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Review

Effects of Interventions Based on Achievement Goals and Self-Determination Theories on the Intention to Be Physically Active of Physical Education Students: A Systematic Review and Meta-Analysis

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Abstract: The aim was to review the effects of interventions based on self-determination theory and achievement goals theory on intention to be physically active in the future in physical education students, as well as to conduct a meta-analysis to determine the overall effect size of these interventions. PRISMA guidelines were followed to conduct this systematic review and meta-analysis. Three scientific electronic databases were used: Web of Science (WOS), Scopus, and SportDiscus. A total of eleven studies fulfilled the inclusion criteria and were included in the meta-analysis. Effect size for intention to be physically active of each study was calculated using the means and standard deviations before and after the intervention. The overall effect size for intention was moderate (standardized mean difference = 0.47 with 95% CI from 0.28 to 0.67), while the heterogeneity was large. Seven of the eleven studies reported significant within-group improvements in intention after the intervention. Eight studies showed significant between-group differences in favor of the experimental group. The findings showed that teaching strategies, family involvement, and the use of videos related to physical activity participation may be relevant factors that must be considered by educators and researchers to conduct future effective interventions. Interventions based on self-determination theory and achievement goals theory could be useful in the process of the promotion of physical activity. However, given the large heterogeneity, these findings must be taken with caution.

Keywords: motivation; school-based interventions; teacher education; physical activity; active living

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1. Introduction

Regular physical activity is associated with multiple health benefits in children and adolescents [1–3]. However, the World Health Organization [4] has shown that 80 percent of adolescents do not perform the recommended moderate to vigorous physical activity. Accordingly, schools would seem to be the ideal context to change this situation and promote habits that promote physical activity [5–7].

Based on theoretical frameworks such as achievement goal theory (AGT, [8,9]) and self-determination theory (SDT, [10–12]), research carried out in the educational field, especially in the area of physical education, has allowed us to look into the role that motivation plays in promoting physical activity [13].

AGT [9] highlights the importance of the teacher in creating the motivational climate for the class. The motivational climate is a set of signals perceived within the environment, which help define the keys to success and failure [14]. This climate is generated by various social figures such as parents, classmates, teachers, and so on, and can take two forms: a motivational climate involving homework, based on effort, skill development, and personal improvement; or a motivational climate involving the ego, based on the demonstration of greater capacity, comparison among peers, and focusing on the end result [14,15]. The

scientific literature has shown that the task's climate is related to the most self-determined types of motivation and has positive behavioural consequences in physical education students [15–17].

Similarly, SDT [10–12] highlights the importance of the teacher's interpersonal style in the satisfaction or frustration of basic psychological needs (autonomy, competence, and relatedness). This theory postulates that the satisfaction of basic psychological needs is associated with the most self-determined types of motivation and, in turn, with positive behavioural consequences [3,18,19]. This theory distinguishes between two motivational styles in the teacher. One, supporting needs, characterised by strategies to support autonomy (responsibility in the learning process, availability of choice, and so on), competence (relevant challenges, activities appropriate to the skill level of the students, use of feedback, and so on), and relatedness (empathic listening, showing interest in colleagues, and so on). The other, frustrating needs, characterised by an external controlling style with the use of controlling language (use of pressure and threats) and an internal controlling style, pressuring students or appealing to their self-esteem or feelings of anxiety, guilt, or shame [11,20].

In recent decades, one of the most frequently analysed behavioural consequences is the intention to be physically active. Intent is conceptualised as the immediate precursor to behaviour [21,22] and is related to an increase in the amount of exercise taken by students [23]. In fact, this variable has been considered one of the most relevant predictors of physically active behaviour [24].

Considering the extensive evidence that supports a motivational climate that implies the task [25] or support for basic psychological needs [18] is associated with autonomous forms of motivation and, consequently, with positive consequences, we could hypothesise that interventions that use motivational strategies significantly improve the intention to be physically active. To test this hypothesis, the effect sizes of the interventions must be determined through a meta-analysis. Therefore, the main objective of this systematic review was to analyse the effects of interventions based on SDT and AGT on the intention to be physically active of physical education students.

2. Materials and Methods

To carry out this systematic review and meta-analysis, we followed the proposals of the PRISMA guide [26].

