.4% to 88.5% of PE time.
- The meta-analysis of seven studies found that children spent 44.8% of lesson time in MVPA.
- 296 Promisingly, the estimated percentage of MVPA in PE lessons was higher than estimated in

the previous review¹¹, which found that elementary school students participated in MVPA for
34.2% of PE time in non-intervention studies. However, the mean percentage of time spent
in MVPA still falls short of the US CDC and UK's afPE recommendation of 50% of PE class
time.^{9,10}

301 A plausible explanation for the increase in the proportion of lesson time spent in MVPA since 302 the previous review is that six of the seven studies pooled into the meta-analysis either solely or partially employed specialist PE teachers to deliver the lessons.^{17, 20, 21, 23, 29, 30} 303 Specialist PE teachers produce higher levels of MVPA than usual classroom teachers.^{11, 32} 304 The previous review¹¹ did not outline teacher training for classes taught under non-305 intervention conditions, therefore a comparison between the two reviews cannot be made. 306 Different accelerometer cut-points used in the studies may also have contributed to the 307 variation in findings. While different MVPA accelerometer cut-points were used in the studies 308 (e.g. >2000^{18-20, 29, 30} and >3500^{18, 19} counts/minute) in the current review, accelerometer cut-309 points were not reported in the previous review¹¹ therefore this hypothesise cannot be 310 confirmed. Only one study used accelerometry to assess MVPA in the previous review¹¹ 311 which is likely the reason that accelerometer cut-points were not reported. 312

313 Summary of the moderator analyses

The review found a 25% difference in the percentage of PE time spent in MVPA between 314 studies that reported MVPA using accelerometers (33%) and observational measures (58%). 315 Conversely, the previous review¹¹ found that heart rate monitors reported the highest 316 percentage MVPA (40.4%), followed by motion sensors (i.e. accelerometers and 317 318 pedometers) (36.8%), and observation methods (32.5%). Although estimates were similar 319 for accelerometers, there was a large increase in the proportion of MVPA time as measured by observational methods between the previous and current review. As the previous review 320 did not assess risk of bias, it is difficult to comment on the relative merits and limitations of 321 the component studies. Due to insufficient study detail on PE activities, and student, teacher, 322 and environmental factors, other moderator analyses were not undertaken. 323 324 There are methodological issues which could explain the discrepancy in MVPA through

different measurement methods. While observational measures such as SOFIT have been
found to be reliable and valid³¹, they do have limitations and may over-estimate the time
students spend in MVPA.³² Since different measurement methods measure different
elements of physical activity (e.g. observation methods measure MVPA through movement
categories, and accelerometers through the number of counts above certain cut-points), the
calculation of MVPA differs accordingly.¹¹ For example SOFIT considers walking as a
moderate activity, whereas non-brisk walking is unlikely to be categorised as MVPA by

- accelerometers. Another reason for the difference could be the between-study discrepancy
- in the definition of 'monitored PE lesson length', which is discussed in more detail below.

334 Risk of bias of included studies

Limited information provided on the school and class sample mean that it is unclear whether the findings are representative of usual PE lessons. Given the limited information reported on the physical activities observed, the small number of studies pooled in to the metaanalysis and the considerable heterogeneity between studies, the findings may not be generalizable to usual elementary school PE lessons and caution should be taken in interpreting the meta-analysis results.

341 While secondary schools typically employ qualified PE teachers to instruct PE lessons,

elementary school PE lessons are often led by classroom teachers with little or no training in 342 physical activity.³³ In eight^{17, 19, 20, 23, 25, 26, 29, 30} of the 13 studies in the review, a PE specialist 343 or qualified PE teacher led the lesson, while just two studies stated that lessons were led by 344 classroom teachers with either minimal ^{27, 28} or some training.²¹ Evidence indicates that 345 employing PE specialist teachers or intensively training elementary school teachers may be 346 one approach to improve FMS outcomes³⁴ and increase MVPA in PE lessons.^{11, 35} As most 347 studies (n=8) employed PE specialists, the findings may not be representative of the MVPA 348 349 levels achieved in PE lessons led by elementary classroom teachers.

