EJAES

JOURNAL OF ADVANCED EDUCATION STUDIES

İleri Eğitim Çalışmaları Dergisi

4(2): 126-151, 2022

EFFECTS OF PHYSICAL ACTIVITY PROGRAMS OF SCHOOL-BASED INTERVENTION ON PHYSICAL FITNESS AND PSYCHOLOGICAL RESPONSE: A SYSTEMATIC REVIEW

Yağmur ÖZATİK [1]

Umut GÖK[2]

Geliş Tarihi/Received:04.12.2022 Kabul Tarihi/Accepted:14.12.2022 Elektronik Yayın/Online Published:15.12.2022

DOI: 10.48166/ejaes.1214508

Abstract

This systematic review aimed to investigate the effect of school-based physical activity interventions on physical fitness and psychological responses in children and young people. Studies were conducted from Web of Science, Scopus and PubMed databases between 1 January 2017 and 1 December 2022 according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist. For the research to be conducted in the databases, "School-Based Intervention", "physical fitness ", "Psychology", School-based intervention, physical fitness and psychological responses were used in the title and abstract. The database review revealed seventy-four (74) studies. However, after eliminating seventeen (17) duplicate studies, fifty-five (57) studies remained. Subsequently, seventeen (17) studies were eliminated after reviewing the abstracts. After forty (40) studies were thoroughly analysed, eighteen (18) publications not involving psychological factors, five (5) publications involving research methods and six (6) review studies were excluded. The remaining eleven (11) studies were used after review. The results of the present systematic review showed that school-based physical activity interventions contribute positively to children's physical fitness and psychological health while ensuring a healthy life for years to come.

Keywords: Adolescents; children; physical activity; psychological response; school-based intervention

[1]Research assistant, Tokat Gaziosmanpasa University, Tokat, Turkey, yagmur.ozatik@gop.edu.tr, ORCID: 0000-0003-4208-4516

[2] PhD student, Tokat Gaziosmanpasa University, Tokat, Turkey, gokumut80@gmail.com, ORCID: 0000-0002-5596-884X

OKUL TEMELLI FIZIKSEL AKTIVITE UYGULAMALARININ FIZIKSEL UYGUNLUK VE PSIKOLOJIK CEVAPLAR ÜZERINDEKI ETKILERI: SISTEMATIK BIR İNCELEME

Özet

Bu sistematik derlemenin amacı okul temelli fiziksel aktivite uygulamalarının çocuklar ve gençlerde fiziksel uygunluk (FU) ve psikolojik cevaplar üzerindeki etkisini araştırmaktır. 1 Ocak 2017 ile 1 Aralık 2022 tarihleri arasında Web of Science, Scopus ve PubMed veri tabanlarından Sistematik İncelemeler ve Meta-Analizler için Tercih Edilen Raporlama Öğeleri (PRISMA) kontrol listesine göre çalışmalar taranmıştır. Veri tabanlarında yapılacak araştırma için başlık ve özette "Okul Temelli Uygulama", "fiziksel uygunluk", "Psikoloji", okul temelli uygulamar, fiziksel uygunluk ve psikolojik yanıtlar kullanılmıştır. Veritabanı incelemesinde, yetmiş dört (74) çalışma ortaya çıkmıştır. Ancak tekrar eden on yedi (17) çalışma hariç tutulduktan sonra geriye elli beş (57) çalışma kalmıştır. Daha sonra, özetler incelendikten sonra on yedi (17) çalışma daha hariç tutulmuştur. Kırk (40) çalışma kapsamlı bir şekilde analiz edildikten sonra, psikolojik faktörleri içermeyen on sekiz (18) çalışma, araştırma yöntemlerini içeren beş (5) yayın ve derleme çalışması olan (6) yayın hariç tutulmuştur. Kalan on bir (11) çalışma incelemeden sonra kullanılmıştır. Mevcut sistematik incelemenin sonuçları, okul temelli fiziksel aktivite uygulamalarının çocukların fiziksel uygunluklarına ve psikolojik sağlığına olumlu katkıda bulunurken, gelecek yıllarda sağlıklı bir yaşam sürmelerini sağlamaya yardımcı olacağını göstermektedir.

Anahtar Kelimeler: Ergenler; çocuklar; fiziksel aktivite; psikolojik tepki; okul temelli müdahale

1. INTRODUCTION

Over the last 30 years, childhood obesity has reached epidemic proportions worldwide (Abarca-Gómez et al., 2017; WHO, 2018). Therefore, the importance of encouraging children to remain physically active is increasing (Reisberg et al., 2020; Riso & Jürimäe, 2018). Physical activity (PA) and physical fitness (PF) are significant instruments for enhancing the quality of life for people with health conditions as well as the cognitive aspect of development in children (Donnelly et al., 2016). Increasing the time spent actively is one of the strategies to cope with obesity. Research recommends 60 minutes of moderate-intensity physical activity (MVPA) per day for children and adolescents aged 5 to 17 (Strong et al., 2005; Janssen, 2007). However, physical activity (PA) data collected in adolescents aged 13 to 15 years from 105 countries worldwide reveal that 80.3% do not meet recommended activity guidelines (Hallal et al., 2012). In addition, studies (Nader et al., 2008; Sember et al., 2020) indicate a significant decline in PA levels during adolescence. The young population has shown less PA participation than moderate exercise recommended in PA guidelines (Costa et al., 2017). Therefore, the active participation of children and young people in physical education classes in schools will play an essential role in physical and psychological well-being.

Schools should be where children and adolescents spend most of their time, as well as a target setting for PA promotion among children and young people (Van de Kop et al., 2019). In addition, the school environment is ideal for implementing PA interventions (Kelso et al., 2020). Because children spend much time at school, schools are recognised as adequate settings to increase the PA levels of

children and adolescents who spend most of their time sitting (Dobbins et al., 2013). The meta-analysis study of Van de Kop et al. (2019) showed that school-based PA interventions increase pre-occupational PA in adolescents. In addition, it is known that PA practices implemented in the school environment contribute positively to the health factors of children and adolescents (Demetriou & Honer, 2012). Inadequate PA is one of the ten (10) leading risk factors for death worldwide and a significant risk factor for non-communicable diseases (WHO, 2018). Low PA levels have been associated with overweight obesity and a higher risk of cardiovascular disease in school-age children (Carson et al., 2016; Kurdaningsih et al., 2016; Ekelund et al., 2012). Furthermore, there is a gender-based inequality in PA among children and adolescents, with girls performing less moderate-to-vigorous PA than boys (Hubbard et al., 2016; Póvoas et al., 2018; Long et al., 2013; Chen et al., 2022). Therefore, it is important to create gender-sensitive environments where children and adolescents can regularly engage in moderate-intensity PA to improve their health profile.

