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BSc: Sports Science

A Literature Review of "Quality Physical Education" Interventions

In the Context of the Global Decline of Physical Activity and Mental Health, and the Reinforcement of Inequalities

Bachelor Thesis

Submitted to the Department of Sports, Exercise and Health at the University of Basel

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Abstract

Background: This BSc thesis is a literature review of QPE interventions in the context of the global decline of physical activity, which fuels the prevalence of deaths through non-communicable diseases, the decline of mental health responsible for high global rates of depression, and the reinforcement of inequalities which denies minorities the equal access to opportunities for a better future.

Methods: This thesis is a review of 20 QPE intervention published in or after 2015, when the UNESCO's QPE guidelines were published. It follows the PRISMA methodology for systematic reviews. All the included studies were school-based RCTs to ensure significant results. The literature search was conducted in the databases PubMed, ERIC, and SPORTDiscus.

Results: Teacher training is an important component for the success of PA interventions. Multi-method interventions are preferable over single-method interventions. Interventions with components that target the increase of participants' intrinsic motivation are promising to counteract the age-typical decline of PA during adolescence. Physical activity can decrease symptoms of depression, which are often mediated by social isolation. Intervention effects varied between the sexes, further emphasising the need for multi-method interventions to affect the whole study population.

Conclusions: The thesis highlights the importance of QPE interventions that educate teachers, target the intrinsic motivation of participants, and employ a multi-method design. Mental health can be positively affected by PA interventions, but this thesis did not provide sufficient evidence on this topic. Interventions must consider the heterogeneity of their study population and choose the intervention components based on that.

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List of Abbreviations

BMI	Body Mass Index
CG	Control Group
FMS	Fundamental Movement Skills
HIIT	High-intensity Interval Training
IG	Intervention Group
LBM	Lean Body Mass
MVPA	Moderate to Vigorous Physical Activity
PA	Physical Activity
PE	Physical Education
QPE	Quality Physical Education
RCT	Randomized Controlled Trial
SDT	Self-Determination Theory
SET	Social-Ecology Theory
UNESCO	United Nations Educational, Scientific and Cultural Organization
VPA	Vigorous Physical Activity
WHO	World Health Organization

1 Introduction

As of 2022, 81% of adolescents and 27.5% of adults do not meet the World Health Organisation's (WHO) recommended levels of physical activity. This affects not only individuals and their families but also society as a whole (WHO, 2022a). The decline of physical activity among the global population is fuelling a global health crisis and accounts for 6% of global mortality (UNESCO, 2015). The United Nations Educational, Scientific and Cultural Organization (UNESCO) is mandated to "promote physical education [...] to support the rounded development of every individual" (UNESCO, 2015) and they have pledged to "mobilise stakeholders and resources in order to ensure the provision of quality physical education (QPE) to young people across the world, regardless of their socio-economic situation, ethnicity, culture or gender." The UNESCO is therefore a central agent of the present and future to counter the global decline of physical activity.

Quality Physical Education (QPE) as defined by UNESCO (2015) is the "planned, progressive, inclusive learning experience that forms part of the curriculum in early years, primary and secondary education [...] and the most effective means of providing all children and youth with the skills, attitudes, values, knowledge and understanding for lifelong participation in society" (UNESCO & MINEPS, 2013). The UNESCO follows a data-driven approach, collecting data through surveys on both a political and school level, which is analysed to facilitate and optimise implementations of QPE in partaking countries.

A core component of QPE is taking measures to guard against the reinforcement of inequalities against minorities, women, people with mental or physical disabilities, and communities living in emergency contexts. For this reason, QPE, in comparison to traditional physical education (PE), does not provide a "one size fits all" approach but a curriculum, which can be tailored to provide everyone with equal opportunity. The UNESCO states that "accessible and flexible curricula, equipment and learning materials can serve as the key to creating inclusive schools" (UNESCO, 2015) because this ensures that educators may adjust their approaches to respect different needs and ensure maximum impact and relevance of their teaching.

This thesis will provide readers with an understanding about the three current global health crises of physical activity, mental health, and inequality and how QPE implementation is an important countermeasure to these crises. The main part is a literature review of the current state of research on the topic of physical education interventions that fulfil the UNESCO's quality criteria.

1.1 Relevance

In UNESCO's 1978 charter, physical education is established as "a fundamental right for all, and an essential element of lifelong education" (UNESCO, 1978). To this day, physical education is perceived as less important than other subjects in educational settings and only 53% of educators on a primary level have been sufficiently trained. However, research has shown that physical education is a central pillar of primary and secondary education and that its being neglected entails negative physical outcomes for the inactive population as well as negative socio-economic outcomes globally. A global improvement of physical education in primary and secondary education is therefore not only desirable for better socio-economic returns but it is also shown to improve self-efficacy, inclusion, and academic achievements of individuals that are sufficiently active (UNESCO). Furthermore, QPE implementation is closely linked to three current global health crises identified by the UNESCO:

Physical inactivity, which is at the root of many non-communicable diseases (NCD) such as diabetes, cancer, or heart diseases (BAG, 2024), accounts for 6% of global mortality and NCDs are projected to be the leading cause of death in Africa by 2030 (UNESCO, 2015). Thus, the

promotion of physical activity through QPE interventions are a vital part of reducing deaths due to NCDs.

Mental health issues currently affect more than one billion people worldwide. Many countries, especially of the Global South, are not equipped to provide sufficient help for patients and the recent Covid-19 pandemic has only made this issue worse (WHO, 2022b). According to the WHO the promotion of physical activity not only acts as a therapy for people with mental health issues but also lowers the occurrence rate.

Inequality is a broad term referring to many pervasive social issues of our time, such as the inequality between men and women, the inequality of minorities, the inequality of migrants, or the inequality of people with physical or mental disorders. The implementation of QPE contributes towards the inclusion of people negatively affected by inequalities and may in the long term contribute to the reduction of inequalities as a whole (UNESCO, 2016).

1.2   Main Research Questions

UNESCO's QPE guidelines for policy makers encompass many thought out concepts, which are shown to be relevant and explained in detail. However, while it is important that guidelines are carefully thought out, the success or failure of the QPE program is dependent on its practical implementation. The importance of successful and efficient practical implementation is even more apparent, when we understand that especially in the Global South resources are scarce and the working environment suboptimal. The first research question aims to help policy makers pinpoint practical implementations, which have succeeded to make resources available where they will serve a purpose.

1.   ***What components of QPE implementation have so far proven most effective?***

The knowledge that PA is beneficial for people's mental health has been well established within the medical community. The UNESCO builds on this and repeatedly states in the guidelines for policy makers, that QPE supports the mental wellbeing of participants. However, this is a broad claim to make and it should be analysed more closely to understand what domains of the mental wellbeing of participants are affected by the implementation of QPE interventions. The second research question aims to answer just that.

2.   ***In what way have QPE interventions improved participants' mental health and is this improvement shown empirically?***

As a central component of inclusion, gender equality is a key part of *quality* PE interventions, which ensures that women are not discriminated against and therefore a step towards the sustainable development of countries worldwide (UNESCO, 2015). The UNESCO guidelines (2015) further elaborate that schools are "the ideal way to reach large numbers of girls and equip them with the information, skills, and confidence necessary for lifelong physical activity." Previous research has established, that when predominantly masculine values of over-competitiveness and aggression override values such as fair-play and cooperation, girls are denied equal opportunities to be physically active. To gain insight into this topic, the third research question aims to elicit further differences between the sexes to provide data of how QPE interventions should be designed to benefit boys and girls equally.

3.   ***How do intervention effects differ between the sexes?***

2   Methodology

This BSc (Bachelor of Science) thesis is a literature review of physical education interventions. According to Snyder "a systematic review can be expl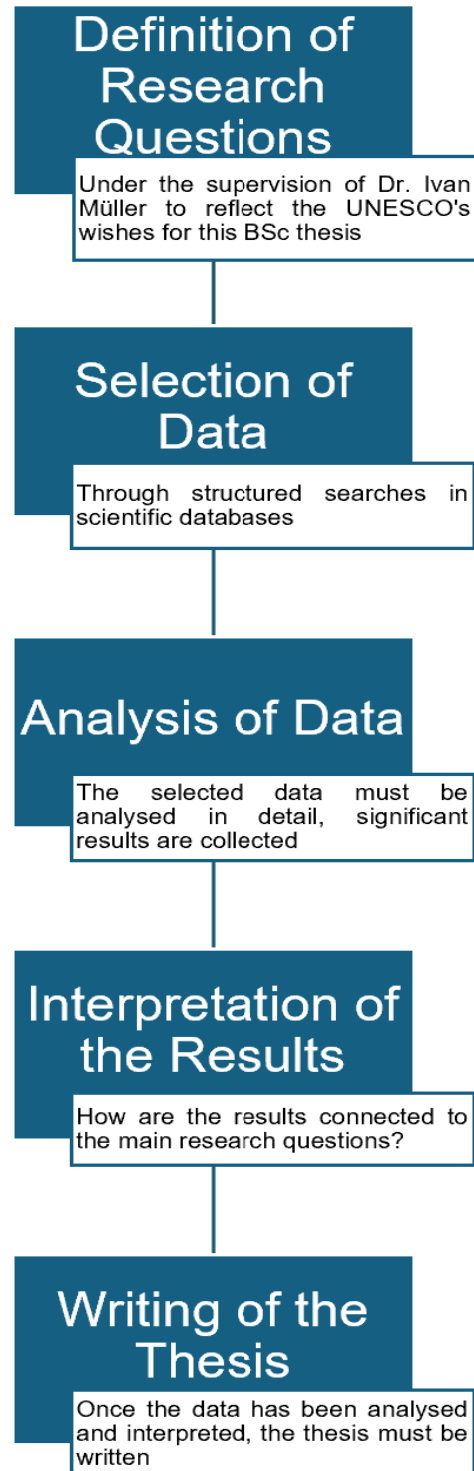ained as a research method and process for identifying and critically appraising relevant research, as well as for collecting and analysing data from said research. The aim of a systematic review is to identify all empirical evidence that fits the pre-specified inclusion criteria to answer a particular research question or hypothesis" (2019). Figure 1 shows a proposed organization chart for this thesis. The review itself is structured according to PRISMA FLOW (Figure 2) and explained in detail in 3.1. The suggested databases which will be considered for this thesis are SPORT Discus, PubMed and ERIC. This review largely follows the procedures of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

2.1   Review Procedure

2.1.1   Development of the Search String

The first step of developing a precise search string was to brainstorm terminology connected to the research questions which would later be combined into a precise search string. This was noted in Table 1 and included key terminology, synonyms, generic terms, and the German terminology.