2.1. Literature Search

The search for articles was carried out in the following electronic databases: Web of Science (WOS), Scopus, and SportDiscus. The search phrase was divided into four blocks of words: (1) "autonomy support", "competence support", "relatedness support", "needs support", "target", "motivational climate", "mastery climate", "task-involving climate", "ego climate", "performance climate", "execution climate", "teaching style", "interpersonal style", "teaching strategies", "instructional strategies", "trans-contextual model", "multi-dimensional", "AMPE MALP", "motivation", "self-determination", "achievement goals", "motivational", "intrinsic motivation", "amotivation"; (2) "intervention", "quasi-experimental", "experimental", "randomized controlled trial"; (3) "intention", "physically active"; and (4) "physical education". The Boolean operator "and" was included between the groups, while the Boolean operator "or" was used to separate the words that made up the first three groups. The search for articles was carried out up to September 2022.

2.2. Assessment of Risk of Bias

To assess the risk of bias in the studies, we used "The Evidence Project risk of bias tool" [27]. This tool is applicable to interventions with a wide range of designs and is composed of eight items divided into three sections: (a) study design (items 1–3); (b) representativeness of the participants (items 4–7); and (c) equivalences of the groups compared at the initial level (items 7–8). Table 1 shows the risk of bias of the articles included in this meta-analysis.

Table 1. Risk of bias according to the Evidence Project risk of bias tool.

Ref.	1	2	3	4	5	6	7	8
[28]	Y	Y	Y	Y	N	Y	Y	Y
[29]	Y	Y	Y	N	N	Y	Y	Y
[30]	Y	Y	Y	N	N	Y	Y	N
[31]	Y	Y	Y	Y	N	Y	Y	Y
[20]	Y	Y	Y	N	N	Y	Y	Y
[32]	Y	Y	Y	Y	N	Y	Y	Y
[33]	Y	Y	Y	N	N	Y	Y	N
[34]	Y	Y	Y	Y	N	Y	Y	Y
[35]	Y	Y	Y	N	N	Y	Y	Y
[36]	Y	Y	Y	N	N	Y	Y	Y
[37]	Y	Y	Y	N	N	Y	Y	N

Y: criterion fulfilled; N: criterion not fulfilled; 1: cohort; 2: control or comparison group; 3: pre-post intervention data; 4: random assignment of participants to the intervention; 5: random selection of participants for assessment; 6: follow-up rate of 80% or more; 7: comparison groups equivalent on sociodemographics; 8: comparison groups equivalent at baseline on outcome measures.

2.3. Study Selection and Data Collection

The study selection process was carried out by two authors independently (C.F.-E. and B.J.A.). In this process, articles were selected if they met the following inclusion criteria: (a) intervention based on SDT or AGT, (b) measurement of the intention to be physically active in the future of physical education students, (c) written in Spanish or English, and (d) published or accepted in a peer-reviewed journal. Data collection was carried out in two steps. First, two authors extracted data from the articles. Second, this information was verified by the third and fourth authors. Following that established by the PRISMA guide, the information was extracted following the PICOS approach: participants, intervention, comparisons, outcomes or results, and study design (PICOS) [38]. Table 2 shows the main participants' characteristics: sex, age, level of education, and sample size, as well as the main characteristics of the different protocols of intervention. Regarding interventions, Table 3 summarizes the following details: duration of the study, number of sessions, and type of motivational intervention program.

Table 2. Characteristics of the participants and the protocol.

	Characteristics of the Sample		Protocol	
Ref	**Sample Size of Groups and Sex**	**Age (SD) and Education Level**	**Experimental Group Treatment**	**Control Group Treatment**
[28]	EG: 175 (81 females) CG: 148 (61 females)	14.29 (NR) High school	TARGET strategies	None
[29]	EG: 427 (209 females) CG: 403 (185 females)	13.86 (NR) High school	TARGET strategies	None
[30]	EG: 49 (NR) CG: 53 (NR)	10.93 (0.75) Primary school	Autonomy-support and dialogic learning	None
[31]	EG: 174 (84 females) CG: 196 (104 females)	14.52 (NR) High school	Autonomy-support strategies	Program of education about student with special needs
[20]	EG: 105(NR) CG: 105 (NR)	13.05 (0.59) High school	Need-support teaching	None
[32]	EG(A): 76 (37 females) EG(B): 95 (49 females) CG: 81 (46 females)	10.48 (0.5) Primary school	Autonomy-support strategies	None
[33]	EG: 23 (NR) CG: 30 (NR)	13.35 (0.62) High school	Need-support teaching	None
[34]	EG: 362 (NR) CG: 474 (NR)	12.81 (.93) High school	Need-support teaching	None

