

Review Article

Correlates of Physical Activity of Students in Secondary School Physical Education: A Systematic Review of Literature

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Received 20 November 2018; Revised 13 January 2019; Accepted 4 February 2019; Published 19 February 2019

Academic Editor: Germán Vicente-Rodriguez

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Background and Objective. Several reviews have summarised studies on secondary school students' moderate-to-vigorous physical activity (MVPA) in physical education (PE), but no systematic review with semiquantitative assessment has been conducted to specifically identify the correlates of their MVPA. This review aims to systematically summarise the existing literature, which investigated correlates of MVPA of secondary school students during their PE lessons. *Methods.* A systematic search using ERIC, SPORTDiscus, PubMed, PsycINFO, Academic Search Premier, and Web of Science was conducted to identify the correlates of the MVPA of secondary school students in PE. Studies were eligible if they were English published articles and examined the association with MVPA during secondary school PE lessons and cross-sectional and prospective longitudinal quantitative studies. Two reviewers independently examined the articles, assessed their methodological quality, and performed data extraction. The correlates of MVPA were synthesised and further assessed semiquantitatively. *Results.* Fifty-five studies were identified to correlate with secondary school students' MVPA in PE lessons. Further analysis only included 43 studies (78.2%) that were of medium and high quality by methodological quality assessment. Out of 54 variables identified from these medium and high-quality studies, 11 were consistently associated with the MVPA. Sex (boys), ethnicity (White), class gender (boys-only), PE activities (team games), lesson location (outdoors), expectancy beliefs, subjective task values, and enjoyment were consistently and positively associated with MVPA. Other variables, namely, class gender (girls-only), PE activities (movement activities), and lesson context (knowledge), were consistently and negatively related to MVPA. *Conclusions.* Interventions focusing on the consistent variables are needed to build active lesson time in PE. This review also provides insights for future research.

1. Introduction

Physical activity (PA) offers physiological and psychological benefit [1]. Adolescence is a critical time to develop PA patterns which extend to adulthood [2]. However, a large proportion of adolescents worldwide is physically inactive [3]. School physical education (PE) is recognized as a key opportunity for improving PA amongst adolescents for two reasons [4]. PE provides opportunities for children and adolescents to accumulate moderate-to-vigorous PA (MVPA) [5]. PE also aims to provide children and adolescents fundamental movement skills, knowledge, and active attitude for lifetime PA [6].

The United States Department of Health and Human Services [4] and the United Kingdom Association for Physical Education [7] have recommended that school students

should engage in MVPA for at least 50% of PE lesson time. However, two reviews by Fairclough and Stratton [8] and Hollis et al. [9], which summarised studies concerning the MVPA level of secondary school students (approximately 10–18 years) in PE classes, found that students spend between 27% and 47% of PE time in MVPA. The findings showed that the MVPA of secondary school students in PE lessons failed to meet the 50% of PE lesson time recommendation.

Understanding the factors influencing MVPA during PE lessons is particularly important for the design of more effective interventions. Many studies have examined the correlates of MVPA in secondary school PE [10, 11]. However, only one review by Fairclough and Stratton [8] analysed 40 relevant studies until 2005 and identified some factors, such as intervention design, activity type, sex, skill level, and motivation which influence the MVPA of secondary

school students in PE classes. Numerous works studying the correlates of secondary school students' MVPA during PE classes have been conducted since 2005, and these studies were not summarised and reviewed. Therefore, this review aims to systematically summarise studies on the correlates of secondary school students' MVPA during PE classes until 2018 and identify variables contributing to their MVPA. The findings will aid in developing effective interventions to improve the PA of students and provide insights for PE teaching practice and future studies.

2. Methods

2.1. Search Strategy. The process and reporting of this review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement [12]. A literature search of all electronically archived literature published until May 2018 was conducted in six electronic databases, namely, ERIC, SPORTDiscus, PubMed, PsycINFO, Academic Search Premier, and Web of Science. Search terms were based on the combination of three main areas: (1) setting (physical education OR PE OR lesson* OR class*); (2) target population (youth* OR adolescent* OR teenager OR child* OR student*); (3) measurement terms (physical activit* OR PA OR MVPA OR exercise* OR health behavior OR motor activi*). The search strategies used for each database were shown in the Supplementary Materials (Table S1). In addition, reference lists of all included studies were manually searched for additional relevant papers. After the removal of duplicates and analyses of the titles and abstracts, 375 records remained (Figure 1).