Another major methodological inconsistency between the studies was the definition for the 350 length of the monitored PE lesson. While three studies measured the lesson for the entire 351 scheduled PE lesson (such as a 50 minute lesson)^{19, 20, 23}, six studies measured the lesson 352 from the time that physical activity commenced or for the time that 51% of the class were in 353 attendance.^{17, 18, 21, 26-29} Five studies^{22, 24, 25, 29, 30} did not state whether the scheduled lesson 354 length was measured or another criteria for the recording period was used. This between-355 study discrepancy in lesson length may have distorted the results reported by the studies 356 resulting in information bias. For example, the mean scheduled lesson length in one study¹⁷ 357 was 43.4 minutes; however the study reported only measuring physical activity when 51% of 358 359 the class were in attendance resulting in a mean PE lesson monitoring time of 31.7 minutes 360 and 27% of the scheduled PE lesson time unmonitored. As a result, the reported lesson time spent in MVPA was 15.8 minutes or 50.7% of the lesson, implying that the children's 361 physical activity levels met the CDC and afPE physical activity recommendation. If the 362 363 scheduled PE lesson length had been applied in the calculation, 36.4% of time spent in MVPA would have been reported. The lack of consistency in these calculations across the 364 studies made it difficult to compare findings between the studies. 365

366 Strengths and limitations

The review has a number of strengths. It updates an important body of evidence that has not been reviewed since 2005. The review employed a comprehensive search strategy across numerous databases. A detailed data extraction instrument and collection technique enabled a comprehensive comparison across all included studies. The review provides insight on how to improve the quality of future PE lesson research, particularly in regards to

measurement methods, reporting results and sub-analyses of interest.

373 This review has limitations which need to be acknowledged. In addition to those mentioned 374 previously, the review limited the search of studies to those published in English and found 375 within a prominent database. Theses, dissertations and conference abstracts were not included in this systematic review. Despite making numerous efforts to contact the authors of 376 studies, three studies were excluded from the systematic review as sufficient data to 377 determine eligibility were not provided. Six studies were excluded from the meta-analysis as 378 379 the authors could not be contacted or were unable to provide additional data to enable the results to be pooled. Studies that identified the physical activity lesson as 'school sport', 380 'fitness' or 'gym/dance' were excluded as it was unclear if the session was PE or another 381 aspect of the curriculum/school activity, and were considered outside the scope of the 382 review. 383

384 *Recommendations for future research*

385 There is a need to standardise the definition of 'PE lesson time' to ensure that a consistent 386 comparison between studies can be made. The US CDC 'recommends that students engage in MVPA for at least 50% of the time they spend in PE class' while the UK afPE health 387 388 position paper states that 'pupils be actively moving for at least 50% of the available learning 389 time', but neither clarifies whether the monitoring time occurs for the length of the scheduled 390 PE class, or whether another criteria for the monitoring period can be used (e.g. when 51% of the class are in attendance). One solution could be reporting MVPA for lessons that 391 392 monitor within a pre-specified proportion of lesson time (such as \geq 90%), separately from 393 lessons that monitor for a smaller proportion of the scheduled lesson (<90%). Consistency in lesson monitoring protocols will reduce between-study discrepancy in lesson length, making 394 395 it easier to compare and summarise findings between the studies.