The creation of the search string was supported by PD Dr. Christian Appenzeller-Herzog of the Medical Information Specialist team of the University of Basel. The decision to exclusively include Randomised Controlled Trials (RCT) was based on Dudley et al. (2022) to ensure significant results despite the limited amount of included studies in this thesis (Hariton & Locascio, 2018). The applied Cochrane RCT sensitivity maximising filter (2023 revision) for PubMed was taken from the ISSG Search Filters Resource (sites.google.com). Based on the UNESCO guidelines being published in 2015, only studies published in 2015 and onwards were included. The three databases that were searched are PubMed (pubmed.ncbi.nlm.nih.gov/), ERIC and SPORTDiscus (both via EBSCO Host web.p.ebscohost.com). PD Dr. Christian Appenzeller-Herzog proposed to additionally include clinical trial registries. However, due to sufficient results from the three databases, this step was omitted. The search string was created in PubMed and rephrased to suit the EBSCO Host syntax through a polyglot tool (sr-accelerator.com). Below are the two completed search strings.

Definition of Research Questions

Under the supervision of Dr. Ivan Müller to reflect the UNESCO's wishes for this BSc thesis

Selection of Data

Through structured searches in scientific databases

Analysis of Data

The selected data must be analysed in detail, significant results are collected

Interpretation of the Results

How are the results connected to the main research questions?

Writing of the Thesis

Once the data has been analysed and interpreted, the thesis must be written

Figure 1 Organisation chart for a Systematic Literature Review

Table 3 Search terms for the development of the research strategy

Thema	Quality Physical Education Interventions in the Context of the Global North					
Key Terminology	**Physical Education**	**Project**	**Mental Health**	**Physical Activity**	**Inclusion**	**Primary/Secondary Education**
Synonyms	PE, sports lessons, school sports	program, intervention	sanity, emotional health, healthy mind	activity, excercise, sports	equity, integration	school-based, school, primary school, elementary school, secondary school, middle school, high school
Generic Terms	physical education	implementation	emotional wellbeing, mental balance	fitness, training, excertion	inequality, imbalance, disparity	teaching, students, teachers
German Terminology	(qualitativer) Sportunterricht, Schulsport	Projekt, Intervention, Programm	psychische Gesundheit, psychisches Wohlbefinden	körperliche Aktivität, Sport, Bewegung	Inklusion, Integration	Schul-basiert, Primarschule, Sekundarschule, Schule

Search String PubMed:

(Physical Education and Training[mh] OR quality physical education[tiab])

AND

(schools[mh] OR school*[tiab])

AND

(((("randomized controlled trial"[pt] OR "controlled clinical trial"[pt] OR "randomized"[tiab] OR "placebo"[tiab]) OR ("clinical trials as topic" [mesh:noexp]) OR (randomly [tiab] OR trial [ti])) NOT (animals [mh] NOT humans [mh]))

Search String EBSCO Host:

("Physical Education"

AND

(MH Training+) OR (TI "quality physical education" OR AB "quality physical education"))

AND

((MH schools+) OR (TI school* OR AB school*))

AND

(((((PT "randomized controlled trial") OR (PT "controlled clinical trial") OR (TI randomized OR AB randomized) OR (TI placebo OR AB placebo)) OR ((MH "clinical trials as topic")) OR ((TI randomly OR AB randomly) OR (TI trial))) NOT ((MH animals+) NOT (MH humans+))).

After completing the search strings, the procedure followed the PRISMA Flow method.

2.1.2 Processing of the Search Results

The PRISMA Flow diagram depicts the flow of information through the different phases of a systematic review. Although this BSc Thesis is not a *systematic* review as restrictions were made to limit the number of results, the Prisma Flow Diagram was still determined to be suitable for this review. The PRISMA Flow diagram maps out the number of records identified, included and excluded, and the reasons for exclusions (Page et al., 2021) as seen in Figure 2 below.
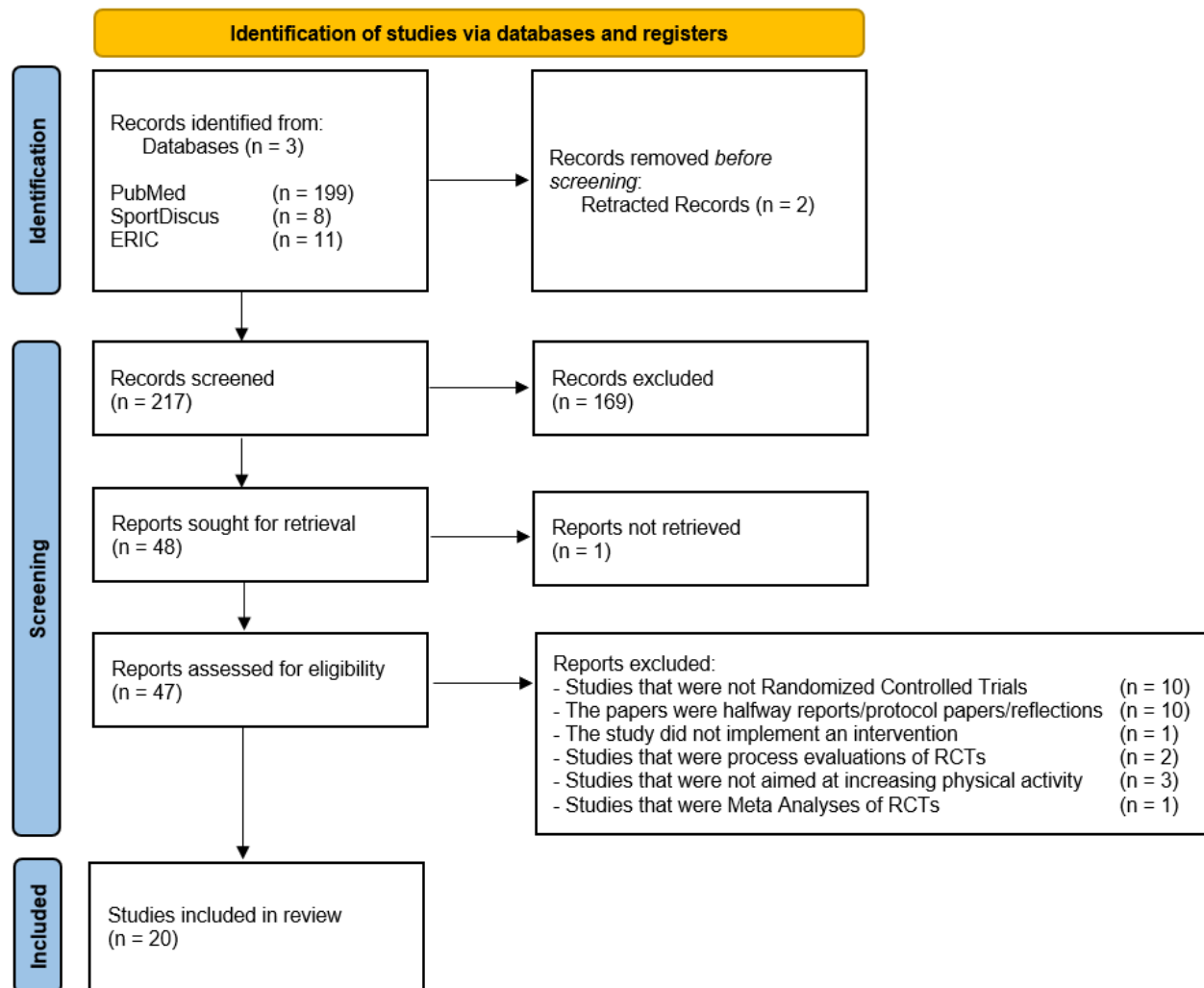
Identification of studies via databases and registers

Identification

Records identified from:
Databases (n = 3)

PubMed (n = 199)
SportDiscus (n = 8)
ERIC (n = 11)

Records removed *before screening*:
Retracted Records (n = 2)

Screening

Records screened
(n = 217)

Records excluded
(n = 169)

Reports sought for retrieval
(n = 48)

Reports not retrieved
(n = 1)

Reports assessed for eligibility
(n = 47)

Reports excluded:
- Studies that were not Randomized Controlled Trials (n = 10)
- The papers were halfway reports/protocol papers/reflections (n = 10)
- The study did not implement an intervention (n = 1)
- Studies that were process evaluations of RCTs (n = 2)
- Studies that were not aimed at increasing physical activity (n = 3)
- Studies that were Meta Analyses of RCTs (n = 1)

Included

Studies included in review
(n = 20)

Figure 2 Research Flow Diagram, prisma-statement.org (modified by author)

The identification process of PRISMA flow allowed for a careful selection of literature before working any further on it. The identified records were transferred to Zotero (a reference management software) and checked for eligibility and duplicates.

In the screening process, all the resulting records were screened in three steps. First, they were broadly screened for being mistakenly identified. Second, they were sought for retrieval and any records that were not accessible were excluded. Third, reports were checked for eligibility based on inclusion and exclusion criteria which were defined in accordance with the research questions of the thesis. The resulting studies were carefully analysed in detail. The inclusion and exclusion criteria of this thesis were the following:

Inclusion Criteria

- The study applied one or multiple interventions in the style of an RCT

- The intervention/interventions applied were school based

- The applied intervention/interventions had the goal of combating one or more of the three current global health crises defined by the WHO

Exclusion Criteria

- Any studies that did not fulfil all three inclusion criteria were excluded
- Halfway reports, process evaluations of RCTs, protocol papers, or reflections were excluded

2.1.3 Analysis of Studies

All the included studies were analysed in detail and summarized in a table (see Table 2 in Chapter 2.2.). It exclusively contains the information that helps to answer the research questions of this thesis. The categories of the table are:

- Author and Year of Publication
- Study Design
- Demographic Parameters
- Intervention Description and Method
- Assessment of Parameters
- Number of Participants
- Timespan of Intervention
- Significant Results and Topically Relevant Results from Discussion

All included studies in Table 2 followed standard protocol for the measurement of anthropometric data unless indicated otherwise. The standard protocol to measure height is to measure in duplicate to the closest 0.1 cm. The standard protocol to measure weight is to measure in duplicate to the closest 0.1 kg. The demographic data of the participants was either available to the research team from the respective schools or self-declared by the participants/the participants' parents through a form unless indicated otherwise.