2.2. Inclusion and Exclusion Criteria. The inclusion and exclusion criteria were as follows. (1) Articles examining variables for their association with PA during school PE classes were included; those focusing on other topics were excluded. (2) Cross-sectional and prospective longitudinal quantitative studies which examined associations between PA and other variables were covered. Qualitative studies, case reports, and expert opinion were disregarded. Intervention studies were also excluded from this review because they were aimed at determinants instead of correlates of MVPA. According to Bauman et al. [13], determinants reflected a cause and effect relationship, and correlates described a correlation between two variables. (3) Only published peer reviewed journal, with full-text articles in English until May 2018 were included, thereby excluding unpublished articles, conference proceedings, and dissertations. (4) Articles focusing only on general secondary school students (middle [i.e., approximately 10–14 years of age; Grades 6–8]) or high school [i.e., approximately 12–18 years of age; Grades 7–12]) were covered. Following the systematic literature search, the identified articles were determined by two reviewers (Yulan Zhou, Lijuan Wang) to independently check whether the screening procedure was consistent with the inclusion and exclusion criteria. A third reviewer (Yuanyuan Hu) was consulted in case of disagreement. The final number of articles identified in the review was 55. Figure 1 summarises the process of the literature research.

2.3. Methodological Quality Assessment. The criteria for assessing the qualities of studies were adapted from the Strengthening The Reporting of Observational studies in Epidemiology (STROBE) statement [14] and the McMaster Critical Review Forms for quantitative research [15], which have been used to assess the methodological quality of previous systematic reviews in similar areas [16, 17]. The criteria contained 8 items which covered aspects of study design, sample, study attrition, data collection, and data analysis (see Table S2 in the Supplementary Materials). Two reviewers (Yulan Zhou, Yuanyuan Hu) independently assessed all studies. Each item was scored as 1 (the assessed item was explicitly described and present) or 0 (the assessed item was inadequately described or absent). Any uncertainty and disagreement were resolved by the third reviewer (Lijuan Wang). The score for each study was summed, and the median score for all included study scores was calculated. Article was determined as high quality when it scored above the median score, medium quality when it scored equal to the median score, and low quality when it scored below the median score [18].

2.4. Categorisation of Variables. The demographic data of these studies were summarised and included geographical location, participant characteristics, PA measurement methods, and analytical approaches. The geographical location was summarised into the countries where the study was conducted. The participant samples were split into four groups (<100, 100-249, 250-500, and >500). Furthermore, the analytical approaches such as univariate analysis (e.g. t-tests, ANOVAs, and correlations) and multivariate analysis (e.g., linear regression, logistic regression, and structural equation modeling) were also presented (Table 1). Studies that used both analytical approaches were numbered in both categories.

Consistent with previous reviews on correlates of children and adolescent PA [19, 20], the potential correlates of MVPA during secondary school PE classes were classified into four categories, namely, demographic and biological variables, instruction-related variables, school physical environment variables and psychological variables on the basis of the subjects, and research content of these studies.

2.5. Coding of Analyses. The review contained three types of variables, namely, ordinal (e.g. self-efficacy), continuous (e.g., lesson length), and categorical (e.g., PE activities and lesson contexts) variables. A variety of analysis methods, including correlation, linear regression, logistic regression, and structural equation modeling, were used to determine the association between the ordinal, continuous variables, and MVPA. The column (Table 2) 'related to MVPA' indicates a significant relationship between these variables and students' MVPA. The codes '+' and '-' indicate positive and negative direction of association, respectively. The column 'unrelated to MVPA' indicates a nonsignificant association between these variables and students' MVPA. With regard to categorical variables (e.g., PE activities), t-test, ANOVA, and multivariate ANOVA (MANOVA) were used to analyse the difference in MVPA amongst multiple variables (e.g., team games, individual games, movement activities and individual