It is important to measure as many lessons as feasible from a representative spread of classes to increase the likelihood that the monitored lessons are representative of MVPA during usual PE lessons. Efforts can be made to ensure that teachers and students are blinded to the monitoring schedule since teachers may plan the lesson to ensure a higher level of activity, however in reality this may be difficult to achieve. Ideally, all consenting children and classes would be measured however, if this is not feasible, then children and

- 402 classes could be randomly selected for monitoring. In the previous review¹¹, the authors
- 403 recommended transparent reporting on the structure, delivery, content and environment of
- 404 the lessons to facilitate in-depth analysis. Only five^{17, 19, 23-25} of the 13 studies in this review
- 405 provided detail on the types of physical activities performed. The authors of this review
- support the former review recommendation¹¹ on the importance of transparent reporting on
- 407 the types of activities performed.
- 408 Many intervention study results were excluded from the review as they measured the PE
- 409 lesson post intervention and did not measure MVPA during usual (or pre-intervention) PE
- 410 lessons. Future intervention studies should aim to report PE lesson MVPA prior to
- 411 intervention delivery and, at minimum, state the mean MVPA percentage of the lesson, a
- measure of variation (e.g. standard deviation), and the number of lessons examined so that
- 413 data can be pooled into a meta-analysis.
- 414 Future systematic reviews on this topic should aim to investigate PE lesson MVPA in
- elementary school students by: i) measurement tool, as there are inconsistencies in MVPA
- 416 between measurement methods^{11, 32}, ii) sex, since studies indicate that girls may be less
- 417 active than boys³⁶, and iii) the physical activities performed as evidence suggests that
- 418 certain activities promote more vigorous activity.³⁷ Other sub-analyses of interest include: iv)
- 419 teacher training, since evidence indicates that specialist PE teachers lead more active
- 420 lessons than generalist elementary school teachers²⁷, and v) the study country, as it may
- 421 impact on MVPA^{18, 19} and reduce the generalisability of the findings. Assessing variability
- 422 between countries will be of particular importance if the aggregate MVPA level meets the US
- 423 CDC and UK afPE recommendation in the future.
- 424 Recommendations for practice in elementary school PE lessons
- 425 Since strong evidence has demonstrated that physical activity levels decline with age
- 426 through childhood and adolescence^{38, 39}, maximising physical activity and refining FMS
- 427 during elementary school PE is crucial.³⁴ Schools report numerous challenges in
- 428 incorporating high activity levels in elementary school PE classes. Policy and infrastructure
- 429 barriers may impact on physical activity in PE lessons.⁴⁰ Low teacher confidence in their PE
- 430 teaching ability, a lack of content knowledge, and limited expertise in teaching active lessons
- 431 may lead to poorer quality lessons with less MVPA.⁴¹ Given that traditional PE lessons often
- 432 require students to cease activity to observe demonstrations, listen to instructions and
- 433 organise equipment, it is unsurprising that maintaining high MVPA levels is challenging for
- 434 teachers.¹¹ Curriculum integration is another issue that elementary school teachers face
- 435 when trying to maximise MVPA in PE whilst also meeting other curriculum outcomes, which
- 436 may not be synonymous with MVPA.

The competing demands for lesson time allocation in elementary schools across a broad curriculum⁴² means that it is unlikely that PE lesson time will increase, so maximising the

- 439 existing allocated time should be a priority. A recent systematic review on interventions to
- 440 increase physical activity in PE lessons found that strategies such as i) supplementing usual
- 441 PE lessons with high-intensity activity (e.g. fitness infusion), and ii) teacher professional
- 442 learning focusing on organisation, management and instruction, were effective in increasing
- 443 MVPA in PE by approximately 10%.³⁵ While PE teachers could achieve high levels of MVPA
- by instructing students to 'run laps of an oval for the duration of the lesson', this approach is
- unlikely to engage students in meaningful learning experiences and assist them to develop
- the FMS and attitudes required for a lifetime of physical activity.³⁵ This approach may also
- 447 negatively impact on student's motivation and enjoyment of physical activity which may
- ⁴⁴⁸ influence long term physical activity engagement.⁴³

