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Original Article

Effect of an Intervention Based on the Picture Exchange Communication System in Physical Education on Physical Activity and Social Skills of Children with Autism

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Abstract

Introduction: It is both essential and significant to undertake research focused on the implementation of innovative educational methods within autism centers.
Objective: This study seeks to investigate the impact of an intervention utilizing the Picture Exchange Communication System (PECS) within physical education (PE) settings on the physical activity (PA) levels and social skills of children diagnosed with autism.
Methods: A quasi-experimental design featuring a pretest-posttest methodology was implemented. The sample comprised 50 children with autism. Participants were categorized into intervention (n=25; 4 girls) and control groups (n=25; 4 girls). The intervention group participated in the PECS during PE over a span of 12 weeks. To evaluate the research variables, accelerometer and The Autism Social Skills Profile were utilized, and the data were subjected to analysis through ANCOVA.
Results: The intervention group engaged in an average of 25.09 minutes of MVPA daily, compared to the control group's average of 26.19 minutes. In addition, the findings revealed that individuals in the intervention group demonstrated a significant enhancement in light PA (F=15.869, P<0.001), MVPA (F=4.857, P<0.001), and social skills (F=14.746, P<0.001) from the pretest to the posttest. In contrast, the control group did not show any significant changes.
Conclusion: Implementation of the PECS method facilitates the enhancement of social skills and increases PA levels among children with autism.

Keywords: Autism Spectrum Disorder, PECS, Exercise Social Skills, Physical Education

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1. Introduction

Autism is a distinct neurodevelopmental condition, both clinically and etiologically, marked by early deficits in social communication and interaction, alongside a variety of repetitive and atypical behaviors (1,2). Typically, the more specific symptoms associated with autism manifest between the ages of 2 and 3, although they can sometimes be identified as early as 18 months (3,4). A critical criterion for the diagnosis of autism is a persistent impairment in social skills (2,3,5). These social skill deficits often hinder children with autism from forming friendships and can result in behaviors that suggest a lack of awareness of others, ultimately leading to social isolation (6). Additionally, a child with autism may exhibit delayed speech development or may be nonverbal (7). While some children may acquire vocabulary or phrases, they often struggle to utilize these effectively for social communication purposes (4,8,9).

Autism often coexists with a range of physical and motor challenges, impacting children diagnosed with the condition (10). These individuals frequently display a variety of movement disorders, which can manifest as unsteady gait, poor posture, coordination difficulties, balance problems, and impairments in both gross and fine motor skills (11,12). Engaging in regular physical activity (PA) is essential for promoting a healthy lifestyle across all age groups and is particularly important for reducing the risk of several chronic health issues (13-15). However, research reveals that a significant number of individuals do not meet the recommended daily PA levels, with this shortfall being especially pronounced among those with disabilities, including those with autism, when compared to their non-disabled peers (16-18). Studies have consistently shown that children with autism engage in markedly less PA than their non-autistic counterparts (19-21). A thorough review of the existing literature underscores a concerning trend of increased sedentary behavior and reduced PA levels among children with autism relative to their peers without autism, highlighting the need for targeted interventions to promote physical engagement in this population (22).

The importance of social skills and engagement in PA for the long-term well-being of children with autism cannot be overstated. Therefore, it is essential to explore effective strategies and interventions that can enhance social abilities and encourage increased PA among this population. A well-designed physical

education (PE) program can act as a valuable intervention, addressing the challenges posed by physical inactivity in children diagnosed with autism (23,24). A program of this kind enhances not only physical fitness but also fosters the growth of psychomotor skills, cognitive functions, social interactions, and emotional health in children (25,26). Research consistently highlights the positive effects of PE and sports on children's mental and physical development, as well as their overall fitness (27,28). An increase in PA is linked to enhancements in health, cognitive abilities, and both behavioral and social skills (23,26). Research and comprehensive meta-analyses have shown that engaging in regular PA significantly improves muscular and cardiovascular endurance, as well as enhances strength and flexibility in individuals with intellectual disabilities (24-26). Nevertheless, there remains a significant gap in understanding the extent to which these benefits apply to children with autism.