School-based PA programmes aim to achieve and maintain a health-related PF level (Yuksel et al., 2020). PF is divided into two parts: fitness related to health and fitness related to motor skills or performance (Vanhees et al., 2005). Coordination, agility, balance, power, speed, and reaction based on performance are all components of skill-related fitness, as opposed to health-related fitness, which focuses on factors like composition and flexibility (Powell et al., 1989; Caspersen et al., 1985). Fitness connected to motor skills is a major element of children's development. However, children's PF may be impacted if they have trouble completing motor skills (Smits-Engelsman et al., 2020). In addition, the competence in fundamental movement skills that provide motor competence and PF of children in daily activities at later ages is directly related to a healthy and active life (Barnett et al., 2008). In this sense, some studies have found that school-based programmes have the potential to improve PF (Neil-Sztramko et al., 2021). As a result, in school-age children, having a healthy cardiorespiratory fitness level, a crucial PF indicator, provides the physical foundation for good mental health and psychological well-being (Chen et al., 2022).

Children and adolescents spend a large part of their lives at school, and this setting significantly impacts how they grow socially, emotionally, and psychologically (Tejada-Gallardo et al., 2020). According to findings by Greenleaf et al. (2010), students with better cardiorespiratory fitness had higher self-esteem and fewer depression symptoms. Additionally, studies show that kids aged 7 to 12 with good cardiorespiratory fitness outperformed their unfit peers on cognitive tests (Haverkamp et al., 2021; Blair et al., 2001). Furthermore, PA positively correlates with school success and perceived pleasure (De Souza et al., 2021).

The structure of the PE curriculum in schools has consistently changed the quantity of PA and student motivation, favouring the quality of life and other biomarkers (Delgado-Floody et al., 2019). Considering the literature, adequate participation in physical education effectively contributes to developing a healthier lifestyle in children and adolescents throughout their lives. Therefore, the main

aim of this systematic review is to examine the effect of school-based PA practices on PF and psychological responses in school-age children and adolescents.

2. MATERIALS AND METHOD

This study is a systematic review of articles in various scientific peer-reviewed journals to examine the effects of school-based PA interventions on PF and psychological responses.

2.1. Inclusion Criteria

Studies that included school-based PA practices and examined PF and psychological responses were included in the study. In addition, the included studies were considered to be peer-reviewed publications and published in English between 1 January 2017 and 1 December 2022. Studies that did not have a school-based practice did not examine PF and psychological reactions, and a study protocol was not included in the study.

2.2. Research Strategy

In the study, Web of Science (WOS), Scopus and Pubmed databases were searched for relevant scientific studies published in English between 1 January 2017 and 1 December 2022 using the keywords " School-Based Intervention ", "PF", "Psychology", in the title and abstract in the context of School-Based Intervention (SBI), PF and psychological responses. After the database review, 74 studies were found. However, 17 repetitive studies were removed, and 57 studies remained. Afterwards, 17 studies whose abstracts were analysed were excluded. As a result of analysing 40 studies in full text, 18 articles that did not contain psychological variables, 5 with study protocols and six review studies were excluded. After the review, the remaining 11 studies were used (Figure 1). The current review study fulfilled the inclusion criteria using the PICO approach (Table 1) (Huang, Lin, & Demner-Fushman, 2006).

3. RESULTS

The results regarding the effects of school-based practices on PF and psychological responses are presented.

3.1. Outcomes Regarding PA, PF and Psychological Response

3.1.1. PA

Studies investigated measuring PA levels are examined, and improvements occur in the PA results measured by accelerometer and PA scale in the groups performing school-based practice (Ha et al., 2020a; Morano et al., 2020a; Morano et al., 2020b). However, in a study by Liang et al. (2020), no significant difference was observed in the time spent in sedentary behaviour, moderate PA (MPA) and vigorous PA (VPA) levels, while significant improvements were observed in light PA (LPA).

3.1.2. PF

PF tests have shown that SBIs have shown significant improvements in aerobic endurance, flexibility, muscular strength, muscular endurance and strength results (Morano et al., 2020a; Pittman,

2020; Morano et al., 2020b; Kwasky & Serowoky, 2018; Sjöwall et al., 2017). However, in the study conducted by Murphy et al. (2022), it was observed that there was little or no effect on the components of PF. In addition, improvements in perceived physical competence and body image were observed (Morano et al., 2020a; Morano et al., 2020b). The results of anthropometric measurements show that school-based practices have a positive effect on body mass index, body fat percentage, and arm and waist circumference (Morano et al., 2020a; Kwasky & Serowoky, 2018), in contrast to studies showing no effect (Pittman, 2020; Liang et al., 2020). In addition, Morano et al. (2020a) stated that school-based practices decreased skinfold thickness.