Table 2. *Cont.*

	Characteristics of the Sample		Protocol	
Ref	**Sample Size of Groups and Sex**	**Age (SD) and Education Level**	**Experimental Group Treatment**	**Control Group Treatment**
[35]	EG: 91 (40 females) CG: 54 (34 females)	10.73 (0.62) Primary school	Autonomy support strategies	None
[36]	EG: 223 (NR) CG: 224 (NR)	14.34 (1.90) High school	TARGET strategies	None
[37]	EG: 21 (10 females) CG: 26 (13 females)	11.28 (0.45) Primary school	Autonomy support strategies	None

EG = experimental group; CG = control group; SD = standard deviation; NR = not reported.

Table 3. Characteristics of the interventions (duration, design, and strategies).

Ref	Duration of Intervention	Design	Type of Motivational Intervention Programme and Strategies
[28]	Five months NR	Quasi-experimental	Learning strategies based on the six TARGET dimensions: (1) task (activity design); (2) authority (participation in decision making); (3) recognition (use of rewards); (4) grouping (work in groups); (5) evaluation (participation and feedback); and (6) time (learning pace).
[29]	1 academic year NR	Quasi-experimental	Learning strategies based on the six TARGET dimensions.
[30]	1 academic year 2 h per week	Quasi-experimental	Support strategies for autonomy from the perspective of dialogic learning. The following structure was used: (1) teacher-led warm-up (presentation of content, reflection of desired behaviours, and content-related tasks); (2) main part: directed by a volunteer family member (heterogeneous groups of 5–7 students, with four different activities carried out simultaneously); and (3) cool down: self-assessment aimed at compliance with the principles of dialogic learning.
[31]	1 month NR	Randomised-experimental	Learning program is based on six autonomy supportive strategies: (1) taking students' perspective, (2) using noncontrolling and informational language, (3) providing rationale, (4) providing choice, (5) displaying patience, and (6) accepting negative affect.
[20]	1 academic year 2 h per week	Quasi-experimental	17 of the 21 techniques proposed by Teixeira et al. [39] were used: five for autonomy need (using non-controlling, informational language, exploring life aspirations and values, providing meaningful logic, offering options, and encouraging students to experiment and engage in the behaviour). Five for the need for competence (clarify expectations; help set an optimal challenge; offer constructive, clear, and relevant feedback; help develop an action plan; and promote self-control). Seven for the need for relatedness (recognise and respect feelings, encourage questioning, show unconditional respect, show interest in the person, use empathic listening, provide opportunities for ongoing support, quick identification, and search for available social support). Techniques were also provided to families to motivate their children to be active.
[32]	6 weeks 2 h per week	Randomised-experimental	Dance activities to promote students' autonomy (zumba, body expression, aerobic dance, hip-hop, traditional Greek dances, and free-style choreography).
[33]	Three months NR	Quasi-experimental	The strategies of Standage and Ryan [40] were used. Three for the need for competence (optimal challenge, use of positive feedback, and fostering task involvement in activities), three for the need for autonomy (opportunity for choice, acknowledging student feelings, and minimising ego involvement), and two for the need for relatedness (recognising students' feelings and supporting an "exercise partner" scheme).
[34]	10 sessions NR	Randomised-experimental	Strategies to satisfy psychological needs were used. For autonomy, emphasis was placed on the importance of alternating teaching styles, on providing freedom to students in decision-making, and on the advantages of avoiding controlling and pressuring behaviours. For the competition, the strategies focused on proposing achievable challenges, a balance was achieved between the difficulty of the tasks and the ability of the students, offering opportunities to achieve the goals, and allowing enough time to successfully complete the tasks. As for the need for relatedness, emphasis was placed on using different strategies for group formation, optimising group monitoring, and developing empathy and active listening in students.