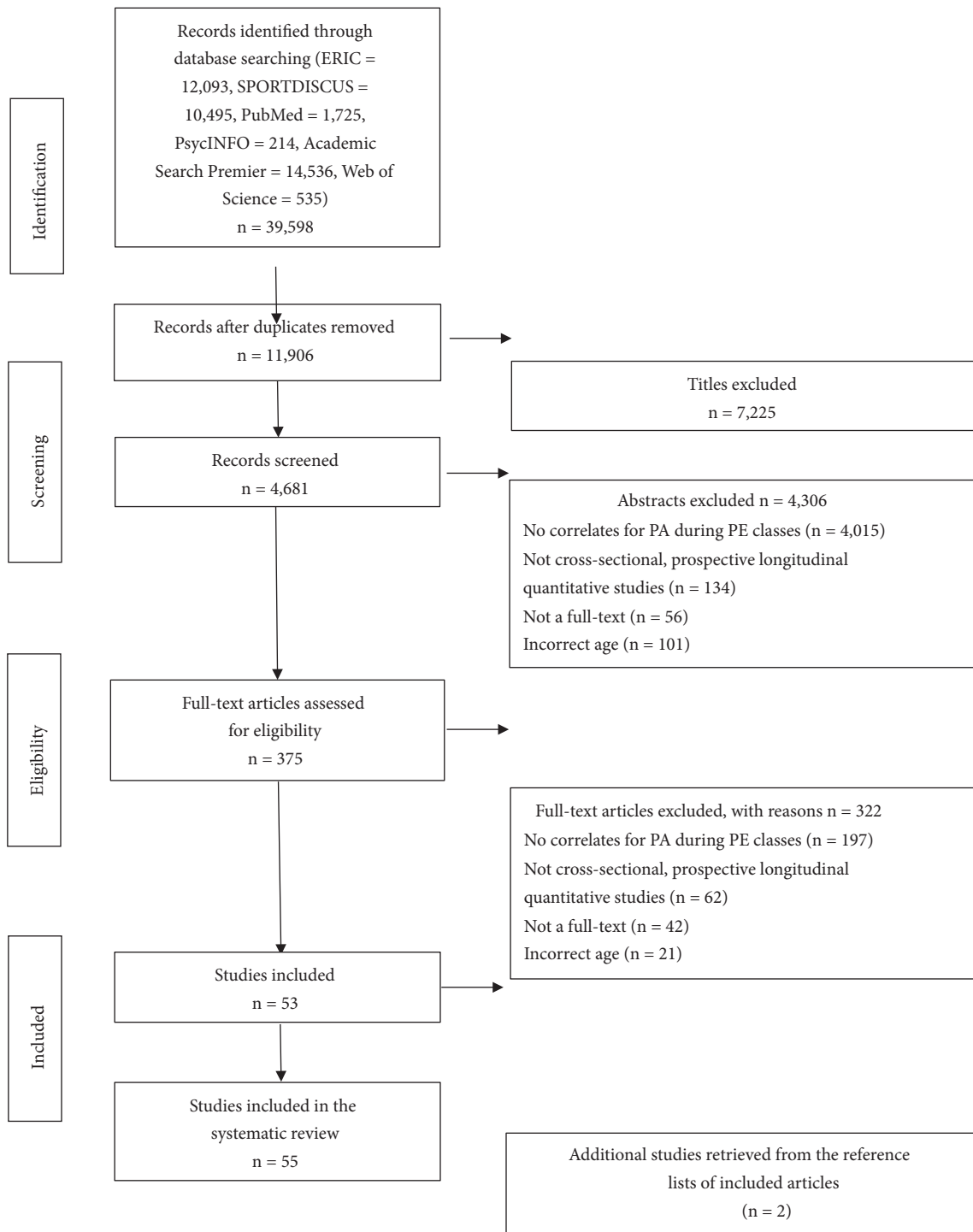


FIGURE 1: Flow diagram of literature research results.

activities). For studies focusing on these variables, multiple associations were recorded and summarised under a general heading (e.g. PE activities). The column ‘related to MVPA’ indicates significant differences in students’ existing MVPA. The codes ‘+’ and ‘-’ for the categorical variables represent the most and least MVPA time amongst these variables. If not, it was coded as ‘unrelated to MVPA’.

Following a previous review by Sallis et al. [20], variables that appeared in less than three comparisons were not described and discussed in the text. However, these variables were included in the tables to better understand the procedure of variable screening in this review. Semiquantitative assessment [20] was adopted to determine the consistency of different types of potential correlates in this review. This

semiquantitative procedure provided additional objective evidence beyond reporting of narrative results only [16]. Variables reported in less than three studies were coded as 'No Description (ND)'. For variables appearing more than three times, the directions of associations were based on the rules drawn up by Sallis and colleagues [20]: 0%–33% of the association in a similar direction was considered to have no association and coded as "0"; 34%–59% of the association in a similar direction was defined as indeterminate or inconsistent and coded as '?'; 60%–100% of the association in a similar direction was regarded as consistent and coded as either '+ + ' (positive) or '- - ' (negative). This cut-off coding was used in previous reviews [16, 17, 19].