449 **Conclusion**

437

438

450 The proportion of time spent in MVPA during elementary school PE lessons does not meet

- 451 the US CDC or UK afPE recommendation. Despite methodological differences between the
- 452 reviews, the findings suggest a possible increase in the percentage of PE lesson time in
- 453 which students are engaged in MVPA. Interventions to increase MVPA time in PE lessons
- are needed. Future PE lesson intervention and observational studies should ensure that the
- recommendations made in this review, particularly regarding measurement method,
- reporting results and sub-analyses of interest, are considered in the study design. This will
- enable researchers, health professionals and policy makers to accurately monitor the
- 458 progress of elementary school PE lessons towards the MVPA target in the future.
- 459

460 Acknowledgements

461 Infrastructure support was received from the Hunter Medical Research Institute (HMRI) and

- 462 Hunter New England Population Health. DRL is supported by an Australian Research
- 463 Council Future Fellowship. The authors would like to acknowledge Debbie Booth a Research
- Librarian at the University of Newcastle who assisted in refining the search strategy and
- 465 conducted the database searches.
- 466 **Conflicts of interest**
- 467 The authors declare that there are no conflicts of interest.

468 Author Contributions

All authors were responsible for the design of the study and the development of the search

470 strategy. JLH and AJW acted as first and second reviewer, respectively, and screened the

- 471 studies, performed the risk of bias assessments and extracted study data. RS acted as third
- 472 reviewer, resolved any disagreements and conducted the meta-analysis. NN developed the
- data extraction tool. JLH drafted the initial paper. All authors contributed to the interpretation
- 474 of the results and all drafts of the manuscript.

475 Appendices

476 Appendix A.

Search filter one identified the setting such as 'physical education', 'lesson*', 'class*'. Search
filter two referred to the target population including 'child', 'adolesc*' and 'student'.
Measurement terms were identified using search filter three such as 'motor activity',
'exercise' and 'MVPA'. Search filter four identified the study design including 'prospective
studies', 'longitudinal studies', 'non-randomized'.

482	Database:	MEDLINE
483	Name of Host:	OVID
484	Number of results:	1128 (1058 after de-duplication)
485	Date searched:	20 th May 2014

#	Searches	Results
1	((physical education or PE or physical activity or PA) adj5 (lesson* or class* or program* or curricul* or school* or instruct*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	5632
2	(school adj3 sport*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	606
3	"Physical Education and Training"/	11777
4	Exercise/	66233
5	schools/	20707
6	(3 or 4) and 5	1001
7	1 or 2 or 6	6628
8	Adolescent/	1603007
9	youth.mp.	36545
10	adolesc*.mp.	1626365
11	teenager*.mp.	9881
12	Child/	1354668
13	((primary or secondary or high or middle or elementary) adj5 (school* or student*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	44307
14	8 or 9 or 10 or 11 or 12 or 13	2262520

15 Motor Activity/	77414
16 physical activity.mp.	50654
17 Exercise/	66233
18 fitness.mp. or Physical Fitness/	49372
 ((Moderate or vigorous) adj5 (physical activity or exercise)).mp. [mp=title, abstract, original title, name of 19 substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] 	9696
20 MVPA.mp.	994
21 Movement/	59073
22 15 or 16 or 17 or 18 or 19 or 20 or 21	262721
23 randomized controlled trial.pt.	373289
24 controlled clinical trial.pt.	88322
25 randomized.ab.	271822
26 randomised.ab.	54401
27 randomly.ab.	193034
28 trial.ab.	281901
29 groups.ab.	1241003
30 Cross-Sectional Studies/	174920
31 prospective longitudinal quantitative studies.mp.	0
32 Prospective Studies/	365188
33 Longitudinal Studies/	85628
34 non randomized.ab.	3820
35 non randomised.ab.	1748
36 pre-post.mp.	3932
37 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36	2238313
38 7 and 14 and 22 and 37	1466
39 limit 38 to yr="2005 -Current"	1183
40 limit 39 to english language	1128

488	Database:	EMBASE
489	Name of Host:	OVID
490	Number of results:	2595 (1806 after de-duplication)
491	Date searched:	20 th May 2014
492		