Table 3. *Cont.*

Ref	Duration of Intervention	Design	Type of Motivational Intervention Programme and Strategies
[35]	4 months 2 h per week	Quasi-experimental	The climate of support for autonomy was characterised by the following: using informal and non-controlling language, allowing critical thinking, reflecting on respect and the value of feelings, being open to modifying uninteresting activities, adopting an attitude of empathic listening, taking into account students' interests and preferences, stimulating their curiosity, helping students understand how schoolwork can help them in their personal lives, and giving students time to work independently, allowing them to take the initiative in activities.
[36]	12 weeks NR	Quasi-experimental	Learning strategies based on the six TARGET dimensions.
[37]	5 weeks 2 h per week	Quasi-experimental	Five videos focused on the motivation and autonomy of adolescents towards their physical activity were used. The topics reviewed were as follows: negative effects of leading a sedentary life, recommendations for exercise, promotion of a healthy lifestyle, factors that influence participation in physical activity, and sociocultural and media influences on physical activity. Discussion groups were also used with the families, who were provided with a guide with recommendations on the promotion of physical activity.

NR = not reported.

2.4. Statistical Analysis

The Review Manager program (RevMan, 5.3) was used to carry out the data analysis. [41]. To perform this meta-analysis, a random effects model was used. The effect size was calculated using the mean and standard deviation before and after the procedure [42]. The magnitude of the effect size was identified as follows: (a) "large", for values greater than 0.7; (b) "moderate", for values between 0.4 and 0.7; and (c) "small", for values less than 0.4 [43]. For the heterogeneity (I^2), the most common classification considers it "large", for values greater than 50%; "medium", for values between 25% and 50%; and "small" for values less than 25% [44].

3. Results

3.1. Study Selection

Figure 1 (PRISMA flow diagram) shows the complete process for the systematic review. A total of 135 articles were located in the electronic databases. Of these, 38 were eliminated as duplicates. Of the remaining 97, 3 were eliminated because they were reviews, 20 because they were not interventions, 24 because they were not SDT- or AGT-based interventions, 18 because they did not measure the intention to be physically active, 1 because it did not use a control group, 7 because they did not present the necessary data (mean and/or standard deviation in the pre-test and post-test), and 13 because they were not carried out in the context of physical education. Finally, after this exhaustive selection process, 11 studies [20,28–37] were included in this systematic review and meta-analysis.

3.2. Risk of Bias

Table 1 shows the risk of bias of the studies chosen. Seven of the eleven studies did not randomly group participants. Further, in the preliminary analysis, three studies showed significant differences between the control group and the experimental group in some of the variables [30,33,37].

3.3. Study Characteristics

Tables 2 and 3 show the characteristics of the studies included in this meta-analysis. The total sample consisted of 3480 physical education students. Of these, 1773 were placed into the experimental group and 1787 were placed into the control group. Of the 11 studies, 4 were carried out in primary education and 7 in secondary education.