3. Results

3.1. Methodological Quality. Agreement in the methodological quality assessment was 87.3% between the two reviewers (Yulan Zhou, Yuanyuan Hu) and achieved full consensus with the help of a third reviewer (Lijuan Wang). The Supplementary Materials (Table S3) provide the results of the methodological quality assessment per study. For the study design, only five (9.1%) studies used a longitudinal/prospective study design. For the sample component, nearly one-third of studies (17 studies, 30.9%) used a representative sample, and the majority of studies (42 studies, 76.4%) describe the participant characteristics in detail. For the study attrition, 13 studies (23.6%) clearly described the response rate and met the criteria. For the data collection, most of the studies used valid measures of PA (50 studies, 90.9%) and reliable measures of the related factors (44 studies, 80.0%). For the analyses component, most of the studies (49 studies, 89.1%) used appropriate statistical analysis and accounted for potential confounders in analysis, and 16 studies (29.1%) reported a power calculation. The median score of all 55 included study scores was 4 (range: 1-7), and 22 studies (40.0%) were rated above the median score and were categorised as high quality; 21 studies (38.2%) were scored as being equal to the median score and described as medium quality, and the remaining 12 studies (21.8%) scored below the median and were classified as low quality. In order to remove the influence of studies with greatest risk of bias, the 12 studies with low quality were excluded from this review [21, 22]. Thus, the final 43 studies were summarised and discussed in the present review.

3.2. Description of Studies. Table 1 summarises the distribution of geographic location, sample size, PA measurements, and analytical approaches. Forty-three studies were included in this systematic review, majority of which were conducted in the USA (23 studies, 53.5%). The majority of studies (27 studies, 62.8%) had <250 samples. Objective measures including accelerometers, HR monitors, pedometers, and direct observation measures were adopted in most of the studies (41 studies, 95.3%). Thirty-seven studies (86.0%) used univariate analyses to evaluate the association between variables and students' MVPA during PE lessons, and 20 studies (46.5%) reported multivariate analyses results.

TABLE 1: Descriptive statistics for studies used in the systematic review.

| Description | N (%) |
|---------------------------------------|-----------|
| <i>Geographic location</i> | |
| United States of America (USA) | 23 (53.5) |
| United Kingdom (UK) | 4 (9.3) |
| Spain | 4 (9.3) |
| Finland | 2 (4.7) |
| Hong Kong | 2 (4.7) |
| Other country | 8 (18.6) |
| <i>Sample size</i> | |
| <100 | 6 (14.0) |
| 100-249 | 21 (48.8) |
| 250-500 | 9 (20.9) |
| >500 | 7 (16.3) |
| <i>Physical activity measurement</i> | |
| Questionnaires | 2 (4.7) |
| Observed/SOFIT | 8 (18.6) |
| HR monitor | 10 (23.3) |
| Pedometers | 10 (23.3) |
| Accelerometer | 13 (30.2) |
| <i>Analytical approaches</i> | |
| Univariate analysis | 37 (86.0) |
| Multivariate analysis | 20 (46.5) |
| <i>Methodological quality</i> | |
| = median score 4 | 21 (48.8) |
| >median score 4 | 22 (51.2) |
| <i>Variable categories</i> | |
| Demographic/biological variables | 23 (53.5) |
| Instruction-related variables | 21 (48.8) |
| School physical environment variables | 9 (20.9) |
| Psychological variables | 16 (37.2) |

3.3. Correlates of Students' PA in Secondary PE Classes.

Table 2 summarises studies on the correlates of MVPA of medium- and high-quality students (i.e., 43 studies). A total of 54 variables were identified from these studies. Thirty variables (55.6%) had been investigated three or more times. Very few of these variables (11 variables, 36.7%) were consistently correlated with students' MVPA in all comparisons, and 14 variables (46.7%) were found to have no association. Only five variables (16.6%) were classified into the "inconsistent" category.