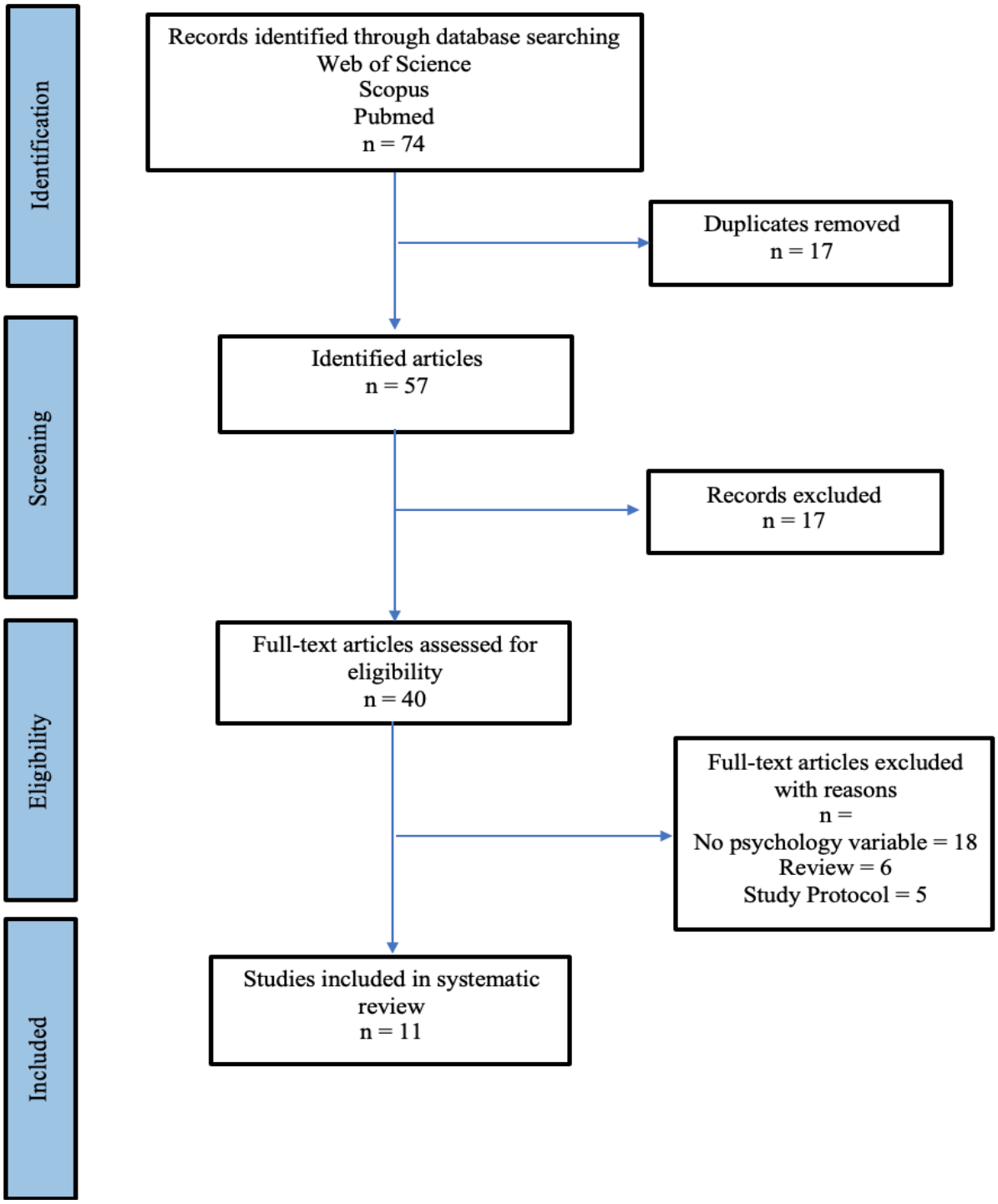

Figure 1. Study selection flowchart

Table 1. PICO Criteria

	Criteria
Population	Students
Intervention	School-Based Intervention
Comparison	School-Based Intervention on PF and psychological response
Results	PF (PA levels, body composition, fitness components, body fat percentage etc.) Psychology (psychology, anxiety, self-esteem, stress etc.)

3.1.3. Psychological Responses

When the studies on psychological responses were examined, Jin et al. (2018) evaluated the significant relationship between PA. They perceived general health and the enjoyment of PA in physical education classes for students aged 5-11 years with a PA level of at least 60 minutes per day and PA in recess for students aged 12-15 years. While the effect of enjoyment on students in physical education class was found to be greater, no effect was observed in children who did PA during recess. Similarly, Hatch et al. (2021) found that students enjoyed the Daily Mile exercises they applied to primary school students. However, Liang et al. (2020) stated that school-based practice did not positively affect enjoyment. In contrast to the studies (Pittman, 2020; Liang et al., 2020), which found no effect of school-based practices on self-efficacy, Murphy et al. (2022) stated that students who participated in school-based PA 2 or 3 days a week increased their self-efficacy levels. Sjöwall et al. (2017) reported that the stress levels of students exposed to a total of 120 minutes of PA per week at school decreased, while the stress levels of those exposed to 300 minutes of PA per week increased. Murphy et al. (2022) reported that while no difference in the group that practised PA one or three days a week, there was an increase in anxiety levels in the group that never practised or practised two days a week and in the same study, it was stated that participation in PA two days a week resulted in a decrease in depression. Kwasky and Serowoky (2018) stated that significant improvements were observed in the social sub-dimension of the scale applied to students four weeks after the end of school-based practices for eight weeks, while Liang et al. (2020) stated that there was no effect on any social support. Ha et al. (2020b) implemented SELF-FIT, a school-based practice, instead of typical physical education classes. They found that SELF-FIT strengthened students' competence, autonomy, and engagement compared to physical education classes. In another study (Ha et al., 2020a), the effects of the same SBI on genders were examined. It was found that the intervention effects were stronger in meeting girls' competence, autonomy needs, and autonomous motivation than boys. In addition, they noted that boys in physical education programs reported higher levels of need fulfilment and autonomous motivation, as well as being more active than girls.

4. DISCUSSION

This systematic review aimed to examine the effects of school-based PA interventions on PF and psychological responses. Studies (Sjöwall et al., 2017; Jin et al., 2018; Kwasky & Serowoky, 2018; Morano et al., 2020a; Morano et al., 2020b; Ha et al., 2020a; Ha et al., 2020b; Pittman et al., 2020; Liang et al., 2020; Hatch et al., 2021; Murphy et al., 2022) all showed that significant improvements were achieved in at least one variable. The content and details of the SBI programme are significant in these studies. As a result of classifying the programme details according to the PA focus, the number of studies directly including PA was 4 (Morano et al., 2020a; Morano et al., 2020b; Ha et al., 2020a; Liang et al., 2020), PF components were 8 (Sjöwall et al., 2017; Kwasky & Serowoky, 2018; Morano et al., 2020a; Morano et al., 2020b; Ha et al., 2020b; Pittman et al., 2020; Liang et al., 2020; Murphy et al., 2022) and all 11 studies included psychological responses.

Considering the variables examined, using PA interventions in schools generally positively affects PF and psychological health. These results highlight the importance of planning the time required for PA programmes in schools, especially in children and adolescents with disabilities (Jin et al., 2018) and obese or overweight (Morano et al., 2020a) groups. The success of school-based PA interventions is influenced by the prevalence of age-appropriate or more specific PA opportunities and content available to young people, whether linked to behaviour or health outcome change (Burns et al., 2017). The priority of lifelong PA and health programmes should be the preparation of appropriate learning environments. The goal of health-based physical education curriculum models targeting a physically active life is to maintain these appropriate learning environments (Haerens et al., 2011). Although evaluations related to different variables have been made in school-based PA studies, only PF and psychological dimensions have been addressed in this systematic research.