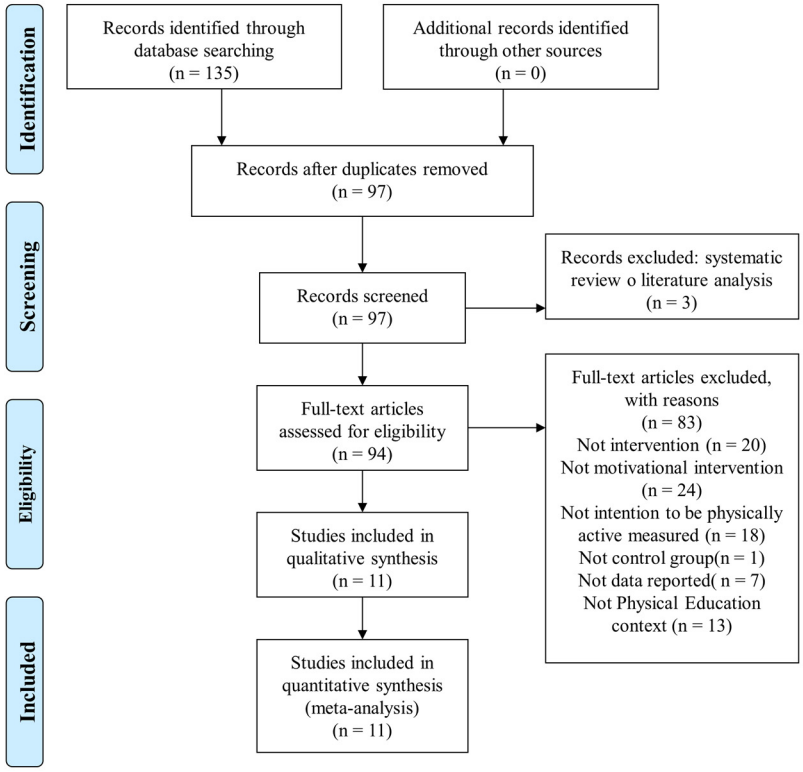

Figure 1. Flow diagram for the systematic review process according to PRISMA statements.

3.4. Interventions

Table 2 shows a summary of the teaching strategies used in the motivational interventions of each article. In this sense, three were based on TARGET strategies, which follow AGT. For their part, the remaining eight interventions were based on strategies based on SDT. Specifically, five studies used strategies to support autonomy, while three of them used strategies to support the three basic psychological needs. For the control group, ten studied did not use alternative teaching strategies. Only the study by Schneider et al. [31] used an alternative program of education on how to apply a monitoring system for physical functional capacity for student with special needs.

Table 3 summarises the duration, the design, and the teaching strategies of the interventions. The intervention duration ranged from five weeks to one academic year (nine months). All of the studies had a quasi-experimental design, except for those studies carried out by Sánchez-Oliva et al. [34], Mavropoulou et al. [32], and Schneider et al. [31], which had a randomised experimental design.

3.5. Outcome Measures

Figure 2 shows the effects of interventions based on SDT and AGT on the intention to be physically active in the future in physical education students. To measure the intention to be physically active, five studies [28,29,33,35,36] used the Spanish version of the Intention to be Physically Active Scale (IPAS) of Hein et al. [45]. This scale was translated and validated for the Spanish context by Moreno-Murcia et al. [46]. The scale consists of five items (e.g., "I usually play sports in my free time"). The preceding sentence for the scale is "Regarding your intention to practice some physical activity or sport...". The responses correspond to a Likert-type scale that ranges from 1 (totally disagree) to 5 (totally agree). The study by Schneider et al. [31] used the intention factor of the Theory of Planned Behaviour Questionnaire. Likewise, three studies [20,30,37] used this factor of the Spanish version [47] of the Theory of Planned Behaviour Questionnaire. This factor consists of four items (e.g., "I have thought about exercising in the next two weeks at least 6 times") on a response scale that ranges from 1 (strongly disagree) to 7 (strongly agree). The study

by Mavropoulou et al. [32] used this factor from the original version of the questionnaire. Finally, one study [34] used the following item: "In the coming years, I intend to practice sport" to measure the intention to be physically active.