2.2   Overview of the Included Studies

Table 4 Overview of the Included Studies

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter-vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Arlinghaus et al. (2021) USA	parallel RCT	Mean Age and/or School Level: 12.10 +/- 0.63, middle school Sex: 53% female, 47% male Weight Status: 48.02% overweight/obese Socioeconomic status: >85% eligible for free/reduced school meals Racial diversity: 100% Hispanic American	Total n = 222 **IG Weekday n = 118** CG Weekday n = 75 **IG Weekend n = 76** CG Weekend n = 60	Description: The intervention was a circuit-based PA intervention according to SAAFE (Supportive, Active, Autonomous, Fair, Enjoyable) principles with the **goal of increasing participants' daily MVPA.** Method: Circuit-based aerobic and strength training exercises for 45min daily during the school week. Participants were provided with ongoing feedback regarding form and procedure. There was a high emphasis on participant autonomy and flexibility according to the participants' fitness levels. Games were intermixed to provide some joy and keep the participants engaged.	45 minutes 5x/week 6 months	Daily minutes of MVPA were assessed using accelerometers (ActiGraph GT1M) worn on the right hip	Weekday: Overall IG increased minutes of MVPA compared to CG over 6 months (p<0.01) Stratified by sex only Girls increased MVPA compared to IG (p<0.01) Healthy weight students increased minutes of MVPA compared to CG (p<0.05) Weekend: Overweight students in the IG increased MVPA compared to overweight students in the CG (p<0.05) zBMI: zBMI decreased for obese students in IG group compared to CG over 6 months (p<0.05)

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter-vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Chan et al. (2019) China	cluster RCT	Mean Age and/or School Level: 8.4 +/- 0.56, grade 3 primary school Sex: 68% female, 32% male Weight Status: - Socioeconomic status: - Racial diversity: -	Total n = 276 **IG n = 147** CG n = 129 Teachers n = 10 Five participating primary schools	Description: Assessment for Learning (AfL) and FMS (fundamental movement skills) teacher-led intervention during the regular PE lessons **to increase participants' FMS competency and assess the participants' perceived physical competence, perceived movement skill competence, enjoyment of PE, and perceived teacher support**. Method: AfL means that FMS criteria are made visible to participants and that they are assessed through questioning and feedback, as well as peer- and self-review. The intervention was conducted during the regular PE lessons (1-2 lessons/Week, 45-70min) for a total of 550 minutes.	550 minutes 6 months (September 2015 - February 2016)	FMS competence for horizontal jump, hop, skip, overhand throw, catch and dribble were assessed through the Test of Gross Motor Development (TGMD-3) Perceived physical competence, perceived movement skill competence, enjoyment of PE, and perceived teacher support were self-assessed by the students. The participants' self-evaluation of their athletic ability was assessed through the 6-item "Athletic Competence" subscale of the Self-Perception Profile for Children (SPPC).	IG improved locomotor skills compared to CG (p=0.004) IG improved FMS competence compared to CG (p=0.001) Perceived teacher support was higher in the IG compared to CG (p=0.047) Perceived physical competence was higher in the IG compared to CG (p=0.029) Teachers reported high satisfaction from the 6-hour workshop (4.9 out of 5 stars)

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter-vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Chen et al. (2021) USA	cluster RCT	Mean Age and/or School Level: 3rd, 4th, 5th grade Sex: - Weight Status: - Socioeconomic status: under-privileged Racial diversity: 70.1% Black or African American 18.7% White 8.4% Hispanic or Latino 2.8% Other	Total n = 3'734 **IG n = 1'749**, 15 schools CG n = 1'985, 15 schools 30 participating primary schools	Description: The Science, PE & Me! (SPEM) curriculum conducts PA experiments as lived experiences **to increase knowledge of cardiorespiratory fitness, muscular function & health, and flexibility & nutrition and to increase the students' PA through a heightened motivational response**. The intervention is based on the 5 "E" instructional system: engagement, exploration, explanation, evaluation, and elaboration. Method: The teachers received a 3-day training to implement the SPEM curriculum correctly. Each lesson starts with an engagement activity to induce enjoyment, followed by an experimental activity to entice curiosity, and finished with an elaboration activity where students do collaborative tasks to learn from each other.	30 less-ons per grade for grades 3, 4, and 5 = 90 total lessons	Motivational response was assessed through 15-item Situational Interest Scale-Elementary (SIS-E) that measures novelty, challenge, attention demand, exploration, and instant enjoyment	IG had higher latent means for attention, challenge, exploration, enjoyment, and novelty compared to CG Effect sizes for attention, challenge, exploration, enjoyment, and novelty were low to moderate in favour of IG compared to CG

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter-vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Ha et al. (2020) China	cluster RCT	Mean Age and/or School Level: 14.4 +/- 0.78, Grade 8 secondary school Sex: 69% female, 31% male Weight Status: - Socioeconomic status: - Racial diversity: -	Total n = 667 **IG n = 311** CG n = 356 Teachers n = 31 26 participating secondary schools	Description: The intervention was the Self-determined Exercise and Learning for FITness (SELF-FIT) intervention to increase children/adolescents' MVPA and motivation in school PE. This intervention was based on principles of self-determination theory (SDT) to **heighten their intrinsic motivation through the satisfaction of their needs of autonomy, competence, and relatedness.** Method: The intervention consisted of three components. First, the teachers of the intervention group underwent two half-day workshops to increase their knowledge of SDT and to learn the SAAFE teaching strategies. The second component was the use of "fitness dice". Fitness dice are dice with cards placed on each side containing an exercise from one of four types (cardiovascular fitness, upper body muscular strength and endurance, lower body muscular strength and endurance, and flexibility) and are fully customisable. The third component was to play upbeat music during the PE lessons to increase enjoyment.	37 PE lessons over the course of one school-year	Time spent in MVPA during school PE and leisure time PA at baseline and follow-up were assessed with an accelerometer worn on the hip (ActiGraph GTX-3+) Students' need satisfaction for competence, autonomy, and relatedness was assessed through a 20-item questionnaire utilising a 7-point scale created by previous researchers (Ng et al.) Autonomous and controlled motivation were assessed through the Perceived Locus of Causality Questionnaire Psychological well-being of the students was assessed through an 8-item questionnaire developed by previous researchers (Diener et al.)	Percentage of time spent in MVPA increased over time in the IG compared to baseline The intervention increased the females' motivation for PE Teacher need-supportiveness did not increase in IG compared to CG Without the application of the intervention, students' autonomous motivation for PE declined

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter-vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Lander et al. (2017) Australia	cluster RCT	Mean Age and/or School Level: 12.47 +/- 0.34, Grade 7 secondary school Sex: 100% female Weight Status: - Socioeconomic status: - Racial diversity: -	Total n = 190 **IG n = 87** CG n = 103 Teachers n = 8 Four participating secondary schools	Description: This study aimed to assess the effectiveness of a teacher-led intervention aimed at **increasing adolescent girls' FMS competency to counter the age-typical decline of PA**. Method: The intervention consisted of two main components. Component one was extensive 4-part teacher training. There was a 4-hour workshop, teachers were provided with written resources, teachers were observed during three lessons and had three post-observation consultations, and ongoing support during the observation. Component two was the implementation and individual (on a class level) modification of the assigned PE curriculum (90min/week) for twelve weeks based on the results of the Canadian Agility and Movement Skill Assessment (CAMSA) which was done three times after two, six, and twelve weeks.	90 min/week Twelve weeks	Assessment of the girls' FMS competency through the Canadian Agility and Movement Skill Assessment (CAMSA) FMS competency was rated by experts for 6 FMS (catch, overhand throw, kick, sprint run, dodge, and vertical jump) Teacher competency was assessed through a modified version of Morgan & Hansen's Primary School PE questionnaire with a 6-point scale Teacher satisfaction was evaluated with a questionnaire with a 6-point scale	IG increased locomotor skills (p=0.04), object control skills (p<0.001), and total skill (p=0.02) compared to CG IG Teachers increased their confidence in teaching and evaluating FMS compared to CG IG Teachers decreased their perception of barriers to effective FMS instruction and assessment compared to post-intervention CG

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter-vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Lima et al. (2022) Brazil	cluster RCT	Mean Age and/or School Level: 14-16 years old (~10% older or younger than 14-16), High School Sex: 56.4% female, 43.6% male Weight Status: - Socioeconomic status: - (Country of Global South) Racial diversity: -	Total n = 1'279 **IG1, IG2, IG3 in total n = ~1'000** CG n = ~250 Exact n for CG and IGs cannot be inferred from the paper Eleven participating high schools	Description: This study investigated the effects of **three interventions targeting the reduction of depressive symptoms** in adolescents and the mediating effect of social isolation, anxiety, and sleep quality. Method: The study conducted three different interventions: 1: Doubling PE-classes for 1h40min/week to 3h20min/week. 2: Five 4-hour teacher workshops to increase teacher's pedagogical and health-related knowledge plus discussions of how to best implement the content of the workshops in the PE classes. 3: Combination of interventions 1 and 2.	6 months including holidays (April-June & August - October 2017)	Depressive symptoms of adolescents were assessed with the Depression Scale of the Center for Epidemiologic Studies from 0 to 60 and a score above 23 indicating depressive symptomology Social isolation was assessed through the 17 question Social Isolation Questionnaire (SIQ) in the domains of "Feeling lonely or excluded", "Friendship", and "Family Support" Social anxiety was assessed with the 26 item Social Anxiety Scale for Adolescents (SAS-A) Sleep quality was assessed through the 19 item Pittsburgh Sleep Quality Index (PSQI) that ranges from 0 to 21 points and a higher score indicating lower sleep quality	IG2 presented lower depressive symptoms, exhibited lower social isolation, and lower poor sleep quality compared to their peers in the control group after the intervention None of interventions affected social anxiety Social isolation mediated 32% of the intervention's effects on depressive symptoms IG2 (93%) and IG3 (54%) lowered the risk of developing high depressive symptomology compared to CG All IGs were not effective in changing depressive symptomology of adolescents with high depressive symptomology