#	Searches	Results
1	((physical education or PE or physical activity or PA) adj5 (lesson* or class* or program* or curricul* or school* or instruct*)).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	13686
2	(school adj3 sport*).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]	1825
3	physical education/	9951
4	exercise/	180665
5	school/	42701
6	(3 or 4) and 5	1623
7	1 or 2 or 6	15620
8	adolescent/	1212474
9	youth.mp. or juvenile/	54533
10	adolesc*.mp.	1277785
11	teenager*.mp.	13525
12	child/	1271165
13	((primary or secondary or high or middle or elementary) adj5 (school* or student*)).mp.	61723
14	8 or 9 or 10 or 11 or 12 or 13	2048397
15	motor activity/	37340
16	physical activity/	79300
17	exercise/	180665
18	fitness/	27860
19	((Moderate or vigorous) adj5 (physical activity or exercise)).mp.	12597
20	MVPA.mp.	1326
21	"movement (physiology)"/	26983
22	15 or 16 or 17 or 18 or 19 or 20 or 21	324876
23	randomized controlled trial/	343796
24	controlled clinical trial/	384560
25	randomized.ab.	381766
26	randomised.ab.	74822
27	randomly.ab.	261744
28	trial.ab.	391764
29	groups.ab.	1708919
30	cross-sectional study/	112824

31 prospective longitudinal quantitative studies.mp.	0
32 prospective study/	249489
33 longitudinal study/	66210
34 non randomized.ab.	6672
35 non randomised.ab.	2444
36 pre-post.mp.	7135
37 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36	2761230
38 7 and 14 and 22 and 37	3116
39 limit 38 to yr="2005 -Current"	2693
40 limit 39 to english language	2595

494	Database:	PsycINFO
495	Name of Host:	OVID
496	Number of results:	322 (120 after de-duplication)
497	Date searched:	20 th May 2014

#	Searches	Results
1	((physical education or PE or physical activity or PA) adj5 (lesson* or class* or program* or curricul* or school* or instruct*)).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]	4527
2	(school adj3 sport*).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]	580
3	Physical Education/	3216
4	Exercise/	14554
5	exp Schools/	49334
6	(3 or 4) and 5	337
7	1 or 2 or 6	5098
8	Adolescent.mp.	113619
9	youth.mp.	58604
10) adolesc*.mp.	194466
11	teenager*.mp.	6834
12	2 Child.mp.	256331
13	((primary or secondary or high or middle or elementary) adj5 (school* or student*)).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]	164303

14 8 or 9 or 10 or 11 or 12 or 13	550695
15 Motor Activity.mp.	5483
16 exp Physical Activity/	23610
17 exp Exercise/	16598
18 exp Physical Fitness/ or fitness.mp.	11650
 ((Moderate or vigorous) adj5 (physical activity or exercise)).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures] 	2247
20 MVPA.mp.	506
21 Movement.mp.	77278
22 15 or 16 or 17 or 18 or 19 or 20 or 21	114143
23 randomized controlled trial*.mp.	12477
24 exp Clinical Trials/	7555
25 randomized.ab.	38271
26 randomised.ab.	4619
27 randomly.ab.	50644
28 trial.ab.	61644
29 groups.ab.	359321
30 Cross-Sectional Stud*.mp.	12396
31 prospective longitudinal quantitative studies.mp.	0
32 exp Prospective Studies/	421
33 exp Longitudinal Studies/	15241
34 non randomized.ab.	453
35 non randomised.ab.	147
36 pre-post.mp.	3703
37 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36	485402
38 7 and 14 and 22 and 37	394
39 limit 38 to yr="2005 -Current"	326
40 limit 39 to english language	322

500	Database:	CINAHL
501	Name of Host:	EBSCO
502	Number of results:	632 (246 after de-duplication)
503	Date searched:	20 th May 2014
504		