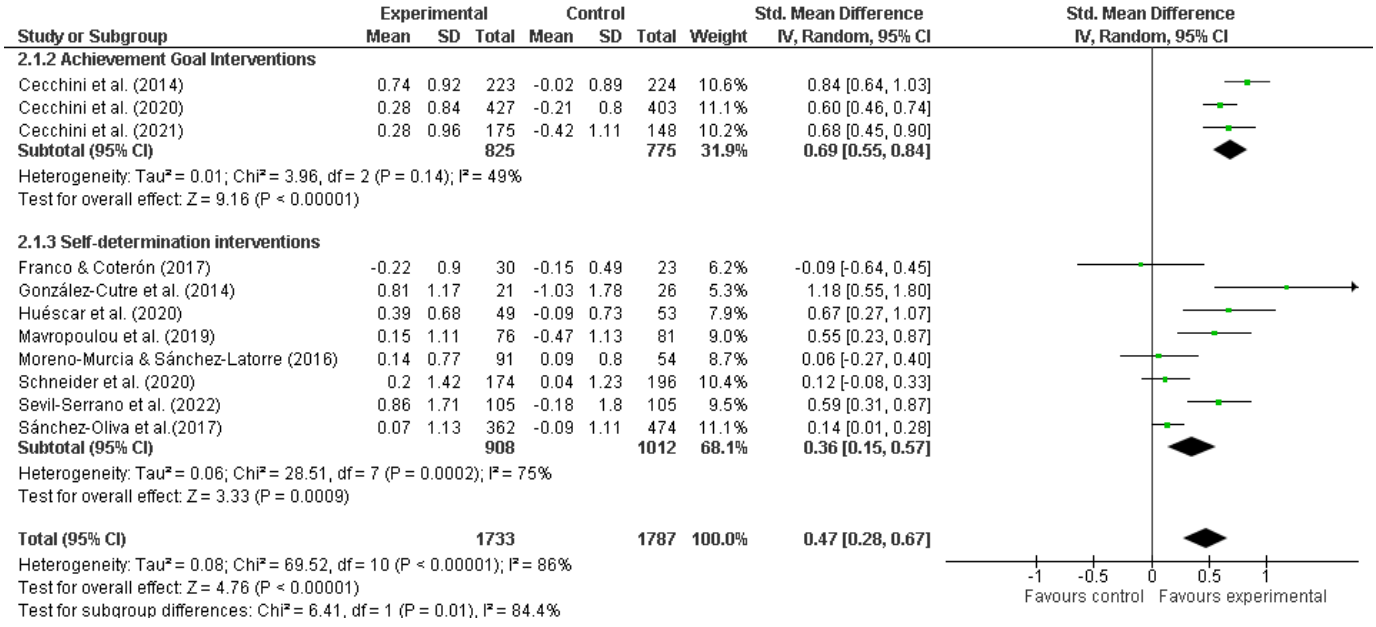

Figure 2. Meta-analysis: effect sizes for the intention to be physically active of motivational interventions [20,28–37].

For the effects caused by the interventions in the experimental groups, seven of the eleven studies [20,28,29,32,35–37] found a significant increase in the intention to be physically active in the future in physical education students compared with the initial level. In contrast, the study carried out by Franco and Coterón [33] showed a reduction in this variable after the intervention. However, this decrease was not significant. For the control groups, six studies [20,30,33,35,36] showed no significant changes in this variable. Only in three studies [28,29,37] did the intention show a significant decrease. For their part, the studies carried out the study by Sánchez-Oliva et al. [34] and Schneider et al. [31] did not report on intragroup effects caused by the intervention. Likewise, as can be seen in Figure 2, the results of the meta-analysis show that all of the investigations reported significant differences between groups in favour of the experimental group, except in three of the studies [31,33,35].

The total effect size for intention to be physically active was 0.47, with a 95% CI of 0.28 to 0.67. According to the proposed classification, the effect size was moderate. The level of heterogeneity was high (I^2 = 86%) and the *p*-value of the Cochran Q-test was < 0.01. On the other hand, the effect size of the three studies that used learning strategies based on achievement goal theory was 0.69, with a 95% CI of 0.55 to 0.84; therefore, according to the established classification, the effect size was moderate. Finally, the effect size of the interventions that used learning strategies based on SDT was 0.36, with a 95% CI of 0.15 to 0.57, providing a small effect size.

4. Discussion

This systematic review and meta-analysis had as its main objective to analyse the effects of motivational interventions on the intention to be physically active of physical education students. The main result of this meta-analysis was that teaching strategies based on SDT and AGT could improve the participation of physical education students in physical activity outside the school context, as these increase the intention of being physically active in the future for this group.

Figure 2 shows that the effect size in eight of the ten studies was in favour of the experimental group. These results are in line with the trans-contextual model, which postulates that what happens during physical education class can affect the behaviour of students in their free time [48]. This improvement can be considered moderate according to the total effect size (standardised mean difference = 0.47 with a 95% CI from 0.28 to 0.67; *p*-value < 0.01). Therefore, the application of interventions based on motivational theories could represent useful teaching strategies to motivate students to practice physical activity and to reduce the levels of physical inactivity that currently exist in students in this age group.