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter- vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Müller et al. (2019) South Africa	cluster RCT	Mean Age and/or School Level: 11.2 years +/- 0.9, Grade 4 Sex: 50% female, 50% male Weight Status: - Socioeconomic status: Quintile 3 (rather poor) (Country of Global South) Racial diversity: Coloured (mixed race ancestry) Black African	Total n = 746 **IG n = 300** CG n = 446 Eight participating primary schools	Description: The Disease, Activity, and Schoolchildren's Health (DASH) multidimensional physical activity intervention aimed to **determine the effects of such an intervention on BMI, skinfold thickness, and fitness** in South African children. The intervention was developed in collaboration with education authorities, teachers, and students from the participating schools. Method: The study conducted three different interventions: 1: Additional PA consisting of 2x40min PE & 1x40min dancing-to-music per week, daily in-class activity breaks, and school adaptations to make it a more friendly school environment. The research team optimised the intensity between the two 10-week interventions. (2: Health and Hygiene Education, not further elaborated due to missing relevance to the research questions of this thesis) (3: Nutrition Education programme, not further elaborated due to missing relevance to the research questions of this thesis)	2x40 min/week + 1x40 min/week 2x10 weeks (July- September 2015 and February- April 2016)	Cardiorespiratory fitness was assessed through a 20-m shuttle run Height and weight were measured to calculate BMI Skinfold thickness was measured at triceps and subscapular position with a Harpenden skinfold calliper	IG zBMI increased less (p<0.001) and thickness of skinfolds increased less (p=0.007) from baseline to endline between IG and CG No detectable effects on cardiorespiratory fitness

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter-vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Nathan et al. (2020) Australia	2x2 factorial cluster RCT	Mean Age and/or School Level: 7.99 +/- 2.04, Kindergarten to Grade 6 Sex: 49.5% female, 50.5% male Weight Status: - Socioeconomic status: - Racial diversity: -	Total n = 1'948 **IG n = 1'169** CG n = 693 Teachers n = 107 Twelve participating schools/kind ergarten	Description: This study applied a multi-strategy intervention **to assess the impact of improving teachers' implementation of a school physical activity policy on student PA levels.** Method: The six strategies to increase the teachers' implementation of the prescribed 150min/week organised PA during PE classes or class-based activities were selected to address known barriers to policy implementation. 1: Mandate change: Meetings between the "support officers" (from the study team) with the principal/school executives to communicate the importance of a proper implementation of the school PA policies 2: Identify and prepare champions: At least two champions per school were nominated to lead their school's policy implementation 3: Develop and distribute educational materials: Champions received an intervention manual and teachers received support materials. 4: Conduct educational outreach visits: Face-to-face meetings between the teachers, school champions, and support officers to clarify the champions' and teachers' respective roles 5: Provide ongoing consultation: Support officers provided remote support for the champions twice per term 6: Centralised technical support: Support officers provided technical	9 months (January to September 2017)	PA was measured using ActiGraphGT3X+ accelerometers worn on the non-dominant wrist Amounts of time spent in MVPA or sedentary behaviour were derived from accelerometer data Teachers' implementation of the 150min/week PA policy was assessed through a logbook that teachers filled out at the end of each day when on the days where the children wore the accelerometers	IG increased minutes spent in MVPA/day more than the CG from baseline to follow-up (p<0.001) (also for boys and girls separately (p=0.001 for both)) IG daily sedentary behaviour decreased more than CG from baseline to follow-up (p=0.02) Adjusted for sex, only girls' sedentary behaviour significantly decreased (p=0.02) Teachers scheduled 36.6 minutes more PA time on average per week at follow-up compared to baseline Overall significant improvements in student daily PA and teachers' implementation of PA policy

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter-vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
				assistance to schools to support policy implementation			

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter-vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Ryom et al. (2022) Denmark	cluster RCT	Mean Age and/or School Level: 11.55 +/- 0.52 Sex: 46.9% female, 53.1 male Weight Status: - Socioeconomic status: - Racial diversity: All ethnic minority	Total n = 1'122 **IG n = 944** IG1 n = 644 IG2 n = 300 CG n = 178 CG1 n = 122 CG2 n = 56 154 participating schools	Description: The "11 for Health" intervention aimed to **raise the health knowledge, well-being, and fitness in ethnic minority 10- to 12-year-olds** to decrease the additional burdens of ethnic minorities in Denmark. Method: Teachers were educated prior to the intervention during a 2 1/2-day training course. The content of the course were demonstrations of the required football skills, discussions of the health-related topics and explanations of the tests. The intervention of 2x45min/week consisting of health education, football drills, and small-sided games was implemented during the regular PE lessons or any other subject but were separated by 40 hours to optimise physiological training effects. The IG and CG were subgrouped into physically active (IG1/CG1) and physically inactive (IG2/CG2).	2x45 min/week 11 weeks	Health knowledge was assessed pre- and post-intervention through a 34-item questionnaire with true/false/don't know and multiple-choice questions Well-being was assessed through a shortened Danish version of the KIDSCREEN-27 5-point Likert-scale questionnaire to self-report well-being Physical fitness was assessed through resting blood pressure and heart rate measured after an 8-minute rest in supine position Body mass, muscle mass, and body fat were assessed using the InBody 270 body composition analyser Lower-body strength was measured through two standing long jumps performed with hands on the hips after resting in a 90 degree squat position for two seconds Cardiovascular fitness was estimated using the YYIR1C test (children's Yo-Yo Test)	Perception of school-environment increased for IG2 compared to IG1 (p=0.04) BMI levels of IGs were lower than BMI levels of CGs post intervention IG2 increased Yo-Yo test and VO2max performance compared to CG2 (these results might be influenced by a higher mean height of the IG2) Enjoyment of the program was moderate-to-high by all the participants not dependent on sex

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter- vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
						Postural balance was assessed through the Stork balance stand test barefoot (one legged balance test on the ball of the foot)	

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter-vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Sacheck et al. (2021) USA	cluster RCT	Mean Age and/or School Level: 8.7+/- 0.62 Sex: 55.98% female, 44.02% male Weight Status: ~ 40% over- or underweight Socioeconomic status: 55.28% eligible for free/reduced school meals Racial diversity: 40.56% Non-Hispanic White 39.52% Hispanic 9.55% Black 10.37% Multiracial/Other	Total n = 979 **IG n = 680** IG1 n = 369 IG2 n = 311 CG n = 299	Description: The "Fueling Learning Through Exercise" study applied the two winning interventions of a nationwide competition among schools to **identify scalable and sustainable school-based interventions that promote children's daily MVPA on school days**. Method: 1: "100 Mile Club" The aim of this intervention is to walk or run for 100 miles (160km) in total over the course of one school year. This can be before, during, or after school. Champions (schoolteachers) were nominated to log the students' miles and help with intervention implementation. 2: "Choosing Healthy and Active Lifestyles for KIDS/Just Move" A classroom-based PA break intervention where teachers were provided with activity cards containing high- and low-intensity exercises for the 5- to 15-minute breaks between or during school lessons. The cards also contained ideas to implement exercises during regular lessons.	2 school years	Teacher education for the "100 Mile Club" teachers were assessed through a training manual, monthly e-mail communications, and annual training Teachers assessed the PA-supporting policies, PA practices, recess, classroom-based PA, and before- and after-school programming through a 14-item survey Daily MVPA was assessed through waist-worn accelerometers (ActiGraph GT3X+ or wGT3X-BT)	The percentage of children meeting the recommended amount of daily PA increased in IG1 and IG2 but remained steady in CG Male students compared to female students and 3rd graders compared to 4th graders spent more time in MVPA School-time MVPA was steady to slightly increasing in IG1 and IG2 and declining in CG from midpoint to endpoint No difference by sex, baseline weight, or baseline daily MVPA Both programs were successful in preventing a decline in school-time MVPA but were not enough to help children reach the recommended amount of daily MVPA Interventions were not successful at increasing school-time MVPA during the first school year but successful at preventing a drop during the second year compared to CG

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter-vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Schneider et al. (2017) USA	parallel cohort RCT	Mean Age and/or School Level: 11.03 +/- 0.38, Grade 6 Sex: 52% female, 48% male Weight Status: - Socioeconomic status: - Racial diversity: 48% Latino 19% Non-Latino White 12% African American 10% Asian 11% Multiracial/Other	Total n = ? (no CG data available) **IG n = 144** IG1 n = 74 IG2 n = 70 CG = n/a	Description: This study evaluates the impact of a theory-based personalised exercise prescription to **enhance motivation for being active and physical activity participation among adolescent reluctant exercisers.** Participants were categorised as either reluctant or latent exercisers (predisposed to either negative or positive affect during exercise respectively). Method: The study conducted two parallel interventions: 1: Students were encouraged to exercise at a moderate-to-high intensity during their regular PE according to an individually calculated heart rate. 2: Students were encouraged to exercise at a level that "feels good".	4 x 8 weeks over the course of four school-years from 2011-2015	Cardiorespiratory fitness was assessed through a ramp-type progressive cycle ergometer test Sugared beverage consumption was assessed with a 4-item questionnaire about the previous seven days Screen time was assessed with a 2-item questionnaire Intrinsic motivation was assessed through 4 items from the Behavioural Regulations in Exercise Questionnaire (BREQ) to assess intrinsically-motivated reasons for exercising on a 7-point scale PA was assessed with an accelerometer worn on the left hip (ActiGraph)	Boys were more physically active than girls ($p<0.001$) and had a higher absolute and relative VO2max (both $p<0.05$) compared to girls No differences across exercise intensity groups, affective styles, or interaction between the two Post-intervention MVPA revealed no differences between IG and CG Exercise intensity manipulation (IG2) had no effect on intrinsic motivation Results failed to support that reluctant exercisers in IG2 would have a greater motivational benefit than in IG1

