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Original Article

Impact of an Autonomy-Based Program on Perceived Autonomy Support, Intrinsic Motivation and Leisure-Time Physical Activity of High-School Student: An Accelerometer-Based Study

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Abstract

Introduction: One of the key factors that enhances individuals' participation in various activities, including physical activity (PA), is motivation. **Objective:** The primary objective was to assess the impact of an autonomy-support (AS) intervention program in physical education (PE) on perceived AS, intrinsic motivation (IM), and PA.
Methods: This study employed a semi-experimental design featuring practical applications, utilizing a pre-test and post-test framework alongside a control group. The research focused on 60 male adolescents, aged 16 to 18, recruited from two high schools and divided into two groups of 30: the intervention group and the control group. To evaluate the research variables, Perceived Autonomy Support in PE, Intrinsic Motivation Scale and The ActiGraph wGT3X-BT accelerometer were utilized. The analysis was conducted using ANCOVA.
Results: The results indicated that both groups exhibited similar levels in the pre-test regarding perceived AS (P=0.842), IM (P=0.790) and MVPA (P=0.527). However, in the post-test, the intervention group demonstrated significantly higher perceived AS (F=13.527, P<0.001), IM (F=15.349, P<0.001) and MVPA (F=56.638, P<0.001) compared to the control group.
Conclusion: These results suggest that the principles of self-determination theory (SDT) can be applied to high-school students as well. Consequently, PE instructors at schools can enhance students' health-oriented PA levels by employing teaching styles based on SDT, which aligns with one of the primary objectives of general PE courses.

Keywords: Adolescent, Exercise, Personal Autonomy, Motivation, Physical Education

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1. Introduction

Adolescence represents a pivotal stage in life, as it is during this time that essential behaviors, referred to as "movement behaviors"—which include sleep, sedentary behavior, and physical activity (PA)—are developed, potentially impacting future health and lifestyle choices (1,2). Throughout their waking hours, adolescents engage in either PA or sedentary behavior (3,4). PA encompasses any bodily movement generated by skeletal muscles that necessitates energy expenditure, ranging from light to vigorous intensity (5). Conversely, sedentary behavior is characterized by minimal energy expenditure during wakefulness (6). Research indicates that these behaviors can coexist in adolescents; for example, a student may meet the guidelines for moderate-to-vigorous PA (MVPA) while simultaneously exhibiting high levels of sedentary behavior (7-9).

There is clear evidence that regular PA and reduced sedentary behavior are crucial, independent factors influencing health and quality of life among high school students (1,10). While engaging in MVPA is consistently linked to positive health outcomes—such as improved physical fitness, cardiometabolic health, and cognitive function—adolescents who spend excessive time in sedentary activities face heightened risks of adverse health effects, including poor fitness levels, increased adiposity, and mental health issues (3,5,11,12). Thus, being physically active alone does not mitigate the detrimental impacts of prolonged sedentary behavior. It is recommended that students engage in at least 60 minutes of MVPA daily while minimizing their sedentary behavior. However, a concerning trend is observed, particularly in secondary school students, where physical inactivity and sedentary lifestyles are prevalent. Consequently, promoting healthy behaviors related to PA and sedentary behavior among high school students has become a critical public health priority.

Schools play a crucial role in enhancing students' physical fitness by fostering health, increasing PA, and influencing psychological factors such as knowledge, motivation, and attitudes toward PA (13,14). Physical education (PE) programs provide essential educational frameworks that encourage student engagement in PA (15,16). The school environment serves as a vital

platform to inspire and support youth in becoming more active, ultimately contributing to a healthier society (13,16). Effective implementation of school PA initiatives promotes a comprehensive approach, advocating for at least 60 minutes of daily PA for youth. However, research indicates that nearly 80% of students globally fail to meet these international guidelines (17,18). Studies highlight that school-aged adolescents often do not achieve the recommended daily PA levels, although they tend to be more active on days when they have PE (7,8,17). This underscores the significant impact of sports and PE on students' overall activity levels. Consequently, the participation of students in PA has emerged as a critical focus in research related to PE, exercise, and health, emphasizing the importance of schools in promoting both immediate and long-term engagement in PA.