The Picture Exchange Communication System (PECS) is a technology-driven approach designed to facilitate communication for individuals with developmental disabilities (29). This system is particularly beneficial in instances where typical speech development is hindered. PECS operates similarly to a communication board, utilizing images to convey messages. It not only fosters communication abilities but also significantly mitigates behavioral issues and supports speech development (30). For many years, the PECS training has been employed to impart skills to individuals with autism and other related conditions that they may struggle to acquire independently (31). Prior to training, the individuals may not be familiar with the subjects, verbs, and objects involved. The methodologies applied in this training can differ across several critical dimensions; however, they generally focus on identifying the essential components of the targeted skills and selecting training objectives that combine these elements (32). The overarching aim of these training programs is to enhance the child's capabilities, encourage social interaction, teach practical skills, and diminish negative behaviors (29). In addition, PECS is an instructional framework designed to facilitate nonverbal (symbolic) communication (30). A substantial body of research has demonstrated the efficacy of this program in enhancing learning outcomes and developing a range of skills among individuals with autism (30,31,33). The primary objective of the PECS is to establish and reinforce a communication network between the child and their surroundings. As a contemporary educational strategy, PECS serves as an alternative image-based communication method that significantly contributes to alleviating the symptoms associated with autism (32,33). Therefore, it is crucial to comprehend the impact of PECS on the diverse skill sets of children diagnosed with autism.

Given the previously discussed challenges and the variety of educational approaches available, it is both essential and significant to undertake research focused on the implementation of innovative educational methods within autism centers. This research should involve an analysis of the PECS method in the PE, assessing its respective advantages and disadvantages. As this study aims to evaluate the efficacy of an intervention in PE based on PECS for children with autism, it has the potential to address existing gaps in the literature. Despite the significant prevalence of autism globally, research on this subject remains insufficient. Given the aforementioned context, it is evident that the impairments in language and social skills, coupled with reduced PA levels among children with autism, lead to adverse effects on their quality of life. Consequently, it can be argued that interventions designed to enhance social skills and encourage PA in children with autism are beneficial. Furthermore, this study addresses the scarcity of research regarding the PECS intervention in PE for children with autism. Hence, this study examined the effect of an intervention based on the PECS in PE on PA and social skills of children with autism. The findings of this investigation will be invaluable for researchers and educational institutions seeking to implement the most effective strategies to improve the circumstances of these children. The central inquiry of this study, therefore, is whether PECS intervention methods utilized in PE are effective in enhancing social skills and increasing PA levels among children with autism.

2. Methods

2.1. Participants

The present study utilizes a semi-experimental design featuring a pretest-posttest structure with a control group. The sample size was determined using G*Power software, with a significance level set at 0.05 and a power of 0.95. The research involved 50 children diagnosed with autism from special education institutions, comprising 42 boys and 8 girls. The sample was obtained through convenience sampling and were equally divided into intervention and control groups (21 boys and 4 girls), all diagnosed with autism by certified professionals. Inclusion criteria required the consent and cooperation of parents and educators, the absence of severe intellectual disabilities, no comorbid disorders aside from autism, and no acute physical illnesses. Exclusion criteria included participation in other treatment programs, incomplete questionnaire responses, and absence from more than two sessions.

2.2. Measurements

2.2.1. Physical Activity

PA was assessed using an accelerometer for seven days. To enhance compliance and ensure proper usage, regular communication was maintained via WhatsApp. After the monitoring period, the accelerometer data were extracted, processed, and analyzed with the appropriate software. The instrument's reliability was confirmed by a Cronbach's alpha coefficient of 0.93.

2.2.2. Social Skills

The Autism Social Skills Profile (34) serves as a tool for assessing the social skills of children with autism. This detailed assessment consists of 44 items designed to evaluate a range of social behaviors in children with autism. It can be completed by parents, educators, or any adult familiar with the child's social interactions, taking approximately 15 to 20 minutes to finish. Respondents use a four-point Likert scale to rate each item, where 1 means "never," 2 stands for "rarely," 3 indicates "often," and 4 signifies "always," with higher scores reflecting more positive social behaviors. In this

study, a panel of eight experts evaluated the questionnaire's validity, achieving a Content Validity Index (CVI) of 0.90 and a Content Validity Ratio (CVR) of 0.92, confirming its effectiveness. Furthermore, the reliability analysis yielded a Cronbach's alpha coefficient of 0.94, indicating strong internal consistency.