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter-vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Skoradal et al. (2018) Faroe Islands	cluster RCT	Mean Age and/or School Level: 11.1 +/- 0.3 Sex: 48.2% female, 51.8% male Weight Status: - Socioeconomic status: - Racial diversity: -	Total n = 392 **IG n = 292** CG n = 100 Twelve participating schools	Description: The FIFA "11 for Health" physical activity intervention based on football training and 3v3 games aimed at **improving central health markers in Faroese schoolchildren and increase general health knowledge** through the incorporation of PA in the educational system. Method: Teachers visited a 2-day instructor course pre-intervention containing information about the program and detailed descriptions of each session. The intervention consisted of 2x45min/week additional football-related PA during either math or English classes with the main physical stimulus being small-sided games. The regular PE classes were continued as normal.	11 weeks starting in January 2017	Body composition was measured using the InBody 230 multi-frequency body composition analyser Blood pressure and heart rate were measured using standard procedures after resting in a quiet dark room for 15-20 minutes Postural balance was assessed using the Standing Stork Balance Test (SSBT) Horizontal Jumping performance was tested through a long jump with hands placed on the hips after holding a squatting position for 2 seconds Cardiorespiratory fitness was assessed with the YYIR1C (children's Yo-Yo test)	Postural balance performance increased in IG and decreased in CG (p<0.05) Horizontal jumping test improved in IG compared to CG (p<0.05) Height, body-weight, and lean body mass (LBM) increased more, and SBP decreased more in IG compared to CG (p<0.05) Horizontal jumping and postural balance performance increase more in IG girls compared to CG girls (p<0.05) SBP decreased in IG and increased in CG for the boys (p<0.05) LBM, BMI, and body mass increased more in girls of the IG than boys of the IG The intervention lowered SBP, improved postural balance and jump performance and increased lean body mass in the IG post-intervention and intermittent running performance (YoYo-test) improved also

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter-vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Sparks et al. (2017) Australia	cluster RCT	Mean Age and/or School Level: 13.5 +/- 1.58, Grade 7-10 Sex: 50% male, 50% female Weight Status: - Socioeconomic status: - Racial diversity: -	Total n = 382 **IG n = 194** CG n = 188 Teachers n = 18 Four participating high schools	Description: Based on findings that teachers are central social agents for their students' PE motivation, this study conducted a teacher education intervention **to increase teachers' interpersonally involving training practices** based on SDT **to improve students' in-class experience.** Method: The intervention was a 3-hour teacher training session, educating teachers about need-supportive teaching, relatedness-supportive practices, and active-learning exercises. The teacher training targeted at allowing teachers to reflect their own behaviour and build on their "good" existing practices. Then, the 2-3 weekly 50min PE lessons were modified to be based on empirical evidence of relatedness-supporting PE teaching.	3 months (September to November 2015)	Relatedness-support was assessed through a 35-item 7-part (individualized conversation, task-related support, promoting cooperation and teamwork, teacher enthusiasm, teacher awareness, teacher car, and general friendly communication) questionnaire utilising a 4- or 5-point scale Enjoyment was assessed through a 4-item 5-point version of the "Sport Enjoyment Scale" (SES) Self-efficacy, other-efficacy, and RISE-appraisals were assessed through a 9-item scale asking about rating and estimating their confidence/confidence and perception of the PE teacher Motivation was assessed through a 20-item 5-part (intrinsic motivation, identified regulation, introjected regulation, external regulation, amotivation) questionnaire utilising a 7-point scale	Perceived relatedness-support increased in the IG over time (p=0.003) Enjoyment of PE classes increased over time in the IG (p=0.002) and compared to the CG (p=0.009) Other-efficacy (p=0.002) and peer-focused RISE (p=0.002) increased from baseline to post-assessment Students reported more confidence in teacher who received the teacher-training sessions (p=0.031) and reported a higher peer-focused RISE (p=0.019) compared to CG IG students' perception of relatedness support was stimulated which resulted in more positive perceptions of enjoyment, confidence in the teacher's abilities, and more favourable estimations of one's classmates' confidence in one's abilities.

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter-vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Sutherland et al. (2016) Australia	cluster RCT	Mean Age and/or School Level: 13, Grade 7 Secondary School Sex: 52.5% female, 47.5% male Weight Status: - Socioeconomic status: Disadvantaged Racial diversity: -	Total n = 1'150 **IG n = 873** CG n = 631 Teachers n = 53 Ten participating secondary schools	Description: The "Physical Activity 4 Everyone" study conducted an intervention to **reduce the decline of daily MVPA among disadvantaged adolescents** over the course of 24 months. The intervention was based on the WHO's "Health Promoting Schools" framework concerned with the school environment, school curriculum, and partnerships. Method: The intervention consisted of 7 parts: 1: Teacher training to maximise students' PA during PE. 2: Development and monitoring of student PA plans for PE lessons. 3: Additional 10-week sport program to promote lifelong PA skills and knowledge. 4: Development/modification of school policies. 5: PA programs during school breaks 6: Promotion of community PA providers at schools. 7: Newsletters promoting PA and community PA providers were sent to parents each term. In addition, there were six intervention implementation strategies to facilitate the intervention implementation at the schools	2 school years	MVPA was assessed using the ActiGraph GT3X+ and GT3X accelerometers Implementation of strategies 1 and 2 was assessed through a teacher survey at follow-up Implementation of strategies 1, 2, and 4 was assessed trough a student survey at follow-up	Change in daily MVPA between groups was in favour of the IG (p<0.002), both sexes increased their daily MVPA Daily minutes of VPA, daily minutes of MPA, and total daily accelerometer counts increased in IG from baseline to follow-up 67.6% of teachers reported that assisting students to develop personal PA plans was useful

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter- vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Sutherland et al. (2017) Australia	cluster RCT	Mean Age and/or School Level: Grade 3 - grade 6, elementary school Sex: ~50% female, ~50% male Weight Status: - Socioeconomic status: Disadvantaged Racial diversity: -	Total n = 7'718 **IG n = 4'299** CG n = 3'419 Teachers n = 382 46 participating elementary schools	Description: This study is an adapted version of an efficacious PA intervention **to increase students' daily MVPA *at scale*** compared to many interventions that are done under ideal conditions and administered by experts. Method: The intervention was based on the "SCORES" program that was successful at increasing students' daily MVPA by 12 minutes, increasing students' FMS and increasing cardiorespiratory fitness. The components of the intervention were implementing school committees and policy reviews, quality PE lessons, student-led recess and lunchtime PA, provision of equipment, and linkage with the parents and community sporting organisations.	7 months	Daily minutes of MVPA were assessed through an ActiGraph GT3X+ accelerometer worn on the hip Quality of PE lessons was assessed through the SAAFE checklist on a 5-point Likert-scale Implementation support strategies, acceptability, and perceived usefulness were assessed through teacher surveys	Increase of daily VPA (p=0.004) but not MPA between IG and CG Increase of school MVPA between IG and CG (p=0.05) and non-significant slight increase of daily MVPA between IG and CG Higher quality of PE lessons in IG compared to CG (p<0.001) All quality components of the SAAFE checklist were higher in IG teachers compared to CG teachers (p<0.001) Compared to a previous trial where the increase of daily MVPA was 12 min, this scaled trial only increased daily MVPA by 2 min (in half the time). School-based interventions have often reported an increased effect from mid-intervention to follow up than from baseline to mid-intervention.

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter- vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Tian et al. (2017) South Africa	partially RCT	Mean Age and/or School Level: 12-13, Grade 7 Sex: 70% female, 30% male Weight Status: - Socioeconomic status: Low SES Racial diversity: multiple ethnic groups	Total n = 110 **IG students n = 40** CG students n = 70 Teachers n = 4 Two participating secondary schools	Description: In light of the low PA levels in South African school children due to the absence of PE in school curricula, this study **evaluated the effects of a weekly enhanced quality PE programme on the PA levels of school children** and was based in part on SDT. Method: The intervention was a 12-week PE intervention programme with five quality-enhancing components compared to the regular PE curriculum: 1: Using well-trained PE teachers 2: Homework activities 3: Using a reward-system 4: Using improvised apparatus 5: Monitoring of the PA intensity	60 min/week 12 weeks	Student PA levels were assessed using the CLASS questionnaire (30 items) Body-fat percentage was measured on triceps and subscapular skinfolds (instrument n/a) Learner's compliance was assured and assessed through the grading of their PE-lesson performance Intensity of PA was self-measured every five minutes by students at the radial pulse (wrist) or carotid pulse (neck)	Time spent in MPA (p=0.028), VPA (p=0.018), and total PA (p=0.017) increased in the IG compared to CG Time spent in sedentary behaviour decreased in the IG compared to CG (p=0.014) Time spent in MPA, VPA and total PA increased between pre-test and post-test Sedentary time decreased compared to CG for girls but not for boys

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter- vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Tong et al. (2022) China	RCT	Mean Age and/or School Level: Grade 2 - Grade 11, Primary School, Secondary School, High School Sex: 47% female, 53% male Weight Status: - Socioeconomic status: - Racial diversity: -	Total n = 596 **IG n = 308** CG n = 288 Teachers n = 50 Three participating schools (one of each level)	Description: This study applied a multi-component intervention based on SET **to increase students' fitness levels** with the "Know It, Do It, Love It" Active School Plan (KDL-ASP). The KDL-ASP is designed to **increase health knowledge and improve motor abilities** (Know it), **develop healthier behaviours** (Do it), and **form sports hobbies** and benefit for life (Love it). Method: The intervention was based on five strategies: 1: Active Classroom 2: Active Playground 3: Energetic Teachers 4: Energetic Students 5: Dynamic Environment The KDL-ASP requires daily PA between 20-60 minutes at low to high heart rates, and varying exercise types.	9 months including holiday breaks and closures due to Covid-19 (September 2019 to June 2020)	3-day teacher training on the KDL-ASP by experts Lung capacity was measured through an automatic electronic spirometer Running speed was measured through a 50m sprint Flexibility was measured using the sit-and-reach test Strength was assessed through the number of push ups and pull ups done in one minute Endurance was measured through a 50x8m shuttle run and a 1000m/800m run	Grade 2 IG girls' speed (p<0.05) and total fitness score (p<0.05) improved compared to CG Grade 3 IG girls' endurance improved compared to CG (p<0.05) Grade 4 boys' strength (p<0.01), endurance (p<0.05), and total fitness score (p<0.05) improved compared to CG Strength improvement was higher among boys than among girls (p<0.01) Having multiple types of PA at school is important to improve physical fitness Solely relying on PE to increase children's/ adolescents PA is unrealistic without a functioning global PE concept Significant differences between the two genders' psychological needs, motivation, and satisfaction