Of the eleven studies included in this meta-analysis, three studies [28,29,36] were based on the AGT. The significant improvement observed in both studies on the intention to be physically active was moderate owing to the effect size (d = 0.69 with a 95% CI from 0.55 to 0.84; *p*-value < 0.01). The three studies used TARGET strategies [49]. The other interventions used strategies based on SDT. Studies conducted by González-Cutre et al. [37], Huéscar et al. [30], Mavropoulou et al. [32], Moreno-Murcia and Sánchez-Latorre [35], and Schneider et al. [31] used autonomy supporting strategies, while the studies carried out by Franco and Coterón [33], Sánchez-Oliva et al. [34], and Sevil-Serrano et al. [20] used support strategies for the three basic psychological needs (autonomy, competence, and relatedness). In this case, the significant improvement observed in the intention to be physically active was of moderate size (standardised mean difference = 0.36 with a 95% CI from 0.15 to 0.57; *p*-value < 0.01). Although it is difficult to compare the effect of the interventions based on one theory to those based on another owing to the unequal number of studies found for each of them, the difference in effect size (chi^2 = 6.41; *p*-value = 0.01) could be due to the degree of structuring of the learning strategies. In this sense, while TARGET strategies are clearly defined in six areas, the strategies to support autonomy and support basic psychological needs come from different sources and are not clearly defined (See Table 2). This could be an important factor when instructing the teachers who are in charge of carrying out the intervention in the experimental groups. In fact, in the study by Girard et al. [50], learning strategies based on AGT and SDT theory were combined and this had no significant positive effect on students' motivation. Accordingly, we would recommend that future SDT-based interventions use defined strategies, such as the 21 techniques to support basic psychological needs, recently agreed upon by a group of experts [39].

Another key factor in this type of intervention for promoting physical activity could be the involvement of the families. The three studies [20,30,37] that involved the students' families obtained the three largest effect sizes for SDT-based interventions. This could be because of the fact that support for autonomy by families is linked to an adaptive educational context [51]. In fact, previous studies have shown how family participation can help children and adolescents to participate in physical activity [52].

On the other hand, the largest effect size was found in the study by González-Cutre et al. [37]. This study differs from the rest by the showing the experimental group of videos focused on the motivation and autonomy of adolescents towards their physical activity and by a group reflection on the topics viewed. It is possible that the inclusion of videos created by motivation experts to work on key aspects of promoting physical activity may be an important factor in improving motivation and continuing with physical activity.

Regarding the duration of the interventions, they varied between five weeks [37] and a full academic year [20,29,30]. The results obtained suggest that duration would not be one of the most relevant factors in achieving significant improvements in the intention to be physically active, as the largest effect size was found in the shorter study. Meanwhile, the interventions carried out by Franco and Coterón [33] and Moreno-Murcia and Sánchez-Latorre [35], despite having durations of 3 and 4 months, respectively, found no significant effect sizes in favour of the experimental group.

As for the age of the participants, this does not seem to be a determining factor either. Similar results were obtained in both educational stages. The study with the largest effect

size [37] was carried out with primary education students of (M = 11.28, SD = 0.45), followed by the intervention by Cecchini et al. [36] in secondary education (M = 14.34, SD = 1.90). On the other hand, the study that obtained the smallest effect size was that carried out by Franco and Coterón [33] in a secondary education sample (M = 13.35, SD = 0.62), followed by the study by Moreno-Murcia and Sánchez-Latorre [35] in primary education (M = 10.73, SD = 0.62).

Finally, this systematic review and meta-analysis has several limitations. First, the meta-analysis showed high heterogeneity. Although, in some cases, testing for heterogeneity can address an unimportant question and heterogeneity is allowed in a meta-analysis using the random-effects model [53], like in this study, the results of this meta-analysis should be viewed with caution. All articles included in this meta-analysis were analyzed to study heterogeneity. The most notable differences between the studies can be observed in the characteristics of the type of the strategies used in each intervention. In this sense, the interventions based on AGT used similar strategies and presented a medium heterogeneity (I^2 = 49%), and the interventions based on SDT used different strategies and presented a large heterogeneity (I^2 = 75%).

Second, the studies used up to three different instruments to measure the intention to be physically active. Third, the search was limited to two languages: Spanish and English. Therefore, it is likely that some studies were excluded.

5. Conclusions

Motivational interventions based on self-determination theory and achievement goal theory are recommended to significantly improve the intention to be physically active of physical education students, regardless of the educational stage (primary or secondary). Defined teaching strategies, the involvement of families and the use of videos related to participation in physical and sports activities could be relevant factors in the promotion of physical activity in children and adolescents and should thus be considered by physical education teachers and researchers for future interventions.

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