#	Query	Results
S38	S7 AND S14 AND S22 AND S37 (English and 2005+)	632
S37	S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36	579,673
S36	pre-post	1,989
S35	AB non randomised	684
S34	AB non randomized	880
S33	"Longitudinal Studies"	2,000
S32	(MH "Prospective Studies")	232,563
S31	"prospective longitudinal quantitative stud*"	0
S30	(MH "Cross Sectional Studies")	88,432
S29	AB groups	152,441
S28	AB trial	52,874
S27	AB randomly	32,891
S26	AB randomised	14,040
S25	AB randomized	53,314
S24	(MH "Clinical Trials")	113,492
S23	(MH "Randomized Controlled Trials")	31,119
S22	S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21	74,744
S21	(MH "Movement")	8,319
S20	MVPA	368
S19	((Moderate or vigorous) n5 (physical activity or exercise))	3,013
S18	(MH "Physical Fitness") OR "fitness"	17,646
S17	(MH "Exercise")	28,327
S16	(MH "Physical Activity")	20,008
S15	(MH "Motor Activity")	7,141

S14	S8 OR S9 OR S10 OR S11 OR S12 OR S13	471,711
S13	((primary or secondary or high or middle or elementary) n5 (school* or student*))	27,256
S12	(MH "Child")	276,395
S11	"teenager*"	3,398
S10	adolesc *	310,214
S9	"youth"	17,555
S8	(MH "Adolescence")	300,000
S7	S1 OR S2 OR S6	4,438
S6	(S3 or S4) and S5	551
S5	(MH "Schools") OR (MH "Schools, Elementary") OR (MH "Schools, Middle") OR (MH "Schools, Secondary") OR (MH "Schools, Nursery")	13,762
S4	(MH "Exercise")	28,327
S3	(MH "Physical Education and Training")	1,769
S2	school n3 sport*	328
S1	((physical education or PE or physical activity or PA) n5 (lesson* or class* or program* or curricul* or school* or instruct*))	3,863

506	Database:	SPORTDISCUS
507	Name of Host:	EBSCO
508	Number of results:	1547 (1315 after de-duplication)
509	Date searched:	20 th May 2014

#	Query	Results
S38	S7 AND S14 AND S22 AND S37 and English and 2005+	1,547
S37	S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36	143,126
S36	pre-post	619
S35	AB non randomised	93

S34	AB non randomized	203
S33	Longitudinal Stud*	4,217
S32	Prospective Stud*	8,093
S31	prospective longitudinal quantitative studies	0
S30	Cross-Sectional Stud*	4,814
S29	AB groups	101,653
S28	AB trial	29,438
S27	AB randomly	10,704
S26	AB randomised	2,571
S25	AB randomized	11,587
S24	Clinical Trial*	10,209
S23	randomized controlled trial*	7,029
S22	S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21	328,852
S21	Movement	49,594
S20	MVPA	519
S19	((Moderate or vigorous) n5 (physical activity or exercise))	4,479
S18	fitness	148,806
S17	Exercise	190,080
S16	Physical Activity	44,363
S15	Motor Activity	1,988
S14	S8 OR S9 OR S10 OR S11 OR S12 OR S13	158,680
S13	((primary or secondary or high or middle or elementary) n5 (school* or student*))	36,787
S12	Child	90,756
S11	teenager*	34,903
S10	adolesc*	27,005
S9	youth	23,120

S8	Adolescence	8,127
S7	S1 OR S2 OR S6	41,453
S6	(S3 or S4) and S5	33,194
S5	Schools	148,418
S4	Exercise	190,080
S3	Physical Education and Training	55,166
S2	school n3 sport*	14,522
S1	((physical education or PE or physical activity or PA) n5 (lesson* or class* or program* or curricul* or school* or instruct*))	1

512	Database:	Cochrane Database of Systematic Reviews
513	Name of Host:	Wiley
514	Number of results:	6 (3 after de-duplication)
515	Date searched:	20 th May 2014