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter- vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Tymms et al. (2016) England	2x2 factorial cluster RCT	Mean Age and/or School Level: 11.85 +/- 0.46, Grade 7 Secondary School Sex: 47.5% female, 52.5% male Weight Status: - Socioeconomic status: 12%-23% eligible for free school meals Racial diversity: 96% White 4% Other	Total n = 1'391 **IG n = 999** IG1 n = 322 IG2 n = 340 IG3 n = 337 CG n = 392 60 participating secondary schools	Description: This study tested two parallel interventions aimed at **increasing the physical activity and well-being of secondary school students** to counteract the typical decline of PA during adolescence and address the concerns for poor mental health in school children. Method: Teachers underwent brief 2-hour teacher training pre-intervention. The peer-mentoring intervention (IG1) involved year 9 students acting as mentors to the year 7 students for 20-30 minutes weekly over a 6-week period where the mentors helped the mentees to complete educational PA tasks and encouraged them to critically reflect the task. The participative learning intervention (IG2) aimed to educate the students about their own PA behaviour and how it is influenced by various factors. This happened during one weekly lesson over six weeks for the year 7 students. A third intervention group (IG3) received both intervention treatments.	6 weeks	PA was measured using ActiGraphGT3X+ accelerometers on the right hip Spatial location data was assessed through a GPS receiver Well-being was assessed using the KIDSCREEN-27 questionnaire that includes the domain of physical well-being, psychological well-being, autonomy and parent relation, peers and social support, and school environment	There were no statistically significant results from this study There was a small increase of MVPA in all three interventions. KIDSCREEN-27 scores slightly increased in the IG2 and slightly decreased in the IG1 and IG3 The study adds to the body of evidence that indicates that the impact of modest school-based interventions is small

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Intervention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Wassenaar et al. (2021) England	parallel group, superiority cluster RCT	Mean Age and/or School Level: 12.5 +/- 0.29, Grade 8 Sex: 55.9% female, 44.1% male Weight Status: - Socioeconomic status: ~17% eligible for free school meals Racial diversity: -	Total n = 16'017 **IG n = 7860**, mean cluster size of 171 CG n = 8157, mean cluster size of 174 93 participating schools	Description: This study applied a one-year HIIT-style VPA intervention to **increase physical fitness, cognitive performance and mental health**. This was done during the regular PE lessons to ensure scalability. Method: The intervention took place during the regular scheduled PE lessons (2x60min/week). Two elements were added to the regular PE lessons: 1: Ten minutes of warm up of which four minutes were in VPA 2: Three 2-minute bouts of VPA during the rest of the lesson. There was an additional 2h teacher training session of the teachers educating them about VPA, the benefits of increased PA levels in students, and guidelines of daily activity levels. Also, teachers had access to a website with videos demonstrating the intervention elements.	One academic year (September 2017 - June 2018)	Cardiorespiratory fitness was assessed through the 20-meter shuttle run test Cognitive performance was assessed using online, computer-based tests including tasks for processing speed, visual relational memory, and core executive functions (working memory, inhibition, and cognitive flexibility) Psychosocial problems were assessed through the Strength and Difficulties Questionnaire (SDQ) Self-esteem was assessed through the Physical Self-Description Questionnaire with a 7-point scale from low to high	There were no statistically significant results from this study for CRF, cognitive performance, or mental health There was low intervention compliance and high dropout rate, in part due to the large-scale nature of the study

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter- vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
Zhou et al. (2019) China	2x2 factorial cluster RCT	Mean Age and/or School Level: 12.66 +/- 0.56, grade 7 Secondary School Sex: 46.6% female, 53.4% male Weight Status: - Socioeconomic status: - Racial diversity: -	Total n = 680 **IG n = 510** IG1 n = 162 IG2 n = 180 IG3 n = 168 CG n = 170	Description: The SET-based Chinese Childhood Health, Activity and Motor Performance Study (Chinese CHAMPS) was a multi-faceted intervention to **maximise the opportunities for MVPA and increase physical fitness in schoolchildren**. Method: Modifications of school policies and the school environment were central tenets of the interventions. All intervention activities contained FMS, aimed to promote the sense of achievement, and decrease boredom during PA by offering new and engaging activities. Intervention 1 was a PE intervention, intervention 2 was a mandatory after-school intervention, and intervention 3 was a combination of both. PE teachers of the IGs underwent training to increase their confidence and abilities in delivering the adapted PE curricula and to modify their lessons according to the students' needs. Parents were engaged through WeChat (social media) to provide information about healthy home environments 2-3 times a week during the whole intervention.	8 months (August 2015 - June 2016	Cardiorespiratory fitness was assessed through a 20-m shuttle run Lower-limb muscle strength was assessed through a broad jump Abdominal and lower-back muscle strength were assessed through 1-min sit-ups Speed was assessed through 50m sprint Agility was assessed through T-test agility run Flexibility was assessed through sit-and-reach Core strength was assessed through plank Body-fat percentage was assessed through a bioelectrical impedance analysis PA and sedentary behaviour was measured though a hip-worn ActiGraph accelerometer (half of the IG) PA was estimated through chest-worn	All IGs significantly improved all PA/physical fitness measures at post-test compared to baseline and compared to CG with the highest effect in IG3, then IG1, then IG2 Body-fat percentage was significantly reduced in IG3 Sedentary behaviour decreased significantly and MVPA increased significantly on school days The multi-method approach (IG3) was the most effective which is in support of previous literature

Author/Year/ Country of Intervention	Study Design	Demographic Parameters	Participants	Intervention Description and Method	Timespan of Inter- vention	Assessment of Parameters	Significant Results and Topically Relevant Results from Discussion
						heart rate monitors (only 10 students)	

3 Results

3.1 Teacher Training

14 of the 20 studies incorporated teacher training and two of those 14 were centred around teacher training. In the other 12, teacher training was carried out so that the teachers were capable and confident in delivering the intervention to the participants. Out of the 14 studies that incorporated teacher training, 6 studies provided results about the teacher training. Two of the 14 studies did not produce any significant results.

Chan et al. (2019) found that the perceived teacher support was higher in the IG compared to the CG ($p=0.047$). Ha et al. (2019) found no increase of teacher need-support between IG and CG.

Lima et al. (2021) found that IG teachers increased their confidence in teaching and evaluating FMS compared to the CG and Sparks et al. (2017) found that students reported more confidence in teachers who received the teacher-training sessions ($p=0.031$). Sparks et al. (2017) also found that IG students' perception of relatedness support was stimulated which resulted in more positive perceptions of the teacher's abilities.

Chan et al. (2019) reported high satisfaction from teachers who did the 6-hour workshop (4.9 out of 5 stars) and Sutherland et al. (2016) reported that 67.6% of the teachers found that assisting the students to develop personal PA plans was useful.

Lima et al. (2021) found that IG Teachers decreased their perception of barriers to effective FMS instruction and assessment compared to the CG post-assessment.

Nathan et al. (2020) found that teachers scheduled 36.6 minutes more PA time on average per week at post-assessment compared to baseline.

Sutherland et al. (2017) found that all quality components of the SAAFE checklist were rated higher in IG teachers compared to CG teachers ($p<0.001$).

3.2 Fundamental Movement Skills and Locomotor Skills

Two out of the 20 studies targeted the improvement of FMS and locomotor skills.

Chan et al. (2019) found that the IG improved locomotor skills compared to the CG ($p=0.004$), that the perceived physical competence was higher in the IG compared to the CG ($p=0.029$), and that the IG improved FMS competence compared to the CG ($p=0.001$).

Lander et al. (2017) found that the IG increased locomotor skills ($p=0.04$), object control skills ($p<0.001$), and total skill ($p=0.02$) compared to CG. The authors highlight the large effect sizes on these parameters.

3.3 Psychological Aspects

3.3.1 Mental Health

Four out of the 20 studies aimed to improve the mental health of the participants.

Lima et al. (2021) found that the IG2 presented lower depressive symptoms, exhibited lower social isolation, and lower poor sleep quality compared to their peers in the control group at post-assessment. None of Lima et al.'s interventions affected social anxiety. Social isolation mediated 32% of the intervention's effects on depressive symptoms. Finally, they found that IG2 and IG3 lowered the risk of developing high depressive symptomology by 93% and 54% respectively compared to the CG, but the IGs were not effective in reducing the depressive symptomology of adolescents with pre-existing high depressive symptomology.

Sparks et al. (2017) found that other-efficacy (p=0.002) and peer-focused RISE (p=0.002) increased from baseline to post-assessment. The peer-focused RISE also improved between IG and CG in favour of the IG (p=0.019).

Tymms et al. (2016) found no significant results. However, the KIDSCREEN-27 scores slightly increased in the IG2 and slightly decreased in the IG1 and IG3.

Wassenaar et al. (2021) found no significant results for mental health.

3.3.2   Motivational Response and Enjoyment

Six of the 20 studies measured various aspects of motivation and enjoyment of their intervention. Four of the six studies found positive correlations between their interventions and their measured aspects of motivation and enjoyment respectively.

Chen et al. (2019) and Sparks et al. (2017) found that the IG had higher latent means for attention, challenge, exploration, enjoyment, and novelty compared to the CG and that the enjoyment of PE classes increased over time in the IG (p=0.002) and compared to the CG (p=0.009) (Sparks) respectively. Chen et al. (2019)'s effect sizes for those parameters were low to moderate in favour of the IG compared to the CG. Similarly, Ryom et al. (2021) found that the IG's enjoyment of the program was moderate-to-high by all the participants, and they found no differences stratified for sex.

Measuring for motivation, Ha et al. (2019) found an increased motivation of females for PE, Sparks et al. (2017) found that the perceived relatedness-support increased in the IG over time (p=0.003) and that this increase resulted in more positive perceptions of enjoyment, and more favourable estimations of one's classmates' confidence in one's abilities. In contrast, Schneider et al. (2017) found no effect of their intervention on intrinsic motivation in IG2, and Tong et al. (2022) found that the effect on girls correlated less with the intervention than boys, which resulted in differences between the satisfaction of psychological needs, motivation, and general satisfaction. These results are connected to conservative home environments in China by the authors. Schneider et al.'s results failed to show that reluctant exercisers in the IG2 would have a greater motivational benefit than the IG1.