3.3.1. Demographic and Biological Variables. A total of 23 studies found seven demographic and biological variables that correlated to students' MVPA time during secondary school PE classes. Five variables, namely, sex, school level, grade, BMI, and ethnicity factors, were studied three or more times. Sex was the most frequently studied correlate (16 studies), and boys were consistently found to be more active than girls (in 75% of the comparisons). The most consistently supported finding in this group was that White students were more active than Black students in PE classes, and all

TABLE 2: Summary of studies of correlates of MVPA during secondary school PE lessons.

| Correlates variables | Related to MVPA References No | Asso (-/+) | Unrelated to MVPA References No | Asso | Summary code | % Studies |
|---|---|------------|------------------------------------|------|--------------|-----------|
| <i>Demographic and biological variables</i> | | | | | | |
| Sex (boys) | [10, 23–33] [37] | + | [34–36] | ++ | | 12/16 75% |
| School level (high school) | [35] [36] | + | [27] | 0 | | 1/3 33% |
| Grade | [23, 36, 38, 39] [31, 33] | - | [27, 34] | ? | | 4/8 50% |
| BMI (overweight) | [40] | + | [10, 33, 41, 42] | 0 | | 1/5 20% |
| Skill level (high) | [26] | + | | ND | | |
| Cardiorespiratory fitness(healthy) | [43] | + | | ND | | |
| Ethnicity (White) | [24, 42, 44] | + | | ++ | | 3/3 100% |
| <i>Instruction-related variables</i> | | | | | | |
| Class size | [10, 45] [49, 50] | + | [31, 46–48] | 0 | | 2/8 25% |
| Class gender | | | | | | |
| Boys-only | [32, 44, 47, 51, 52] [48, 52] | + | [44, 51] | ++ | | 5/5 100% |
| Co-educational | [32] | + | | ? | | 2/5 40% |
| Girls-only | [32, 44, 47, 48, 51, 52] [51] | - | [47] | -- | | 6/6 100% |
| Lesson length | | - | | ND | | |
| PE activities | | - | | | | |
| Team games | [10, 26, 30, 35–38, 40] [34] | + | [27, 31, 47] | ++ | | 8/12 67% |
| Individual games | [38, 47] | - | | | | |
| Movement activities | [10, 26, 30, 35–38, 40, 47, 53] [34, 38, 53] | + | [10, 26, 30, 31, 34–37] | 0 | | 2/10 20% |
| Individual activities | [36] | - | [31, 34] | -- | | 10/12 83% |
| Lesson context | | | [10, 26, 31, 35, 37, 47] | 0 | | 3/10 30% |
| Fitness activities | [32, 48, 50] | + | [45, 47, 51, 52] | ? | | 3/7 43% |
| Free play | | | [32, 45, 47, 48, 50–52] | 0 | | 0/7 0% |
| Game play | [32, 51, 52] | + | [45, 47, 48, 50] | ? | | 3/7 43% |
| Skill drills | [32, 52] | + | [45, 47, 48, 50, 51] | 0 | | 2/7 29% |
| Management | [32] | - | [45, 47, 48, 50–52] | 0 | | 1/7 14% |
| Knowledge | [32, 47, 48, 50, 51] | - | [45, 52] | -- | | 5/7 71% |
| Teacher gender (male) | | | [47, 48, 50] | 0 | | 0/3 0% |
| Teacher experience | [45] | - | [50] | ND | | |
| Teacher type (PE specialist) | | | | ND | | |
| Teacher behavior | | | | | | |
| Fitness promotion | | | [47] | ND | | |
| Fitness demonstration | | | [47] | ND | | |
| General instruction | [47] | - | | ND | | |
| Observation | [47] | + | | ND | | |
| Class management | | | [47] | ND | | |
| Other tasks | | | [47] | ND | | |

TABLE 2: Continued.

| Correlates variables | Related to MVPA | | Unrelated to MVPA References No | Asso | Summary code | % Studies |
|--|------------------|------------|------------------------------------|------|--------------|-----------|
| | References No | Asso (-/+) | | | | |
| <i>School physical environment variables</i> | | | | | | |
| Lesson location (outdoors) | [45, 48, 50, 54] | + | [10, 47] | ++ | | 4/6 67% |
| Accessibility of facilities/equipment | [49] | + | | ND | | |
| Large Space | [47] | + | [31] | ND | | |
| Natural environment (Fall) | [54] | + | [47] | ND | | |
| School structure quality | | | [11] | ND | | |
| School structure quantity | | | [11] | ND | | |
| <i>Psychological variables</i> | | | | | | |
| Self-determined motivation | [55] | + | | ND | | |
| Autonomous motivation | [46] | + | | ND | | |
| Controlled motivation | | | [46] | ND | | |
| Intrinsic motivation | [56] | + | [2, 57] | 0 | | 1/3 33% |
| Identified regulation | | | [2, 56, 57] | 0 | | 0/3 0% |
| Introjected regulation | | | [57] | ND | | |
| External regulation | [2] | - | [56, 57] | 0 | | 1/3 33% |
| Amotivation | [56] | - | [2, 46, 57] | 0 | | 1/4 25% |
| Competence | [39] | + | [25, 57, 58] | 0 | | 1/4 25% |
| Autonomy | [58] | + | [57] | ND | | |
| Relatedness | [58] | + | [57] | ND | | |
| Expectancy beliefs | [29, 59] | + | [28] | ++ | | 2/3 67% |
| Subjective task values | [28, 59, 60] | + | [29] | ++ | | 3/4 75% |
| Achievement goals | [61] | + | | ND | | |
| Self-efficacy | [59-61] | + | [10, 23, 62] | ? | | 3/6 50% |
| Outcome expectancy | [59] | + | | ND | | |
| Enjoyment | [2, 62] | + | | ++ | | 2/3 67% |
| | [25] | - | | ++ | | |