One of the key factors that enhances individuals' participation in various activities, including physical exercise, is motivation (19,20). Numerous scientific theories have been proposed to explain the role of motivation in human engagement across different activities. Among these, the self-determination theory (SDT) has garnered significant attention regarding individuals' involvement in PA (20-22). This theory focuses on different types of motivation, ranging from autonomous motivation to controlled motivation. In SDT, motivation is identified as a crucial factor influencing human behavior (20). This theory distinguishes between intrinsic motivation (IM), extrinsic motivation, and amotivation, each representing varying degrees of self-determined motivation (23). IM reflects the highest level of self-determination, occurring when individuals engage in activities that they find interesting and enjoyable, thereby providing opportunities for learning. In contrast, extrinsic motivation arises from external sources, manifesting when individuals participate in activities primarily for the value of the outcomes rather than the activities themselves (22,23). While both intrinsic and extrinsic motivations indicate different levels of volition, amotivation signifies a lack of motivation, evident when individuals show no intention or desire to engage in a specific behavior. Motivationally uninspired actions are characterized by passivity and a lack of intentionality (24). When an individual is unmotivated, they lack the desire and will to take action. Such individuals do not value activities, feel inadequate in their ability to engage in them, and believe that their efforts will not yield the desired outcomes. This state often leads to an inability to regulate their behavior, resulting in feelings of incompetence and a perceived loss of control, which frequently drives them away from those activities. Research indicates that individuals with autonomous motivation tend to be more effective in their actions, whereas those driven by external motivation are likely to continue their behaviors only when external rewards are available (23-25).

According to SDT, there are specific psychological and social goals that, when fulfilled, can facilitate an individual's growth, integrity, and well-being. This theory identifies essential needs for personality development and cognition as fundamental psychological needs, which include autonomy, competence, and relatedness. Autonomy refers to the integrated processing of capabilities and the alignment of these abilities with one's emotions, needs, and limitations. It encompasses the need for self-respect and the freedom to make decisions independently while engaging in various activities and responsibilities. Competence is a multidimensional, dynamic, and interactive concept that influences the pursuit of mastery and successful behaviors. Relatedness pertains to the experience of interpersonal relationships and reflects an individual's sense of belonging to a community, the presence of caring relationships, and connections with significant others (19,20).

Among the basic psychological needs, autonomy has garnered significant attention in the research literature concerning individuals' participation in PA. Studies have indicated a positive correlation between support for autonomy and the engagement of youth in PA (26-29). Furthermore, fostering autonomy has been shown to enhance IM for sports participation among these younger populations. However, there has been limited research exploring the impact of AS-interventions on increasing IM and participation in PA among high-school students. This study was designed to expand the existing knowledge regarding the influence of autonomy support (AS) on IM and participation in PA among high-school students. Consequently, the primary aim of this research was to investigate the effects of an AS-intervention in PE on the perceived AS, IM and PA among high-school students.

2. Methods

2.1. Design and Participants

This study employed a semi-experimental design featuring practical applications, utilizing a pre-test and post-test framework alongside a control group. The research focused on 60 male adolescents, aged 16 to 18, recruited from two high schools and divided into two groups of 30: the intervention group and the control group. Participants were randomly assigned to each group using a simple random sampling technique, ensuring equal opportunity for placement and minimizing biases. A power analysis conducted with G*Power indicated that a minimum of 15 participants per group was necessary, with an alpha level of 0.05 and a power of 0.95. Initially, 32 participants were assigned to each group, but two from each group were excluded due to inability to complete the study, resulting in 30 participants per group. Prior to the study, both participants and their parents were informed about the research aims and methods, and written consent was obtained. Each participant underwent a health assessment by a qualified physician, receiving a health certificate and medical clearance for PA. Inclusion criteria mandated that participants be high school male students, free from injuries or illnesses, and unrestricted in cognitive-motor activities, with those not meeting these standards being excluded from the study.

2.2. Measurements

2.2.1. Perceived Autonomy Support

We utilized a five-item scale to evaluate perceived AS in PE (26). Each item was assessed using a Likert scale from 1 (strongly disagree) to 7 (strongly agree). The validity of this measurement tool was established through the evaluation of eight experts, resulting in a

Content Validity Index (CVI) of 0.88 and a Content Validity Ratio (CVR) of 0.90. Additionally, the reliability of the questionnaire was confirmed to be high, with a Cronbach's alpha coefficient of 0.94.

2.2.2. Intrinsic Motivation

IM was assessed through eight items derived from the Intrinsic Motivation Scale (26), with responses measured on a Likert scale from 1 (strongly disagree) to 7 (strongly agree). The validity of this measurement tool was affirmed by eight experts, resulting in a CVI of 0.94 and a CVR of 0.92. Additionally, the reliability of the questionnaire was evaluated, achieving a high Cronbach's alpha coefficient of 0.97.

2.2.3. Leisure Time Physical Activity

The ActiGraph wGT3X-BT accelerometer, a highly validated device from ActiGraph LLC in Pensacola, FL, was employed to objectively assess the intensity and duration of PA. Over the course of a week, the participants wore the device on their right hip, and the accompanying software facilitated data analysis. The established cutoff points for categorizing PA intensity were defined as follows: light PA ranged from 101 to 2,799 counts per minute (CPM), moderate PA from 2,800 to 3,999 CPM, and vigorous PA was identified as any activity at or above 4,000 CPM.