3.3.3   Self-Determination Theory and Social-Ecology Theory

Seven studies focused on creating an intervention that was either based on tenets of SDT (Ha et al. (2019); Schneider et al. (2017); Sparks et al. (2017); Tian et al. (2015)) or SET (Sutherland et al. (2017); Tong et al. (2022); Zhou et al. (2019)).

Ha et al. (2019) found that without the application of the intervention CG, students' autonomous motivation to PE declined. Additionally, students' need satisfaction and autonomous motivation suggests that the intervention was more effective for girls than for boys. Sparks et al. (2017) showed that the IG students' relatedness-support was higher which resulted in higher levels of PE enjoyment and relatedness-supportive teachers were perceived as more competent.

Schneider et al. (2017) found no observable differences in intrinsic motivation for any of the affective style-exercise intensity pairing in relation to the reference group.

For SET, Tian et al. (2015) found that the quality enhancing components [teacher training and motivational strategies] in the PE intervention program were effective in increasing the participants' PA levels and that the application of SET should be further emphasized in future research. Sutherland et al. (2017) and Tong et al. (2022) did not elaborate on aspects of SET in their results or discussion but both implementations produced positive results.

3.4 Weight Status

3.4.1 BMI and zBMI

Four of the 20 studies aimed to reduce the participants' BMI.

Arlinghaus et al. (2020) found that the zBMI decreased more for obese students in IG group compared to CG over 6 months (p<0.05) and Müller et al. (2019) found that the IG zBMI increased less (p<0.001) from baseline to endline compared to the CG. Ryom et al. (2021) found that the BMI levels of the IGs were lower than BMI levels of the CGs at post-assessment. Skoradal et al. (2018) found that the BMI increased more in girls of the IG than boys of the IG.

3.4.2 Body Fat Percentage and Skinfold Thickness

Three out of the 20 studies looked at the skinfold thickness of participants.

Müller et al. (2019) found that skinfolds increased less (p=0.007) from baseline to post-assessment between IG and CG. Tian et al. (2015) and Ryom et al. (2021) measured body fat percentage but did not produce any significant results. Zhou et al. (2019) found that the body fat percentage was significantly reduced in all IGs compared to the CG (p<0.001).

3.5 Physical Fitness Parameters

3.5.1 Physical Activity and Sedentary Behaviour

Ten out of the 20 studies looked at increasing physical activity and/or decreasing sedentary behaviour. Eight of the ten studies measured and found significant results for MVPA, three of the ten studies measured and found significant results for VPA, and three studies measured MPA, two of which found significant results. Three studies measured sedentary behaviour, and all found significant results.

Arlinghaus et al. (2020) (p<0.01), Nathan et al. (2020) (p<0.001), and Sutherland et al. (2016; 2017) (p<0.002; p=0.05) found that the IG increased daily minutes of MVPA compared to CG from baseline to post-assessment. Nathan et al. (2020) and Sutherland et al. both found significant increases from IGs to CGs overtime for both sexes separately. In Arlinghaus et al. (2020), stratified by sex only girls increased MVPA compared to CG (p<0.01). Stratified by sex and age, Sachek et al. (2021) found that boys spent more time in MVPA compared to girls, and that 3rd graders spent more time in MVPA compared to 4th graders. Schneider et al. (2017) was the only study that found no differences in MVPA at post-assessment between IG and CG. Compared to a previous study where daily MVPA was increased by 12 minutes, Sutherland et al.'s scaled version only increased daily MVPA by 2 minutes (in half the amount of time).

Sachek et al. (2021) found school-time MVPA to be steady to slightly increasing in IG1 and IG2 and declining in CG from midpoint to endpoint, and that both IGs were not successful at increasing school-time MVPA from baseline to midpoint but successful at preventing a drop from midpoint to post-assessment compared to CG. They also found that both IGs were successful in preventing a decline in school-time MVPA but were not enough to help children reach the recommended amount of daily MVPA.

In Arlinghaus et al. (2020), stratified for weight, both healthy weight students (during weekdays) (p<0.05) and overweight students (on weekends) (p<0.05) in the IG increased minutes of MVPA compared to CG.

Nathan et al. (2020) (p=0.02), Tian et al. (2015) (p=0.014), and Zhou et al. (2019) all found that sedentary time decreased or decreased more in the IGs compared to the CGs. Additionally, Nathan et al. (2020) found the same effect in the IG from baseline to post-assessment. Stratified

by sex, Nathan et al. (2020) (p=0.02) and Tian et al. (2015) found that sedentary time decreased for IG girls but not for IG boys compared to the CG.

Sutherland et al. (2016) and Tian et al. (2015) both found increases in the time spent in VPA from baseline to post-assessment for the IG. Sutherland et al. (2017) (p=0.004) and Tian et al. (2015) (p=0.018) found increases of daily VPA between the IG and CG.

Sutherland et al. (2016) and Tian et al. (2015) both found increases in the time spent in MPA from baseline to post-assessment. Tian et al. (2015) also found an increase of time spent in MPA between the IG and CG. Sutherland et al. found no increase of time spent in MPA between IG and CG.

Sutherland et al. (2016) and Tian et al. (2015) found increases in total PA between baseline and post-assessment and Tian et al. (2015) also found an increase in total PA between the IG and CG (p=0.017).

Zhou et al. (2019) found that the multi-method approach (IG3) was the most effective. This is in support of previous literature that also states that multi-method interventions have a higher efficacy than single-method interventions. Tong et al.'s results support this, suggesting that having multiple types of PA at school is important to improve physical fitness because solely relying on PE to increase children's/adolescents PA is unrealistic without a functioning global PE concept

3.5.2 Markers of Physical Strength and Physical Fitness

A total of 6 of the 20 studies measured for aspects of physical strength and/or physical fitness (speed, agility, strength of muscle groups, endurance). Three measured for VO_2 max, three measured for various aspects of muscle strength and/or an increase of the LBM, and three measured for CRF.

Ryom et al. (2021) found that the IG2 increased VO_2 max performance compared to CG2 (although these results might be influenced by a higher mean height of the IG2) and Schneider et al. (2017) found that boys were more physically active than girls (p<0.001) and had a higher absolute and relative VO_2 max (both p<0.05) compared to girls. Skoradal found an improvement in YYIR1C performance (which is an indicator of VO_2 max) in the IG from baseline to post-assessment.

For muscle strength and/or the increase of LBM, Skoradal et al. (2018) (p<0.05) and Zhou et al. (2019) both measured an improved jumping test performance in the IG compared to the CG. Stratified by sex, Skoradal et al. (2018) found that IG girls improved horizontal jump performance more than CG girls. Tong et al. (2022) measured an increase in running speed in grade 2 IG girls compared to the CG (p<0.05) and Zhou et al. (2019) also measured an increase in speed and agility from IGs to CG and within all IGs from IG3 to IG1 to IG2. Tong et al. (2022) also found that grade 4 boys' strength improved compared to CG (p<0.01). The overall strength improvement of the study was in favour of the boys compared to the girls (p<0.01).

Skoradal found that postural balance and LBM was increased in the IG and decreased in the CG (p<0.05) and that the postural balance and LBM increased more in IG girls compared to CG girls (p<0.05) than for boys.

Zhou et al. (2019) found that all IGs improved all physical fitness and PA measures (lower-limb muscle strength, abdominal muscle strength, lower-back muscle strength, speed, agility, flexibility, core strength (and CRF) at post-test compared to baseline and compared to CG with the highest effect in IG3, then IG1, then IG2

Tong et al. (2022) found that grade 2 IG girls' fitness score ($p<0.05$) improved compared to CG, that grade 3 IG girls' endurance improved compared to CG ($p<0.05$) and that the endurance ($p<0.05$), and total fitness score ($p<0.05$) of the IG improved compared to CG.

In Zhou et al. (2019) all three IGs improved CRF from baseline to post-assessment and the IGs compared to the CG. The highest effect was measured for the multi-method IG3, then IG1, then IG2. Both Müller et al. (2019) and Wassenaar et al. (2021) found no significant results for CRF.

3.6   Other Results

Sutherland et al. found that the IG reported higher quality of PE lessons compared to the CG ($p<0.01$).

Ryom et al. (2021) found that the IG2 perceptions of the school environment increased compared to IG1 ($p=0.04$).

Tymms et al. (2016) and Wassenaar et al. (2021) both provided no significant results. Tymms et al. (2016) argue that their study supports previous literature indicating that the impact of modest school-based interventions is small. Wassenaar et al. (2021) argue that the large-scale nature of the intervention was in part responsible for the low intervention compliance and high dropout rate.

4 Discussion

The studies of this BSc thesis implemented many different interventions, often with several components each. In the following discussion, the three main research questions of this paper are discussed in detail, based on the results in Chapter 3 and comments by the researchers in their respective studies.

4.1 What components of QPE implementation have so far proven most effective?

With 14 of the 20 studies prescribing teacher training pre- and/or during the intervention, teacher training of any form was the most widely used intervention component. This shows a general recognition of the researchers that teachers are central agents of intervention implementation. The importance of teacher education is also established by the UNESCO in their guidelines where it is stated that "high-quality pre- and in-service training for teachers, based on respect for human rights and the principles of inclusive education, is an essential element for supporting teacher effectiveness" (UNESCO, 2015). Stratified by developmental state of the countries, there are gaps between the education of PE teachers and, subsequently, the quality of PE lessons at school. In countries of the Global South, such as South Africa (Müller et al., 2019; Tian et al., 2017) and Brazil (Lima et al., 2022), teachers trained specifically for PE are less common than in countries of the Global North, negatively impacting the level of PE classes. This is also acknowledged by Müller et al. (2019), who state that "a common observation in LMICs (low- to middle-income countries) is the paucity and often low quality of sport and recreation facilities, coupled with a lack of qualified teachers offering physical education classes." These results show that especially in countries of the Global South, researchers and policy makers must consider the educational level of the teachers and prioritise the teachers' education accordingly to ensure proper and sustainable implementation of the interventions/policies. A mismatch between teacher competency and complexity of interventions/policies is likely to result in low effectiveness of said interventions/policies. Such considerations should also be made in Countries of the Global North, especially in communities with low SES. This is acknowledged by Chen et al. (2019) for their intervention stating that "the implementation […] can be challenging, but through *tailored* [emphasis added] staff training, PE teachers can successfully implement the curriculum into their schools. Further, teacher training increased the teachers' confidence in delivering PE lessons, decreased their perception of barriers (Lima et al. 2021) and increased the students' confidence in their teachers, as well as their perception of support (Sparks et al. (2017). Teachers reported a high satisfaction with (Chan et. Al (2019)) and usefulness of (Sutherland et al. (2016)) the training.