Note: Asso = association.

Variables were coded as 'no description (ND)' when reported less than three studies; when variables appear more than three times, 60%–100% of the association in a similar direction was coded as '+' (positive) or '-' (negative); 34%–59% of the association in a similar direction was coded as '?' (indeterminate/inconsistent); 0%–33% of the association in a similar direction was coded as '0' (no association).

comparisons supported this conclusion. Grade was significantly related to MVPA time in 50% of the comparisons. Therefore, the relationship was inconsistent. No association was found between two variables (i.e., school level and BMI) and the MVPA of students because only 33% and 20% of the associations were in a similar direction, respectively.

3.3.2. Instruction-Related Variables. Twenty-one studies provided information about 24 instruction-related variables that correlated to MVPA during secondary school PE classes, of which 15 variables, such as class size, class gender (boys-only, coeducational, or girls-only), PE activities (team games, individual games, movement activities, and individual activities), lesson contexts (fitness activities, free play, game play, skill drills, management, and knowledge), and teacher gender appeared in three or more studies. Three types of classes were compared to examine the effect of class gender on students' MVPA. All comparisons supported that students engaged in the most MVPA time in boys-only classes and the least MVPA time in girls-only classes. Four types of PE activities were also grouped together; out of 12 comparisons, team games were reported to accumulate the most MVPA time in 67% of the comparisons. Movement activities (e.g., dance and gymnastics) were reported to accrue the least MVPA time in 83% of the comparisons, thereby confirming the consistency of the association. Amongst different lesson contexts variables, only one variable, knowledge consistently (i.e., 71% of the comparisons) provided the least MVPA time for students. Class gender (coeducational) and lesson contexts (fitness activities and game play) were categorised as inconsistent variables. The other variables, such as class size, PE activities (individual games and individual activities), lesson contexts (free play, skill drill, and management), and teacher gender showed no association with students' MVPA.

3.3.3. School Physical Environment Variables. Nine studies investigated the associations between six school physical environment variables and students' MVPA. However, only one variable (i.e., lesson location) was reported by three or more studies, which found that students consistently (i.e., in 67% of the comparisons) spent significantly more time on MVPA during outdoor lessons than during indoor ones.

3.3.4. Psychological Variables. Sixteen studies identified 17 psychological variables as correlates of students' MVPA time during secondary school PE classes, and 9 of those variables were studied three or more times. These variables included intrinsic motivation, identified regulation, external regulation, amotivation, competence, expectancy beliefs, subjective task values, self-efficacy, and enjoyment. Variables found to have consistent and positive association with MVPA time were expectancy beliefs, subjective task values, and enjoyment, which were supported by 67%, 75%, and 67% of the studies, respectively. Although self-efficacy was significantly associated with MVPA, it was reported in less than 60% of the comparisons, thus making the associations inconsistent. Intrinsic motivation, identified regulation, external regulation, amotivation, and competence were classified as not

being associated with students' MVPA because less than 34% of the comparisons were in the same direction.

4. Discussion

For this review, we identified 55 studies correlating to secondary school students' MVPA in PE lessons. The results of methodological quality assessment showed that most of the studies reviewed were identified as medium and high quality, and only a small group of studies were categorised as low quality.