While favourable results were observed in four studies regarding the PF factor, no effect was observed in two studies. One study reported improvements in fitness tests and increases in anthropometric measures (such as body fat percentage, BMI). The main goal of school-based PA programmes is to improve health-related PF and to ensure that this is long-lasting. Therefore, in this review study, health-related (Ortega et al., 2008) PF components (anthropometrics, muscular strength, muscular endurance, flexibility, etc.) were assessed. In some studies, there are results showing that SBIs are effective in improving PF (Lu et al., 2018; Janssen & LeBlanc, 2010; Bogataj et al., 2021). Unlike typical PE lessons, SELF-FIT practice improves students' competence, autonomy and relatedness skills. Guthold et al. (2020) reported that low PF among adolescents is relatively high, and the global prevalence of inadequate PA is 78.4% for boys and 84.4% for girls aged 11-17.

Table 2. A Detailed Overview of the Work

Reference	Sample	Study design	Protocols	Measurements	Results
Jin et al., 2018	Children and adolescent students with disabilities N=241 (age: 5-15 years)	Three key concerns were noted in order to address the study questions. a) Days spent engaging in 60 minutes of PA (b) enjoyment with school-based PE programs (such as recess and physical education); (c) general health.	The number of days the PA attended for at least 60 minutes each week provided as a measure for their involvement. Children between the ages of 5 and 11 were asked how much they enjoyed recess, while children between the ages of 12 and 15 were asked how much they enjoyed physical education. A five-point scale from "excellent" to "poor" was used to rate participants' perceptions of their general	-Psychological Response (Perceived general health, Enjoyment)	The perception of overall health among children with disabilities is correlated with the enjoyment of school-based PA programs, primarily through daily PA involvement. For older children receiving physical education, but not for younger children receiving recess, enjoyment impacted PA and perceived general health.

			health and pleasure.		
Morano et al., 2020a	Obese or overweight student N=18 (Age: 11.3±0.4)	Participants followed a 6-month obesity programme that included nutrition counselling and exercise training. The exercise programme consisted of two sessions, two hours per week, and took place in the school gym after school hours.	Weekly 30-minute interactive group sessions were provided to educate children on the importance of PA and fitness. These included reviewing PA diaries, goal setting, self-monitoring and self-empowerment activities, and basic concepts of body functioning and healthy behaviour. Nutrition counselling was provided at the programme's beginning, middle and end. Children were invited to keep an exercise diary	-Anthropometrics -PA Questionnaire -Fıtness tests (VJ, MBT, SR, Harre) - Psychological Response (Perceived Physical Ability Scale, Body image)	Body mass index, body fat percentage, arm and waist circumference and skinfold thickness decreased. Actual and perceived physical abilities, body image and PA improved.

			outside the programme.		
Pittman, 2020	Secondary school students N=650 Age: 11-15	Children were assigned to 3 different groups. 1- Activity Tracker group (AT) 2- Text Messaging group (TM) 3- AT + TM	In the AT group, people followed the activities. In the TM group, people were also sent reminders and motivational messages. In the AT+TM group, people practised both. The study took place from September to December 2016.	-Anthropometrics -Fitness Test (FITNESSGRAM TEST) -Psychological Response (SE)	There was no effect of PA on self-efficacy in AT, TM and AT+TM groups. While positive improvements were observed in fitness tests in AT group, no difference was observed in AT+TM and TM groups. In anthropometric measurements in AT, TM and AT+TM groups, negative results were observed.

Physical Education = PE; Active Video Games = AVG; Physical Activity = PA; Moderate-to-vigorous physical activity MVPA; Vigorous Physical Activity = VPA; Light Physical Activity = LPA; Moderate Physical Activity = ; MPA; Counts Per Minute = CPM; Beck Depression Inventory = BDI; Beck Anxiety Inventory = BAI; Self-efficacy = SE; Warwick Edinburgh Mental Wellbeing Scale = WEMWS; Cardiorespiratory Endurance = CRE; Standing Long Jump = SLJ; Shuttle-Run = SR; Medicine Ball Throw = MBT; Vertical Jump VJ; Self-determined Exercise and Learning For FITness = SELF-FIT; PA Questionnaire = PAQ-C; The Self-Efficacy Questionnaire for Children = SEQ-C

Table 2. Continue

Reference	Sample	Study design	Protocols	Measurements	Results
Liang et al., 2020	Volunteer primary school students n=80 (Age: 9-12)	Children were assigned to 2 different groups. Intervention Group=29 Control Group=51	The intervention group participated in after-school AVG classes for eight weeks for 1 hour twice a week. Before the games started, a 15-minute warm-up was performed. Children chose their preferred game partner. Children who played AVGs on the television were to play AVGs on the projector in the next lesson. They were told to wear accelerometers only on school days.	- Anthropometrics -Accelerometers (Sedentary time, MVPA, LPA, MPA, VPA, CPM) - Psychological Response (Enjoyment, Social support, SE)	The average amount of time spent in MPA and VPA and the daily time spent in sedentary behavior did not show any discernible changes, although LPA and CPM did. Psychological responses and anthropometric data showed no significant changes.
Ha et al., 2020a	Secondary school students n=667 age:14.4	Students were randomly assigned to 2 groups.	While students in the control group attended their lessons as normal, those in the experimental	-Accelerometers (MVPA, LPA, MPA, VPA) - Psychological Response (Perceived	The SELF-FIT intervention effectively improved students' PA outcomes as

		Intervention Group=311 Control Group=356	group participated in the school-based SELF-FIT intervention, which was created to include fitness and game-like components into PE using the concepts of self-determination theory.	autonomy support, Competence, Autonomy, Relatedness, Autonomous motivation, Controlled motivation, psychological well-being, Intention)	measured by accelerometery, regardless of students' gender. Compared to students who did not receive SELF-FIT instruction, intervention group students spent less time inactive and more time performing light, moderate, and vigorous exercises. The intervention effects were stronger for girls in terms of meeting participants' competence and autonomy needs, and autonomous motivation. During physical education sessions, boys were more active than females and reported higher need satisfaction and autonomy motivation.

Morano et al., 2020b	Secondary school students N=64 Age:11.3±0.5	Students were randomly assigned to 2 groups. Intervention Group=35 Control Group=29	In addition to physical education lessons, the clinical intervention group engaged in a 7-month after-school program, whereas the control group attended regular curriculum sessions.	- Anthropometrics -PA Questionnaire -Fitness Tests (SLJ, MBT, SR) - Psychological Response (Perceived Physical Ability Scale)	In contrast to their peers in the control group, clinical group members showed improvements in PA levels, perceived physical ability, and physical test performance.