A second promising approach taken by a total of nine researchers was to increase PA indirectly through the enhancement of factors of intrinsic motivation, such as challenge, novelty, enjoyment and support (Chen et al. (2019); Sparks et al. (2017); Ryom et al. (2021); Ha et al. (2019); Tong et al. (2022); Schneider et al. (2017)) and/or tenets of SDT and SEC (Ha et al. (2019); Schneider et al. (2017); Sparks et al. (2017); Tian et al. (2015); Sutherland et al. (2017); Tong et al. (2022); Zhou et al. (2019)). All researchers but Schneider et al. (2017) found positive results respective to what they assessed, which indicates that the targeting of intrinsic motivation is an effective tool to increase PA in school-aged children and adolescents. Chen et al. (2019) state that their "motivational component built into the curriculum generated positive results" and Ha et al. (2019) propose the "use of SDT […] as guiding framework for school-based interventions." The fostering of intrinsic motivation, especially through SDT, is a promising approach to counteract the age-typical decline of PA during adolescence mentioned by several authors, such as Arlinghaus et al. (2020), Lander et al. (2017), (Müller et al. (2019), Tymms et al. (2016).

Finally, several authors (Müller et al. (2019); Tong et al. (2022); Zhou et al. (2019)) argue for the importance of multi-method intervention designs compared to interventions targeting only one area of PA to broaden the possibilities of interventions to positively affect PA. Müller et al. (2019)

argue for this based on the recognition that "only few physical activity intervention programmes proved to be effective in school-aged children" and therefore "assume that a multidimensional intervention might be particularly beneficial." Tong et al. (2022) state that "having multiple types of in-school PA is an important factor for improving physical fitness." This is based on their large body of results providing evidence that interventions rarely affect the whole study population which entails that several components might increase the quantity of positively affected school children. Zhou et al. (2019) further supports this argument by stating that their "multi-level school-based intervention is efficacious in improving […] physical fitness in middle school children" and that the multi-method design was chosen to "maximize the opportunities for […] PA."

4.2 In what way have QPE interventions improved participants' mental health and is this improvement shown empirically?

Only two of the four studies that specifically aimed to improve the participants' mental health produced positive significant results. Therefore, an extensive answer to this research question is not possible due to a lack of quantity of results. However, the following discussion will still provide evidence for the importance of PA for mental health. Although many studies did not specifically target or measure aspects of mental health, many of the included studies acknowledge the positive correlations between PA and mental health in school-aged children that were established prior to the respective interventions by other researchers. For example, Wassenaar et al. (2021) draw attention to the adolescence as "peak onset time for mental health issues" and that "regular PA […] could improve mental health in young people." The lack of significant results of their study is blamed on poor fidelity and large amounts of missing data due to the large scale of the intervention, not on missing effects of PA on mental health. Sachek et al. (2021) refers to the Activity Guidelines for Americans that school-aged children should engage in 60 minutes of MVPA daily "given the positive association with […] mental health benefits." Tymms et al. (2016) refer to reviews that found "small-to-moderate effects for the benefits of PA on a number of psychological health outcomes including depression, anxiety, psychological distress, self-esteem and emotional disturbance." Their own intervention targeted at improving the participants' mental health did not produce any significant results. The authors hypothesise that this was due to their "modest" intervention being insufficient to meaningfully increase the mental well-being of their study population. Ryom et al. (2021) add the emphasis that ethnic minority children are affected more by poor mental health than the majority population and that this effect is even worse for girls. Lima et al. (2021) were the only researchers who produced significant empirical results. They managed to reduce depressive symptoms, social isolation, and poor sleep quality in their IG2, and to reduce the risk of developing high depressive symptomology in their IG2 and IG3 by 93% and 54% respectively. Additionally, they found that social isolation was a central mediator for depressive symptoms, mediating one third of depressive symptoms (32%).

A brief scan of a "review of reviews" of physical activity and mental health in children and adolescents (Biddle & Asare, 2011), which was not included in this review reveals that there is empirical evidence suggesting positive effects of PA on mental health. The quantitative lack of results of this review should therefore not be considered as contradicting evidence of the positive effects of PA on mental health. Instead, it should be considered as a shortcoming of the initial search string. The search string should have been extended by the author to include mental health specifically. This would have likely increased the number of studies that specifically targeted to increase the participants' mental health and, based on the extent of previous literature, the results would have likely contributed towards a more nuanced understanding of how PA influences mental health.

4.3 How do intervention effects differ between the sexes?

Thirteen of the included studies in this review provided results specific to the sex of the participants. Again, this shows that researchers have largely acknowledged the UNESCO QPE guidelines (2015), which state the importance of gender equality in interventions and policies repeatedly. Ha et al. (2019) observed several sex-related differences for their intervention. Their SELF-FIT intervention "enhanced girls', but not boys' autonomous motivation." To have an intervention that is well-received among girls is an important finding towards making PA interventions more inclusive. This is also recognised by the authors who call this finding "encouraging" because "girls, relative to boys, have lower activity levels and poorer motivation toward PE" and are therefore "at higher risk of subsequent ill effects of physical inactivity." A second observation was that the boys were very active during fitness activities or during free play, which was not observed for the girls. Instead, the authors observed that guided activities and game-like activities were received better by the girls than the boys. Based on these observations, the authors call for "more gender specificity in initiatives to improve the physical activity and well-being of students." Nathan et al. (2020) whose study resulted in a 1.5 times larger positive effect for boys compared to girls also suggest that "as girls are less likely to than boys to participate in PA, […] teachers need to consider activities that may be particularly appealing to girls when scheduling PA." Müller et al. (2019) also mention sex-specific intervention for adolescent girls who are more at risk to become obese than boys at that age. The importance of Ha et al.'s (2019) and Nathan et al.'s (2020) call is further emphasised by Wassenaar et al. (2021) who suggest that "it is unlikely an intervention works for all," which in turn highlights the results of Chapter 4.1. favouring multi-method interventions over single-method interventions.

Several studies in this review found the same effects of their interventions for both boys and girls. Ryom et al. (2022) found that their intervention was rated moderately to highly enjoyable by both boys and girls separately (3.6/5). Nathan et al. (2020) and Sutherland et al. (2016) both found significant increases from IGs to CGs over time for both sexes separately for daily MVPA and Chan et al. (2019) found no differences of intervention effects between boys and girls. However, there are also studies who found larger intervention effects for either boys or girls respectively. Tong et al. (2022) found that the overall strength improvement of the study was in favour of the boys compared to the girls and Zhou et al. (2019) and Nathan et al. (2020) also both found higher intervention effects in favour of the boys. Contrasting those findings, Nathan et al. (2020) and Tian et al. (2015) found that sedentary time decreased for IG girls but not for IG boys compared to the CG, Skoradal et al. (2018) found that the postural balance and LBM increased more in IG girls compared to CG girls than for boys and both Ha et al. (2019) and Arlinghaus et al. (2020) both found higher intervention effects for girls than for boys. Lander et al. (2017) were the only study that only included girls in their intervention. Based on previous findings, they highlight that girls often have lower FMS competency than boys after primary school, which makes it harder to participate in middle- and high-school PE. They strongly encourage future FMS interventions to, such as theirs, be based on the SAAFE principles due to the large positive effect sizes of their intervention.

The reason for the reported differences of intervention effects stratified by sex is often unclear. The question arises of whether the findings are due to 1. unequal FMS and/or fitness levels at baseline, 2. the differences in sport proficiency of the participants, 3. the type of intervention, 4. distinct activity preferences between the sexes, or 5. combinations of 1. to 4. For increased equity in the provided programs, future researchers should clarify the hypothesised source for the differences of effects between the sexes. The results of this review suggest that there is no favourite as to which sex profits the most from PA interventions. Rather, it seems that there are certain types of PA that are preferred by one of the sexes respectively, e.g. free play for boys and

game-like activities for girls, which determine who profits most. Again, this emphasises the call for multi-method interventions from Chapter 4.1.

4.4 Conclusion

The results of the research and their discussion in the context of the three main research questions elicited several key components that were contributors towards successful school-based interventions. Question 1 (Chapter 4.1) revealed three key components of successful school-based interventions. First, it was shown that teachers were central for the proper implementation of the interventions, and that educated teachers were more confident in delivering PE lessons, which increased the confidence of the students in their teachers. Second, the attempt to increase PA through the increase of intrinsic motivation was successful and promising to counteract the age-typical decline of PA during the adolescence. Finally, several authors argued for the application of multi-method interventions to increase intervention effects for a larger number of participants than single-method interventions. This argument is based on findings that single-method interventions often are not sufficient to impact the whole heterogenous study population. Question 2 (Chapter 4.2) provided evidence from one study showing that an increase of PA contributes towards the reduction of depressive symptoms and that social isolation is a central mediator for depressive symptoms. It was also argued that relatively modest school-based interventions are not sufficient to meaningfully increase mental health. Therefore, research with the specific target of increasing mental health should consider applying vigorous PA as a component of the intervention. Question 3 (Chapter 4.2) provided ample evidence that school-based interventions do not affect boys and girls equally and that a 'one size fits all' concept is insufficient to affect all the participants. The results suggest that interventions do not universally favour boys or girls. Instead, there are preferences by the sexes for certain types of PA respectively, which co-determine intervention effects. Thus, interventions must consider the heterogeneity of their study population and choose intervention-components tailored to the study population.

5 Limitations and Outlook

The main limitation of this study was the relatively small scope for a literature review of 20 included studies, which resulted in a small body of evidence to answer the second main research question. Further, the studies rarely assessed the same parameters. The numerous parameters of weight status, psychological well-being, physical fitness, teacher training and more, complicated the comparison of intervention results.

This thesis is a literature review of recent QPE interventions and their most important results. As such, it is a resource for future researchers to develop effective interventions and avoid shortcomings of past interventions. To make future interventions more comparable, which is an important step towards identifying both successful and undesired intervention effects based on a broader foundation than this review can provide, there should be a consensus among researchers of which parameters are used to assess which components.

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