2.3. Procedure

The independent variable in this research was participation in the AS-intervention, which functioned as a professional development opportunity. Both the intervention and control groups participated in this professional development simultaneously, with the program structured into two sessions of three hours each. The first session for both groups occurred one week prior to the start of the intervention, while the second session was held three weeks later for the experimental group and two months later for the control group. The initial workshop for the experimental group began with introductory activities, followed by a PowerPoint presentation that detailed the intervention's goals and the theoretical foundations of AS teaching practices. Teachers were encouraged to enhance students' IM, employ informational language, provide explanatory rationales, and constructively manage negative student emotions. The session incorporated real-life case studies relevant to urban PE, enabling teachers to engage in both individual and collaborative problem-solving regarding challenging teaching scenarios. The workshop concluded with a group discussion focused on potential challenges teachers may face in urban PE environments.

The initial workshop for the control group teachers began with introductory activities, followed by a PowerPoint presentation that addressed the assessment challenges currently faced in the state. This was followed by opportunities for teachers to discuss and reflect on issues pertinent to their daily responsibilities. The focus of this workshop was specifically on curriculum and assessment, intentionally steering clear of teaching practices that might influence the treatment effect. This distinction is vital, as it ensures that teachers in the control group receive a comparable level of exposure, albeit with a different emphasis, compared to their peers in the experimental schools. Three weeks later, the second professional development workshop for the experimental group teachers was held, lasting three hours. This session aimed to empower teachers by allowing them to reflect on their initial experiences, including both successes and challenges in implementing AS teaching practices. The research team facilitated hands-on activities to demonstrate the integration of AS content in PE, alongside group discussions about the instructional strategies teachers had employed throughout the semester. During this workshop, teachers shared positive experiences, voiced concerns, identified potential barriers, and critiqued various instructional methods. The session concluded with a practical gym activity, where teachers learned to enhance their teaching organization, particularly by engaging students in warm-up activities through AS methods rather than the controlling practices typically observed in the metropolitan school district.

2.4. Statistical Analysis

In this research, the variables were defined through the calculation of the mean and standard deviation (SD). The Kolmogorov-Smirnov test was employed to evaluate the normality of the data distribution, revealing P values exceeding 0.05 across all results. Furthermore, analysis of covariance (ANCOVA) was utilized to examine the differences between the two groups from pretest to posttest. A significance level of 0.05 was established for all analyses, and the data were analyzed using SPSS version 27.

3. Results

Table 1 presents the demographic characteristics of the research sample. The average age, height, weight, and BMI of both the selected and non-selected groups were nearly identical.

Table 1. Comparison of the Demographic Data across Groups.

Variable	Intervention	Control	Comparison
Age (years)	16.74 ± 0.23	16.76 ± 0.21	P=0.980
Height (m)	1.70 ± 0.04	1.68 ± 0.03	P=0.876
Weight (kg)	62.58 ± 1.74	62.41 ± 1.56	P=0.928
BMI	21.70 ± 1.33	22.1 ± 1.29	P=0.638

Table 2 presents the mean and SD of the research variables, including perceived AS, IM, and PA (i.e., MVPA) during the pre-test and post-test phases. Regarding perceived AS, the results indicated that both groups exhibited similar levels in the pre-test (P=0.842). However, in the post-test, the intervention group demonstrated significantly higher perceived AS compared to the control group (P<0.001). In addition, regarding IM, the results indicated that both groups exhibited similar levels in the pre-test (P=0.790). However, in the post-test, the intervention group demonstrated significantly higher IM compared to the control group (P<0.001). Finally, regarding MVPA, the results indicated that both groups exhibited similar

levels in the pre-test (P=0.527). However, in the post-test, the intervention group demonstrated significantly higher MVPA compared to the control group (P<0.001).

Table 2. The Results of ANCOVA.

Variable		Intervention	Control	F	P-Value
Perceived Autonomy Support	Pre-test	2.22 ± 0.25	2.19 ± 0.20	13.527	<0.001
	Post-test	4.06 ± 0.36	2.18 ± 0.17		
Intrinsic Motivation	Pre-test	2.03 ± 0.15	2.01 ± 0.13	15.349	<0.001
	Post-test	4.05 ± 0.26	2.02 ± 0.15		
MVPA	Pre-test	22.49 ± 2.17	22.10 ± 2.23	56.638	<0.001
	Post-test	36.41 ± 4.25	21.98 ± 2.14		

4. Discussion

The primary objective was to assess the impact of an AS-intervention in PE on perceived AS, IM and PA. Results indicated that the intervention group reported significantly higher levels of perceived AS, IM, and MVPA in the post-test compared to the control group. These findings suggest that an AS approach in PE can effectively boost motivation and PA levels.