Physical Education = PE; Active Video Games = AVG; Physical Activity = PA; Moderate-to-vigorous physical activity MVPA; Vigorous Physical Activity = VPA; Light Physical Activity = LPA; Moderate Physical Activity = ; MPA; Counts Per Minute = CPM; Beck Depression Inventory = BDI; Beck Anxiety Inventory = BAI; Self-efficacy = SE; Warwick Edinburgh Mental Wellbeing Scale = WEMWS; Cardiorespiratory Endurance = CRE; Standing Long Jump = SLJ; Shuttle-Run = SR; Medicine Ball Throw = MBT; Vertical Jump VJ; Self-determined Exercise and Learning For FITness = SELF-FIT; PA Questionnaire = PAQ-C; The Self-Efficacy Questionnaire for Children = SEQ-C

Table 2. Continue

Reference	Sample	Study design	Protocols	Measurements	Results
Murphy et al., 2022	Secondary School Adolescent female students N=85 Age:13±0.7	Twenty-four students participated in the study once a week, 22 students participated twice a week, and eighteen students participated three times a week to form the intervention group. Twenty-one students acted as the control group.	The students were offered two activities to play at each lunchtime. Students were free to choose any of them. The intervention consisted of lunchtime games three days a week for 40 minutes. The intervention lasted ten weeks. The control group had their lunch in their classrooms.	-PF (SR, Muscular Strength, Endurance, SLJ, sit and reach) - Psychological Response (BDI, BAI, SE, WEMWS)	There was an increase in depression in the control group, a decrease in those who applied the activity for two days and no difference in those who applied it for 1 or 3 days. While there was an increase in anxiety in the control group and those who applied the activity for two days, there was no difference in those who applied it for 1 or 3 days. For WEMWS and SE, there was no difference in the control group and those who applied the activity for one day, while an

					increase was seen in those who applied it for 2 or 3 days. PA had little or no effect on the components of PF.
Kwasky & Serowoky, 2018	Secondary School Adolescent female students N=14 Age: 12.21±1.47	All participants were assigned to the intervention group. Measurements were applied as pre-test and post-test.	The intervention was implemented twice a week for eight weeks. Participants completed the SEQ-C test 4 weeks after the completion of the intervention.	- Anthropometrics -Fitness test (flexibility) - Psychological Response (SEQ-C)	Improvements were observed in the social sub-dimension of the SEQ-C Scale. There was a significant decrease in waist circumference in the participants. They also achieved improvement in flexibility.
Sjöwall et al., 2017	Students from 1st to 6th grade N=270 Age:(6-13)	Active school (n = 228) Control school (n = 242) Each school was mandatorily exposed to PA for 120 minutes per week, while	The study was conducted in 2 schools for two years. PA was varied to be fun for the students and consisted of aerobics classes, an obstacle course, boxing, jumping rope,	-PF (SR) -Psychological Response (Stress)	PA levels and PF levels improved by almost 50 per cent in the active school, while the control school remained at a constant level. While stress decreased in the

		the active school was exposed to PA for an additional 180 minutes since the start of the study.	running and various high-intensity games. PA was compulsory. Students in both the active and control school were assessed four times over two years: at the beginning of each autumn and at the end of each spring.		control school, stress increased in the active school.
Physical Education = PE; Active Video Games = AVG; Physical Activity = PA; Moderate-to-vigorous physical activity MVPA; Vigorous Physical Activity = VPA; Light Physical Activity = LPA; Moderate Physical Activity = ; MPA; Counts Per Minute = CPM; Beck Depression Inventory = BDI; Beck Anxiety Inventory = BAI; Self-efficacy = SE; Warwick Edinburgh Mental Wellbeing Scale = WEMWS; Cardiorespiratory Endurance = CRE; Standing Long Jump = SLJ; Shuttle-Run = SR; Medicine Ball Throw = MBT; Vertical Jump VJ; Self-determined Exercise and Learning For FITness = SELF-FIT; PA Questionnaire = PAQ-C; The Self-Efficacy Questionnaire for Children = SEQ-C					

Table 2. Continue

Reference	Sample	Study design	Protocols	Measurements	Results
Ha et al., 2020b	Secondary school students N=75 age=14.4 ±0.9	All of the participants participated in the experimental group. Eleven teachers were assigned to the students to implement the intervention.	The focus group and teacher interviews average 25-32 minutes. Specific to SELF-FIT implementation, a typical class includes a series of warm-ups (usually running), stretching, fitness activities, teaching sports-related skills and free play. The content was varied but generally included games such as basketball, volleyball, badminton, gymnastics, etc. Teachers were asked about students' perceptions of the differences between competence, autonomy and	- Psychological Response (Competence, Autonomy, Relatedness)	Unlike typical PE lessons, SELF-FIT practice improves students' competence, autonomy and relatedness skills.

			relatedness during SELF-FIT sessions and regular PE lessons.		
Hatch et al., 2021	Primary school students N=87 Age:10.4±0.7	The study included a familiarisation trial seven days before the first experimental trial. Participants then completed two experimental trials, again separated by seven days. 1-Intervention (Daily Mile) 2-Control (rest) completed.	The children practised a school-based Daily Mile PA involving 15-20 minutes of self-paced exercise. The study utilised focus groups to explore children's perceptions and enjoyment of participation in The Daily Mile. In the focus group, open-ended questions were asked of the children.	- Psychological Response (Enjoyment)	Children enjoyed participating in The Daily Mile.

Physical Education = PE; Active Video Games = AVG; Physical Activity = PA; Moderate-to-vigorous physical activity MVPA; Vigorous Physical Activity = VPA; Light Physical Activity = LPA; Moderate Physical Activity = ; MPA; Counts Per Minute = CPM; Beck Depression Inventory = BDI; Beck Anxiety Inventory = BAI; Self-efficacy = SE; Warwick Edinburgh Mental Wellbeing Scale = WEMWS; Cardiorespiratory Endurance = CRE; Standing Long Jump = SLJ; Shuttle-Run = SR; Medicine Ball Throw = MBT; Vertical Jump VJ; Self-determined Exercise and Learning For FITness = SELF-FIT; PA Questionnaire = PAQ-C; The Self-Efficacy Questionnaire for Children = SEQ-C

For this reason, the importance of school-based PA interventions to increase overall PF is emphasised in terms of public health (Kriemler et al., 2011). In addition, there are studies suggesting that improved PF may have beneficial effects on cardiovascular disease risk factors in children (Andersen et al., 2011). The results of the present systematic review suggest that, although SBIs vary, PA generally has positive effects on PF. However, in order for PA interventions to be entirely successful, it is seen that the programmes and the target group should be well evaluated and analysed. In addition, systematic review studies have revealed that low PF is associated with psychological parameters such as depressive symptoms, psychological distress, impaired psychological well-being and perceived quality of life (Carson et al., 2016; Hoare et al., 2016; Suchert et al., 2015).