'(("physical education" OR PE OR "physical activity" OR PA) NEAR/5 (lesson* OR class* OR program* OR curricul* OR
school* OR instruct*)) OR (school NEAR/3 sport*) OR (exercise NEAR/5 school*) in Title, Abstract, Keywords and Adolesce*
OR teenager* OR youth OR child OR ((primary OR secondary OR high OR middle OR elementary) NEAR/5 (school* OR
student*)) in Title, Abstract, Keywords and "Motor Activity" OR "physical activity" OR exercise OR fitness OR ((Moderate OR
vigorous) NEAR/5 ("physical activity" OR exercise)) in Title, Abstract, Keywords in Cochrane Reviews'

521Database:CENTRAL (Cochrane Central register of Controlled Trials)522Name of Host:Wiley523Number of results:410 (62 after de-duplication)524Date searched:20th May 2014

525

526 Cochrane Central Register of Controlled Trials : Issue 4 of 12, April 2014

527 There are 410 results from 789657 records for your search on '(("physical education" OR PE OR "physical activity" OR PA)
528 NEAR/5 (lesson* OR class* OR program* OR curricul* OR school* OR instruct*)) OR (school NEAR/3 sport*) OR (exercise
529 NEAR/5 school*) in Title, Abstract, Keywords and Adolesce* OR teenager* OR youth OR child OR ((primary OR secondary
530 OR high OR middle OR elementary) NEAR/5 (school* OR student*)) in Title, Abstract, Keywords and "Motor Activity" OR
531 "physical activity" OR exercise OR fitness OR ((Moderate OR vigorous) NEAR/5 ("physical activity" OR exercise)) in Title,
532 Abstract, Keywords in Trials'

534	Database:	ERIC	
535	Name of Host:	Proquest	
536	Number of results:	192 (81 after de-duplication)	
537	Date searched:	20 th May 2014	
538			
539	(("physical education" OR PE OR "phy	sical activity" OR PA) NEAR/5 (lesson* OR class* OR program* OR curricul* OR	
540	school* OR instruct*)) OR (school NEA	R/3 sport*) OR (exercise NEAR/5 school*)	
541	AND		
542	Adolesce* OR teenager* OR youth OR	child OR ((primary OR secondary OR high OR middle OR elementary) NEAR/5	
543	(school* OR student*))		
544	And		
545	"Motor Activity" OR "physical activity" C	R exercise OR fitness OR ((Moderate OR vigorous) NEAR/5 ("physical activity" OR	
546	exercise))		
547	AND		
548	("randomized controlled trial*" OR "clini	cal trial*" OR randomized OR randomised OR randomly OR trial OR groups OR	
549	"Cross-Sectional Stud*" OR "prospectiv	/e longitudinal quantitative stud*" OR "Prospective Stud*" OR "Longitudinal Stud*" OR	
550	"non randomized" OR "non randomised	/")	
551			
552	Database:	SCOPUS	
553	Name of Host:	SCOPUS	
554	Number of results:	1468 (517 after de-duplication)	
555	Date searched:	20 th May 2014	
556			
557	(("physical education" OR PE OR "physical	sical activity" OR PA) W/5 (lesson* OR class* OR program* OR curricul* OR school*	
558	OR instruct*)) OR (school sport*)		
559	AND		
560	Adolesce* OR teenager* OR youth OR child OR ((primary OR secondary OR high OR middle OR elementary) W/5 (school*		
561	OR student*))		
562	And		
563	"Motor Activity" OR "physical activity" OR exercise OR fitness OR ((Moderate OR vigorous) W/5 ("physical activity" OR		
564	exercise))		
565	AND		
566	("randomized controlled trial*" OR "clini	cal trial*" OR randomized OR randomised OR randomly OR trial OR groups OR	
567	"Cross-Sectional Stud*" OR "prospective longitudinal quantitative stud*" OR "Prospective Stud*" OR "Longitudinal Stud*" OR		
568	"non randomized" OR "non randomised	/")	
569			

570 Appendix B. Assessment of methodological quality for PE lesson MVPA

- 571 systematic review
- 572 Study number:
- 573 **Review type:**

Authors:

Year of publication:

Assessment of methodological quality criteria		Answer	
School level			
1.	Did the study adequately describe the key demographic characteristics of the school sample?		
	i.e. SES and/or geographical location.		
	$\mathbf{Y} = \mathbf{y}\mathbf{e}\mathbf{s}$, the study adequately described the school characteristics including SES and/or geographical		
	location; $N = no$, the study did not adequately describe the school characteristics; $U =$ unclear.		
2.	Was the school sample representative of the population? i.e. schools randomly selected from		
	region.		
	Y = yes, the school/s were randomly selected from the population or all schools from a region were		
	invited to participate; N = no, the school/s were not randomly selected e.g. convenience sampling or		
	if stated they were not representative; $U =$ unclear.		
Cla	ass level		
3.	Was the class chosen representative of all school classes? i.e. class of students randomly selected		
	or an entire grade/s invited to participate.		
	Y = yes, the class/es were randomly selected or all classes from a grade/s were invited to participate;		
	N = no, the class/es were not randomly selected e.g. convenience sampling; $U =$ unclear.		
4.	. Did the study adequately describe the key demographic characteristics of the class sample? i.e.		
	grade, sex breakdown.		
	Y = yes, the study adequately described the class characteristics (i.e. grade, sex breakdown); $N = no$,		
	the study did not adequately describe the class characteristics; $U =$ unclear.		
Stu	ident level		
5.	Did the study adequately describe the participant eligibility criteria? i.e. grade, age.		
	Y = yes, the study adequately described the participant eligibility; $N = no$, the study did not		
	adequately describe the participant eligibility criteria; $U =$ unclear.		
6.	Did the study adequately describe the key demographic characteristics of the student sample?		
	i.e. number of participants and their mean age (or age range) and sex breakdown.		
	Y = yes, the study adequately described the number of students who participated, mean age (or age		
	range) and sex; $N = no$, the study did not adequately describe the number of participants, mean age		
	(or age range) and/or sex; U = unclear.		
7.	Was the student sample representative of the population? i.e. students measured were		
	randomly selected or an entire grade/s invited to participate/measured.		
	Y = yes, the students were randomly selected from the population or all participants from a grade/s		
	invited to participate/measured; N = no, the students were not randomly selected e.g. convenience		

	sampling; U = unclear.	
PE lesson observation		
8.	Did the study adequately describe the number of PE lessons observed?	
	Y = yes, the study adequately described the number of PE lessons observed; $N = no$, the study did not	
	adequately describe the number of PE lessons observed; $U =$ unclear.	
9.	Did the study use an objective measure of physical activity (i.e. accelerometers, heart rate	
	monitors, pedometers) or did the study <u>cite validation studies or state validity data</u> for	
	observational measures in the study population (e.g. elementary and secondary school	
	children).	
	Y = yes, the study used an objective measure of physical activity, or used an objective measure in a	
	sub-sample of students, or used observational measures and cited validation studies/stated validity	
	data in the study population being examined; $N = no$, the study did not used objective measures, or	
	did not cite a validation study/validation data in the population being studied; U = unclear.	
10.	Did the study use an objective measure of physical activity (i.e. accelerometers, heart rate	
	monitors, pedometers) or did the study state <u>reliability data or cite reliability studies</u> for	
	observational measures in the study population (e.g. elementary and secondary school	
	children).	
	Y = yes, the study used an objective measure of physical activity, or used an objective measure in a	
	sub-sample of students, or used observational measures and cited reliability studies/stated reliability	
	data in the study population being examined (inter-rater reliability: ICC > .70 is considered	
	acceptable); $N = no$, the study did not used objective measures, or did not cite reliability study/data in	
	the population being studied; $U =$ unclear.	
11.	Did the study report the nature of the physical activities observed?	
	Y = yes, the study reported the type of activities observed (e.g. type of sport or game); $N = no$, the	
	study did not reported the type of activities observed; $U =$ unclear.	

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