Further analysis identified 30 variables that were reported three or more times in the medium and high-quality studies. The results showed few variables (11 variables, 36.7%), namely, sex (boys), ethnicity (White), class gender (boys-only, girls-only), PE activities (team games, movement activities), lesson context (knowledge), lesson location (outdoors), expectancy beliefs, subjective task values, and enjoyment were consistently associated with MVPA, which were in accordance with those found in previous reviews on correlates of PA [17, 20]. The other 14 variables were not associated with students' MVPA, which indicated that these correlates may be not important to MVPA. The remaining five variables were placed in "inconsistent" category. It is hard to draw a conclusion from these studies because nearly half the studies found an association and half did not. The few consistent relationships may be attributed to research design, measures, and sample size. According to the descriptive statistics and quality assessment of studies in this review, objective measures (e.g., accelerometer and direct observation) and cross-sectional design were utilized by most of the studies. However, the application of objective measures of MVPA and cross-sectional design may weaken the strength of the relationships between the correlates and the MVPA time of students in PE [63, 64]. Therefore, few consistent relationships were reported in the studies that were included in this review. Another reason for the few consistent associations may be the small sample size. The samples in majority of the studies were limited (27 studies, 62.8% <250 participants). Schönbrodt and Perugini [65] reported that obtaining stable correlations is difficult when sample size is less than 250 participants. A small sample size may inflate the actual significance of results because detecting a specific effect is challenging [66]. This issue contributes to the few consistent associations in this review. Furthermore, most of the studies concerning PA of secondary school students in PE were from Western countries. The few consistent relationships found by this review may be representative of Western countries only rather than worldwide.

Demographic and biological variables which were consistently associated with students' MVPA during secondary school PE lessons were sex and ethnicity. The studies consistently reported that boys were more active than girls. This finding was in line with the previous review by Fairclough and Stratton [8]. Sex was the most studied variable in MVPA level differences in the adolescents' PA literature. Substantial evidence indicated that girls were less active than boys [67, 68]. The main reason was that activeness, bravery, aggressiveness, and perseverance are valued more in

boys than in girls while gentleness, kindness, approachability, sensitivity, quietness, weakness, and malleability are valued in girls [69]. Moreover, secondary school students are entering their teenage years, a period characterised by increasing sex differences. During this period, girls may perceive or experience additional barriers to PA due to their physical changes (e.g., widening of the hips, increased fat mass) and thus feel less efficacious in PA [70]. These reasons may also explain the considerable MVPA time of boys in PE classes in the current review. This finding implied that targeted intervention should be considered to increase the MVPA time of girls in PE classes. Regarding the ethnicity variable, White students were consistently more active than Black students but for unclear reasons. Further studies are required to explore the reasons behind this difference.

Class gender, PE activities, and lesson contexts were the three instruction-related variables which were consistently associated with MVPA of secondary school students in PE. Amongst three types of classes, namely, boys-only, girls-only, and coeducational PE classes, the consistent findings were that boys-only classes accrued the most MVPA time and girls-only classes yielded the least. This result was predictable because boys are more physically active than girls in PE classes. With regard to the variable of PE activities, students were consistently found to engage in the most MVPA time in team games and accumulate the least MVPA time in movement activities, which was in accordance with previous review on this topic [8]. Students are more active in team games activities probably because of several continuous body movements and the comparatively large translocation across space when compared with other types of activities [71]. In addition, students easily engage in PA that they perceive as meaningful, enjoyable, and display their abilities [72]. Team games were reported to be fun activities that encouraged students' competence, which may contribute to the most MVPA time of students in team game activities [73]. By contrast, movement activities, such as dance and gymnastics, stimulated the least MVPA time primarily because movement activities address aesthetic appreciation and body control [8]. Finally, the consistent finding for the variable of lesson contexts was that students were the least active during knowledge. Knowledge is possibly an inactive lesson context in which students are likely to merely stand or sit, which may result in the small amount of MVPA time [50]. These findings implied that the government should guide the active lesson plans and implementation to meet the MVPA recommendation. Professional development programs focusing on teaching design and teaching strategies for the promotion of student PA in PE classes should be provided to PE teachers. Moreover, PE teachers should thoroughly and considerately design the class content to be taught, allocate the amount of time spent in different lesson contexts, and implement effective teaching strategies to achieve PE objectives and engage students in additional MVPA time.

The only one school physical environmental variable consistently associated with MVPA was lesson location. Students yielded higher MVPA time during outdoor lessons than indoor lessons. Two reasons may explain the difference. Firstly, outdoor lessons provide available facilities, equipment

(e.g., soccer fields and playground) and large play spaces, which may be conducive to gross motor experiences and opportunities for students to be active [74]. Secondly, the natural environments during outdoor lessons positively affect certain aspects of mood, such as increased energy, relaxation, and delight, along with decreases in exhaustion, tension, and depression, which probably increased the MVPA time during PE lessons [75].