Another essential variable of the systematic review is the relationship between school-based PA practices and psychological responses. All 11 studies examined in this study dealt with the psychological dimension of PA. The studies evaluated included enjoyment (Jin et al., 2018; Liang et al., 2020; Hatch et al., 2020), depression-anxiety-stress (Murphy et al., 2022; Sjöwall et al., 2017), self-efficacy (Pittman et al., 2020; Liang et al., 2020; Murphy et al., 2022; Kwasky & Serowoky, 2018), perceived physical ability and perceived general health (Morano et al., 2020a; Morano et al., 2020b; Jin et al., 2018) and self-determination (Ha et al., 2020a; Ha et al., 2020b). The studies showed that PA positively affected the parameters of enjoyment and perceived physical ability. However, there were inconsistent results with significant differences in depression-anxiety-stress parameters, self-efficacy and self-determination. In this context, it is essential to know that there are many reasons besides PA programmes to combat children's physical inactivity. Studies have investigated which factors affect the PA levels of children and adolescents, and one of the main factors identified was the enjoyment of activity (Burns et al., 2017). One study investigated whether a high-intensity intervention targeting cardiovascular and musculoskeletal health influenced psychological factors related to children's participation in regular PA and whether these factors were associated with the health outcomes of the intervention. Team sports involving high-intensity activities did not negatively affect children's perceptions of enjoyment and adaptation to PA; on the contrary, individual exercises were found to be disadvantageous for the development of enjoyment and adaptation (Elbe et al., 2017). In a study focusing on gender differences and conducted with 667 secondary school students, it was concluded that boys were more active than girls and reported high levels of need satisfaction and autonomous motivation during physical education classes (Ha et al., 2020a). In addition, Póvoas et al. (2018) reported that males reported less enjoyment in mixed games in an application in which both genders played small-sided games in football. These results provide significant evidence that gender should be considered in psychological responses during PA and should be considered when designing SBI programmes.

Regular PA can have many positive effects on children that are not only related to their fitness levels. For example, it positively affects children's well-being and mental health, such as showing higher feelings of self-worth and vitality and reporting fewer depressive symptoms (Brown et al., 2013; Liu et al., 2015). However, the impact of children's PA on mental health outcomes has been examined, and

increased PA levels have significantly reduced depression, anxiety, psychological distress and emotional disturbances in children (Ahn & Fedewa, 2011). Murphy et al. (2022) emphasised that doing PA resulted in significant differences in depression and anxiety levels. Duncan et al. (2018) stated that the movement skills of children with a low perception of competence would be low in parallel. Contrary to these results, there are also studies showing that PA does not affect self-efficacy (Pittman et al., 2020; Liang et al., 2020). Compared to other psychological concepts, the literature on self-efficacy needs to be clarified, and more precise evidence is needed. Research shows that physical education (PE) and school sports provide an appropriate and practical framework for transferring and teaching skills and strategies to reduce health-risk behaviours and increase psychological well-being (Piñeiro-Cossio et al., 2021; Opstoel et al., 2020).

5. CONCLUSION

The results of this systematic review showed that adjusting the physical education curriculum in schools can result in consistent PA and student motivation changes, with positive effects on quality of life and other biomarkers. Children's adequate participation in PA during their developmental process can lead to improved PF for older age and, consequently, to healthy lifestyles. Therefore, schools are appropriate for PA interventions and should help students acquire and develop skills and strategies to achieve high levels of physical and psychological well-being and healthy living activities. Popular play-based methods and different types of subject-specific warm-ups in physical education classes can diversify school-based PA interventions further to improve PF and psychological responses and more positive feedback.

REFERENCES

Abarca-Gómez, L., Abdeen, Z. A., Hamid, Z. A., Abu-Rmeileh, N. M., Acosta-Cazares, B., Acuin, C., ... & Cho, Y. (2017). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128· 9 million children, adolescents, and adults. *The lancet*, *390*(10113), 2627-2642.

Ahn, S., & Fedewa, A. L. (2011). A meta-analysis of the relationship between children's physical activity and mental health. *Journal of pediatric psychology*, *36*(4), 385-397.

Andersen, L. B., Riddoch, C., Kriemler, S., & Hills, A. (2011). Physical activity and cardiovascular risk factors in children. *British journal of sports medicine*, *45*(11), 871-876.

Barnett, L. M., Van Beurden, E., Morgan, P. J., Brooks, L. O., & Beard, J. R. (2008). Does childhood motor skill proficiency predict adolescent fitness?. *Medicine & Science in Sports & Exercise*, *40*(12), 2137-2144.

Blair, S. N., Cheng, Y., & Holder, J. S. (2001). Is physical activity or physical fitness more important in defining health benefits?. *Medicine & Science in Sports & Exercise*, *33*(6), S379-S399.

Bogataj, Š., Trajković, N., Cadenas-Sanchez, C., & Sember, V. (2021). Effects of school-based exercise and nutrition intervention on body composition and physical fitness in overweight adolescent girls. *Nutrients*, *13*(1), 238.

Brown, H. E., Pearson, N., Braithwaite, R. E., Brown, W. J., & Biddle, S. J. (2013). Physical activity interventions and depression in children and adolescents. *Sports medicine*, *43*(3), 195-206.

Burns, R. D., Fu, Y., & Podlog, L. W. (2017). School-based physical activity interventions and physical activity enjoyment: A meta-analysis. *Preventive medicine*, *103*, 84-90.

Carson, V., Hunter, S., Kuzik, N., Gray, C. E., Poitras, V. J., Chaput, J. P., ... & Tremblay, M. S. (2016). Systematic review of sedentary behaviour and health indicators in school-aged children and youth: an update. *Applied physiology, nutrition, and metabolism*, *41*(6), S240-S265.

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public health reports*, *100*(2), 126.

Chen, W., Gu, X., Chen, J., & Wang, X. (2022). Association of cardiorespiratory fitness and cognitive function with psychological well-being in school-aged children. *International Journal of Environmental Research and Public Health*, *19*(3), 1434.

Costa, M., Oliveira, T., Mota, J., Santos, M. P., & Ribeiro, J. (2017). Objectively measured physical activity levels in physical education classes and body mass index. *Retos: nuevas tendencias en educación física, deporte y recreación*, (31), 271-274.