2.3. Procedure

In accordance with ethical standards, the research objectives were clearly communicated to both participants and their guardians, who were informed of their right to withdraw from the study at any point. A consent form outlining the terms of participation was then provided, and parents were given a copy to sign upon agreeing to their child's involvement. One week prior to the start of the protocol, children, accompanied by their parents, collected an accelerometer from the examiner to monitor their PA levels and sedentary behaviors. The intervention group subsequently engaged in a three-month program, while the control group did not receive any specialized training during this time. At the end of the intervention, all participants completed a post-test under the same conditions as the pre-test. Participation in the intervention, which integrated PECS into PE curriculum, was mandatory. The intervention group attended PE that employed PECS model, aimed at promoting effective communication among children, teachers, and peers, as well as developing interpersonal skills through collaborative activities over the course of three months and twelve lessons (30,31). In contrast, the control group participated in conventional PE characterized by individual drills and repetitive exercises aimed at skill development and procedural mastery. The design of the intervention program was informed by previous research on PECS methodologies, which included objectives such as "learning to communicate," "increasing distance and persistence in communication," "discriminating pictures," "constructing simple sentences," "answering questions," and "commenting." Participants completed paper-based questionnaires on the first (pretest) and last days (posttest) of the intervention.

2.4. Statistical Analysis

In this investigation, the research variables were defined through the computation of the mean and standard deviation (SD). The normality of the data distribution was evaluated utilizing the Kolmogorov-Smirnov test, with all outcomes demonstrating P>0.05. Furthermore, an analysis of covariance (ANCOVA) was performed to examine the impact of the intervention on the research variables. A significance threshold of 0.05 was established for all statistical evaluations. Data analysis was executed using SPSS software version 27.

3. Results

The mean ages for the intervention and control groups were 8.55 ± 0.14 years and 8.57 ± 0.16 years, respectively, showing no statistically significant differences (P>0.05). Furthermore, the average BMI for the intervention group was 17.85 ± 0.85, while the control group had a BMI of 17.80 ± 0.82, with no significant differences noted (P>0.05).

Table 1 displays the mean and SD of the PA patterns, which include light PA, moderate PA, vigorous PA, MVPA, and sedentary time, alongside social skills scores during both the pretest and posttest phases across groups. The data indicate that there are no statistically significant differences between the intervention and control groups regarding light PA (533.86 ± 53.74 for the intervention group and 529.54 ± 52.47 for the control group, t = 0.534, P > 0.05), moderate PA (148.85 ± 13.77 and 157.43 ± 12.93, respectively, t = 0.341, P > 0.05), vigorous PA (26.84 ± 3.39 and 25.93 ± 3.84, respectively, t = - 0.417, P > 0.05), MVPA (25.09 ± 4.76 and 26.19 ± 3.83, respectively, t = - 0.208, P > 0.05), sedentary time (4856.52 ± 247.33 and 5869.74 ± 251.70, respectively, t = 0.173, P > 0.05), and social skills (105.28 ± 7.39 and 106.86 ± 7.24, respectively, t = - 0.308, P > 0.05). These findings imply that the research groups were comparable in terms of the study variables before the intervention began.

Table 1. Mean and SD of PA Pattern and Social Skill Scores in the Pretest and Posttest Across Groups.

	Intervention		Control	
	Pre-test	Post-test	Pre-test	Post-test
Light PA (min/week)	533.86 ± 53.74	603.84 ± 61.54	529.54 ± 52.47	531.29 ± 53.02
Moderate PA (min/week)	148.85 ± 13.77	176.28 ± 16.65	157.43 ± 12.93	155.98 ± 11.87
Vigorous PA (min/week)	26.84 ± 3.39	29.59 ± 4.41	25.93 ± 3.84	26.10 ± 3.59
MVPA (min/day)	25.09 ± 4.76	29.41 ± 5.34	26.19 ± 3.83	25.14 ± 3.39
Sedentary (min/week)	4856.52 ± 247.33	4734.22 ± 242.63	5869.74 ± 251.70	5870.32 ± 247.40
Social skills	105.28 ± 7.39	132.55 ± 12.58	106.86 ± 7.24	105.90 ± 6.91