The educational strategies employed in this study included providing students with opportunities for decision-making, avoiding controlling and coercive behaviors, engaging in active listening during PE, utilizing informational language to clarify the objectives of PA, enhancing students' authority and commitment, soliciting their perspectives, and allowing freedom of choice in certain aspects of PA. These strategies have previously been examined for their effectiveness in increasing motivation and PA among youth (22,24,25,27). However, the findings of the current research suggest that the principles of SDT can also be applied to and adolescents (i.e., high-school students). According to SDT, supporting autonomy fulfills basic needs, which in turn enhances autonomous motivation through the process of internalization. Internalization is the process by which behaviors that were previously influenced by external sources become driven by internal causal factors (27,28).

IM plays a crucial role in fostering PA behaviors, as it encourages sustained engagement in activities without the need for external rewards or pressure. For example, when teachers enhance students' IM during PE, they are likely to see improved performance and increased participation in PA (21,22). This enhancement often stems from the support of autonomy, which empowers students to feel in control of their actions, leading to greater feelings of competence and satisfaction. Conversely, a lack of IM necessitates reliance on external incentives to promote PA, which may not cultivate positive emotions or a sense of achievement in PE. Thus, fostering IM in PE is essential and can be viewed as a key aspect of perceived AS. Furthermore, when motivation is nurtured in PE classes, it can extend beyond the classroom, encouraging students to engage in PA (24,25).

The SDT posits that autonomy-related behaviors and the fulfillment of basic needs, such as the need for autonomy, can foster behavioral change through a process known as internalization (19,20). This process involves transforming behaviors initially driven by external motivations into self-motivated actions. As a result, behaviors that were once influenced by external factors become internally driven, reflecting IM. Internalization highlights the fluidity of behavioral contexts, suggesting they can be shaped by supportive elements within environments conducive to fostering autonomy, such as PE. Research indicates that PE teachers can enhance students' IM and persistence in PA by emphasizing autonomous learning and allowing students to make choices regarding their exercise (24,28). Furthermore, studies have shown that when PE teachers provide AS, they facilitate a shift in motivation from external to internal sources. These findings align with previous research, demonstrating that increased AS from PE teachers correlates with heightened IM for PA, which can extend beyond the school environment into leisure activities.

The findings of this study regarding PA revealed that initially, high-school students engaged in less than 30 minutes of MVPA per day, indicating a significantly low level of health-oriented PA. This aligns with previous research (17,18) highlighting the insufficient PA levels among youth, suggesting that adults are not adhering to the WHO's recommendation of at least 60 minutes of MVPA daily. However, as anticipated, exposure to an AS-intervention in PE, compared to traditional teaching styles, resulted in a significant increase in MVPA among high-school students, with the intervention group averaging around 36 minutes of MVPA per day in the post-test. Despite this improvement, students in the intervention group still did not meet the WHO's guideline of 60 minutes of MVPA daily, underscoring the urgent need to enhance overall PA levels within the community.

This study faced several limitations that warrant consideration. Notably, the research focused solely on male adolescents, which may limit the generalizability of the findings to female adolescents. Therefore, it is advisable for future studies to explore the effects of AS specifically among adolescent girls. Furthermore, the absence of a follow-up assessment conducted over an extended period after the initial test restricts the ability to evaluate the long-term impacts of AS. Future research should include follow-up assessments with longer intervals to better understand these effects. Also, despite the intervention, students in the experimental group reached only ~36 minutes/day of MVPA, which is still far below the WHO's recommended 60 minutes/day. This limitation should be more directly addressed in the discussion and conclusion. On a positive note, this study also showcased significant strengths, particularly in its incorporation of AS within PE, suggesting a promising variable that could be integrated with traditional PE practices to improve PA levels of adolescents.

4.1. Conclusion

This study represents one of the pioneering investigations into the effects of an AS-intervention in PE on motivation and objectively measured PA (using accelerometers). The findings indicated that modifying

teaching strategies in PE was effective, as AS-intervention led to an increase in IM and PA among high-school students. These results suggest that the principles of SDT can be applied to high-school students as well. Furthermore, students did not adhere to the WHO's recommendation of engaging in 60 minutes of MVPA daily. Nevertheless, exposure to an AS-intervention resulted in greater participation in MVPA compared to traditional teaching styles. This underscores the positive effectiveness of teaching approaches grounded in SDT. Consequently, PE instructors at schools can enhance students' health-oriented PA levels by employing teaching styles based on SDT, which aligns with one of the primary objectives of general PE courses.

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Footnotes

Authors' Contribution: This study was carried out solely by the corresponding author.

Conflicts of Interest

Non to declare.

Data Availability: The data that support the findings of this study are openly available upon request from the corresponding author.

Ethical Approval: The author confirms that all steps and requirements of this study comply with ethical guidelines. Participants were informed about the characteristics of the study and gave written informed consent.

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