In terms of the psychological variables, the results consistently supported the positive role of three psychological variables in MVPA time during secondary school PE lessons, including expectancy beliefs, subjective task values, and enjoyment. Expectancy beliefs and subjective task values are two constructs of expectancy-value theory, which suggested that the expectancy-value model is a useful framework for predicting secondary school students' MVPA engagement in PE classes. Expectancy beliefs refer to beliefs regarding the ability to achieve goals and expectancies for success [59]. Subjective task value is defined as a function of four distinct components, namely, importance, interest, usefulness, and cost [76]. Students become increasingly physically active in PE classes when they consider themselves competent in the activity and viewed the PE classes as important, interesting, and useful. However, some researchers suggested that the influence of these two variables on students MVPA is different. Expectancy beliefs motivate students to engage in a particular task at a given moment, whereas subjective task values influence students' long-term motivation. Furthermore, they have different sensitivity levels for content during PE [29]. These findings implied that PE teachers should employ some motivational strategies to enhance students' perceived competence in PE, such as modifying activities to students' ability, helping them to achieve success in class, and providing positive instructional feedback during PE classes. Furthermore, it is also important for PE teachers to present PE activities in novel and meaningful way. Enjoyment is the other psychological factor consistently associated with students' MVPA, which suggested that students are involved in PE activities when they experience happiness and enjoyment in PE. Accordingly, PE teachers should adopt certain strategies (e.g., modifying activities to students' ability and self-directed tasks) to present PE activities more interesting and emphasize students' effort in PE.

5. Strengths and Limitations

An extensive and systematically searches have been conducted in multiple databases to identify the literature. Furthermore, this systematic review is the first to use a semiquantitative evaluation to identify correlates of secondary school students' MVPA in PE classes. This evaluation allowed for more information concerning the strength of the evidence of an association.

The present review has several limitations. The first potential limitation of this review is the completeness of the literature search. Although an extensive literature search was conducted to identify all published studies, a few published studies were possibly missed in this review due to the use of keywords other than those used in the

current work and unclear titles or abstracts used in these missed studies. The other limitation is the exclusion of non-English published studies. Certain studies that could have added relevant information to the field may have been discarded. Thirdly, lack of longitudinal study design has limited the quality of the studies included in this review. Fourthly, semiquantitative evaluation was adopted to analyse the research findings of the studies included. This approach addressed the significance and direction of each association to determine the consistency of reported association and could not assess the strength or magnitude of these associations.

6. Conclusion and Recommendations

This review classified the variables that correlate with MVPA as “consistent association”, “inconsistent association”, and “no association” categories. Eleven variables are categorised as “consistent association” with students’ MVPA time in PE classes. Amongst them, certain correlates, such as sex (boys), ethnicity (White), class gender (boys-only), PE activities (team games), lesson location (outdoors), expectancy beliefs, subjective task values, and enjoyment, are positively associated with students’ MVPA; the other variables, including class gender (girls-only), PE activities (movement activities), and lesson context (knowledge), are negatively related to students’ MVPA. These variables provided evidence for possible strategies to intervene aiming at increasing students’ MVPA. Variables with “inconsistent” relationships with students’ MVPA may be subjected to further detailed study. Variables that have “no association” with students’ MVPA should be de-emphasised in future studies.

Most of the studies were conducted in Western countries and thus represented the correlates of students’ MVPA under Western culture only. Further studies are needed from other countries to identify any cultural difference. In addition, out of the four research domains, that on the influence of school physical environment on students’ MVPA has been investigated the least (i.e., 9 studies), further studies concentrating on these variables are needed.

Furthermore, the relationship between a variety of demographic and biological, instruction-related, school physical environment, and psychological variables and students’ MVPA during PE lessons have been studied but in isolation. Additional studies may be necessary to explore these variables simultaneously to assist in identifying potential interactions amongst different domains.

Finally, a few demographic factors, such as sex, grade, and BMI, may influence the relationship between the correlates in this review and students’ MVPA in PE classes. For example, the association between psychological factors and students’ MVPA differed between boys and girls. Therefore, future research should be conducted to study the difference in these associations by the sex, grade, and BMI.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This project was supported by Shanghai Key Lab of Human Performance (Shanghai University of Sport) [no. 11DZ2261100] and Key Project of the Shanghai Committee of Science and Technology [no. 18080503300].

Supplementary Materials

Table S1: a record of the search strategy used for each database. Table S2: methodological quality assessment items. Table S3: methodological quality assessment per quality item and per study. (*Supplementary Materials*)

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