De Souza-Pajuelo, A. A. R., Luján, A. F. T., & Reyes-Bossio, M. (2021). Physical activity enjoyment and self-efficacy in school performance of 11-17-yearold students at educational institutions in Lima. *Journal of Physical Education and Sport*, *21*, 2183-2189.

Delgado-Floody, P., Latorre-Román, P., Jerez-Mayorga, D., Caamaño-Navarrete, F., & García-Pinillos, F. (2019). Feasibility of incorporating high-intensity interval training into physical education programs to improve body composition and cardiorespiratory capacity of overweight and obese children: A systematic review. *Journal of Exercise Science & Fitness*, *17*(2), 35-40.

Demetriou, Y., & Höner, O. (2012). Physical activity interventions in the school setting: A systematic review. *Psychology of sport and exercise*, *13*(2), 186-196.

Dobbins, M., Husson, H., DeCorby, K., & LaRocca, R. L. (2013). School- based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. *Cochrane database of systematic reviews*, (2).

Donnelly, J. E., Hillman, C. H., Castelli, D., Etnier, J. L., Lee, S., Tomporowski, P., ... & Szabo-Reed, A. N. (2016). Physical activity, fitness, cognitive function, and academic achievement in children: a systematic review. *Medicine and science in sports and exercise*, *48*(6), 1197.

Duncan, M. J., Jones, V., O'Brien, W., Barnett, L. M., & Eyre, E. L. (2018). Self-perceived and actual motor competence in young British children. *Perceptual and motor skills*, *125*(2), 251-264.

Ekelund, U., Luan, J. A., Sherar, L. B., Esliger, D. W., Griew, P., Cooper, A., & International Children's Accelerometry Database (ICAD) Collaborators. (2012). Moderate to vigorous physical activity and sedentary time and cardiometabolic risk factors in children and adolescents. *Jama*, *307*(7), 704-712.

Elbe, A. M., Wikman, J. M., Zheng, M., Larsen, M. N., Nielsen, G., & Krustrup, P. (2017). The importance of cohesion and enjoyment for the fitness improvement of 8–10-year-old children participating in a team and individual sport school-based physical activity intervention. *European Journal of Sport Science*, *17*(3), 343-350.

Greenleaf, C. A., Petrie, T. A., & Martin, S. B. (2010). Psychosocial variables associated with body composition and cardiorespiratory fitness in middle school students. *Research quarterly for exercise and sport*, *81*(sup3), S65-S74.

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2020). Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1· 6 million participants. *The Lancet Child & Adolescent Health*, *4*(1), 23-35.

Ha, A. S., Lonsdale, C., Lubans, D. R., & Ng, J. Y. (2020a). Increasing Students' Activity in Physical Education: Results of the Self-determined Exercise and Learning For FITness Trial. *Medicine and science in sports and exercise*, *52*(3), 696-704.

HA, A., Sam, C. H., & Young, J. Y. (2020b). Students' and teachers' reactions to a novel school-based physical education SELF-FIT intervention. *Int. J. Sport Psychol*, *51*, 183-196.

Haerens, L., Kirk, D., Cardon, G., & De Bourdeaudhuij, I. (2011). Toward the development of a pedagogical model for health-based physical education. *Quest*, *63*(3), 321-338.

Hallal, P. C., Andersen, L. B., Bull, F. C., Guthold, R., Haskell, W., Ekelund, U., & Lancet Physical Activity Series Working Group. (2012). Global physical activity levels: surveillance progress, pitfalls, and prospects. *The lancet*, *380*(9838), 247-257.

Hatch, L. M., Williams, R. A., Dring, K. J., Sunderland, C., Nevill, M. E., Sarkar, M., ... & Cooper, S. B. (2021). The Daily Mile™: Acute effects on children's cognitive function and factors affecting their enjoyment. *Psychology of Sport and Exercise*, *57*, 102047.

Haverkamp, B. F., Oosterlaan, J., Königs, M., & Hartman, E. (2021). Physical fitness, cognitive functioning and academic achievement in healthy adolescents. *Psychology of Sport and Exercise*, *57*, 102060.

Hoare, E., Milton, K., Foster, C., & Allender, S. (2016). The associations between sedentary behaviour and mental health among adolescents: a systematic review. *International journal of behavioral nutrition and physical activity*, *13*(1), 1-22.

Huang, X., Lin, J., & Demner-Fushman, D. (2006). Evaluation of PICO as a knowledge representation for clinical questions. In *AMIA annual symposium proceedings* (Vol. 2006, p. 359). American Medical Informatics Association.

Hubbard, K., Economos, C. D., Bakun, P., Boulos, R., Chui, K., Mueller, M. P., ... & Sacheck, J. (2016). Disparities in moderate-to-vigorous physical activity among girls and overweight and obese schoolchildren during school-and out-of-school time. *International Journal of Behavioral Nutrition and Physical Activity*, *13*(1), 1-8.

Janssen, I. (2007). Physical activity guidelines for children and youth. *Applied Physiology, Nutrition, and Metabolism*, *32*(S2E), S109-121.

Janssen, I., & LeBlanc, A. G. (2010). Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *International journal of behavioral nutrition and physical activity*, *7*(1), 1-16.

Jin, J., Yun, J., & Agiovlasitis, S. (2018). Impact of enjoyment on physical activity and health among children with disabilities in schools. *Disability and health journal*, *11*(1), 14-19.

Kelso, A., Linder, S., Reimers, A. K., Klug, S. J., Alesi, M., Scifo, L., ... & Demetriou, Y. (2020). Effects of school-based interventions on motivation towards physical activity in children and adolescents: A systematic review and meta-analysis. *Psychology of Sport and Exercise*, *51*, 101770.

Kriemler, S., Meyer, U., Martin, E., van Sluijs, E. M., Andersen, L. B., & Martin, B. W. (2011). Effect of school-based interventions on physical activity and fitness in children and adolescents: a review of reviews and systematic update. *British journal of sports medicine*, *45*(11), 923-930.

Kurdaningsih, S. V., Sudargo, T., & Lusmilasari, L. (2016). Physical activity and sedentary lifestyle towards teenagers' overweight/obesity status. *Int J Community Med Public Health*, *3*(3), 630-635.

Kwasky, A. N., & Serowoky, M. L. (2018). Yoga to enhance self efficacy: An intervention for at-risk youth. *Archives of Psychiatric Nursing*, *32*(1), 82-85.

Liang, Y., Lau, P. W., Jiang, Y., & Maddison, R. (2020). Getting active with active video games: A quasi-experimental study. *International Journal of Environmental Research and Public Health*, *17*(21), 7984.

Liu, M., Wu, L., & Ming, Q. (2015). How does physical activity intervention improve self-esteem and self-concept in children and adolescents? Evidence from a meta-analysis. *PloS one*, *10*(8), e0134804.

Long, M. W., Sobol, A. M., Cradock, A. L., Subramanian, S. V., Blendon, R. J., & Gortmaker, S. L. (2013). School-day and overall physical activity among youth. *American journal of preventive medicine*, *45*(2), 150-157.

Lu, K. D., Cooper, D. M., Haddad, F., & Radom-Aizik, S. (2018). Four months of a school-based exercise program improved aerobic fitness and clinical outcomes in a low-SES population of normal weight and overweight/obese children with asthma. *Frontiers in pediatrics*, *6*, 380.

Morano, M., Robazza, C., Bortoli, L., Rutigliano, I., Ruiz, M. C., & Campanozzi, A. (2020b). Physical activity and physical competence in overweight and obese children: An intervention study. *International Journal of Environmental Research and Public Health*, *17*(17), 6370.

Morano, M., Robazza, C., Rutigliano, I., Bortoli, L., Ruiz, M. C., & Campanozzi, A. (2020a). Changes in physical activity, motor performance, and psychosocial determinants of active behavior in children: A pilot school-based obesity program. *Sustainability*, *12*(3), 1128.

Murphy, J., Sweeney, M. R., & McGrane, B. (2022). The effect of a games-based intervention on wellbeing in adolescent girls. *Health Education Journal*, *81*(4), 463-478.

Nader, P. R., Bradley, R. H., Houts, R. M., McRitchie, S. L., & O'Brien, M. (2008). Moderate-to-vigorous physical activity from ages 9 to 15 years. *Jama*, *300*(3), 295-305.

Neil-Sztramko, S. E., Caldwell, H., & Dobbins, M. (2021). School- based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. *Cochrane Database of Systematic Reviews*, (9).

Opstoel, K., Chapelle, L., Prins, F. J., De Meester, A., Haerens, L., van Tartwijk, J., & De Martelaer, K. (2020). Personal and social development in physical education and sports: A review study. *European Physical Education Review*, *26*(4), 797-813.

Ortega, F. B., Ruiz, J. R., Castillo, M. J., & Sjöström, M. (2008). Physical fitness in childhood and adolescence: a powerful marker of health. *International journal of obesity*, *32*(1), 1-11.

Piñeiro-Cossio, J., Fernández-Martínez, A., Nuviala, A., & Pérez-Ordás, R. (2021). Psychological wellbeing in physical education and school sports: A systematic review. *International Journal of Environmental Research and Public Health*, *18*(3), 864.

Pittman, A. F. (2020). Effect of a school-based activity tracker, companion social website, and text messaging intervention on exercise, fitness, and physical activity self-efficacy of middle school students. *The Journal of School Nursing*, *36*(2), 112-120.

Póvoas, S., Randers, M. B., Krustrup, P., Larsen, M. N., Pereira, R., & Castagna, C. (2018). Heart rate and perceived experience differ markedly for children in same-versus mixed-gender soccer played as small-and large-sided games. *BioMed research international*, *2018*.

Powell, K. E., Caspersen, C. J., Koplan, J. P., & Ford, E. S. (1989). Physical activity and chronic diseases. *The American journal of clinical nutrition*, *49*(5), 999-1006.

Reisberg, K., Riso, E. M., & Jürimäe, J. (2020). Associations between physical activity, body composition, and physical fitness in the transition from preschool to school. *Scandinavian Journal of Medicine & Science in Sports*, *30*(11), 2251-2263.

Riso, E. M., & Jürimäe, J. (2018). Physical activity, sedentary behaviour, sleep duration and well-being among Estonian schoolchildren: a thematic review. *Handbook of Leisure, Physical Activity, Sports, Recreation and Quality of Life*, 365-391.

Sember, V., Jurak, G., Kovač, M., Đurić, S., & Starc, G. (2020). Decline of physical activity in early adolescence: A 3-year cohort study. *PloS one*, *15*(3), e0229305.

Sjöwall, D., Hertz, M., & Klingberg, T. (2017). No long-term effect of physical activity intervention on working memory or arithmetic in preadolescents. *Frontiers in Psychology*, *8*, 1342.

Smits-Engelsman, B., Neto, J. L. C., Draghi, T. T. G., Rohr, L. A., & Jelsma, D. (2020). Construct validity of the PERF-FIT, a test of motor skill-related fitness for children in low resource areas. *Research in Developmental Disabilities*, *102*, 103663.

Strong, W. B., Malina, R. M., Blimkie, C. J., Daniels, S. R., Dishman, R. K., Gutin, B., ... & Trudeau, F. (2005). Evidence based physical activity for school-age youth. *The Journal of pediatrics*, *146*(6), 732-737.

Suchert, V., Hanewinkel, R., & Isensee, B. (2015). Sedentary behavior and indicators of mental health in school-aged children and adolescents: A systematic review. *Preventive medicine*, *76*, 48-57.

Tejada-Gallardo, C., Blasco-Belled, A., Torrelles-Nadal, C., & Alsinet, C. (2020). Effects of school-based multicomponent positive psychology interventions on well-being and distress in adolescents: A systematic review and meta-analysis. *Journal of Youth and Adolescence*, *49*(10), 1943-1960.

van de Kop, J. H., van Kernebeek, W. G., Otten, R. H., Toussaint, H. M., & Verhoeff, A. P. (2019). School-based physical activity interventions in prevocational adolescents: a systematic review and meta-analyses. *Journal of Adolescent Health*, *65*(2), 185-194.

Vanhees, L., Lefevre, J., Philippaerts, R., Martens, M., Huygens, W., Troosters, T., & Beunen, G. (2005). How to assess physical activity? How to assess physical fitness?. *European Journal of Preventive Cardiology*, *12*(2), 102-114.

WHO, I. (2018). Obesity and overweight. http://www.who.int/mediacentre/factsheets/fs311/en/

WHO. *Global Recommendations on Physical Activity for Health*; WHO Press: Geneva, Switzerland, 2010.

Yuksel, H. S., Şahin, F. N., Maksimovic, N., Drid, P., & Bianco, A. (2020). School-based intervention programs for preventing obesity and promoting physical activity and fitness: a systematic review. *International journal of environmental research and public health*, *17*(1), 347.