The results concerning the impact of the intervention on the research variables are summarized in Table 2. In terms of PA patterns, the data revealed that participants in the intervention group experienced an increase of 27.43 minutes/week in their participation in light PA from the pre-test to the post-test (with scores of 533.86 ± 53.74 and 603.84 ± 61.54 for the pretest and posttest, respectively). Conversely, the control group did not demonstrate any significant changes in their scores (recording 529.54 ± 52.47 and 531.29 ± 53.02 in the pretest and posttest, respectively). The ANCOVA analysis indicated a statistically significant effect for the group (F = 15.869, P < 0.001), highlighting a notable difference between the intervention and control groups. These results imply that involvement in a PECS intervention within PE has resulted in increased engagement in light PA among children with autism.

Moreover, in terms of MVPA, the data revealed that participants in the intervention group experienced an increase of 4.32 minutes/day in their participation in MVPA from the pre-test to the post-test (with scores of 25.09 ± 4.76 and 29.41 ± 5.34 for the pretest and posttest, respectively). Conversely, the control group did not demonstrate any significant changes in their scores (recording 26.19 ± 3.83 and 25.14 ± 3.39 in the pretest and posttest, respectively). The ANCOVA analysis indicated a statistically significant effect for the group

(F = 4.857, P < 0.001), highlighting a notable difference between the intervention and control groups. These results imply that involvement in a PECS intervention within PE has resulted in increased engagement in MVPA among children with autism.

Furthermore, regarding sedentary behavior, the findings indicated that participants in the intervention group experienced a reduction of 122.30 minutes per week in their sedentary time from the pre-test to the post-test, with pre-test and post-test scores of 4856.52 ± 247.33 and 4734.22 ± 242.63, respectively. In contrast, the control group showed no significant changes in their scores, which were 5869.74 ± 251.70 for the pre-test and 5870.32 ± 247.40 for the post-test. The ANCOVA analysis revealed a statistically significant effect for the group (F = 6.452, P < 0.001), underscoring a significant difference between groups. These findings suggest that participation in a PECS intervention within PE has led to a reduction in sedentary time among children with autism.

The results pertaining to social skills revealed that participants in the intervention group exhibited an increase of 27.27 in their social skills scores from the pre-test to the post-test, with initial and final scores recorded at 105.28 ± 7.39 and 132.55 ± 12.58, respectively. In contrast, the control group did not demonstrate any notable changes in their scores, which were 106.86 ± 7.24 for the pre-test and 105.90 ± 6.91 for the post-test. The ANCOVA analysis indicated a statistically significant effect for the group (F = 14.746, P < 0.001), highlighting a meaningful difference between groups. These results imply that engagement in a PECS intervention within PE has contributed to an enhancement in social skills among children diagnosed with autism.

Table 2. Comparison of Research Variable between Groups.

	F-Value	P-Value	η^2
Light PA (min/week)	15.869	<0.001	0.352
Moderate PA (min/week)	9.541	<0.001	0.217
Vigorous PA (min/week)	1.024	>0.05	0.012
MVPA (min/day)	4.857	<0.001	0.112
Sedentary (min/week)	6.452	<0.001	0.134
Social skills	14.746	<0.001	0.156

4. Discussion

Hence, this study examined the effect of an intervention based on the PECS in PE on PA and social skills of children with autism. Analysis of the baseline accelerometer data revealed that the intervention group engaged in an average of 25.09 minutes of MVPA daily, compared to the control group's average of 26.19 minutes. These findings indicate that the children with autism involved in this study did not meet the recommended guideline of 60 minutes of MVPA each day. This trend aligns with previous studies (16,17,19,22) that highlight a concerningly low level of participation in health-related PA among children with autism. Consequently, it can be deduced that insufficient PA is a prevalent issue within this demographic. Contributing factors may include limitations in educational initiatives, inadequate access to sports facilities and equipment, the financial implications associated with certain sports, and prevailing cultural attitudes (18,19). Therefore, it is crucial to focus on PA behaviors of children with autism in the context of health-related interventions and programs.

Regarding PA, the results of this study revealed that exposing to the PECS intervention in PE resulted in an increase in light PA and MPVA as well as a decrease in sedentary behavior in children with autism. Although there has been limited research on the positive impact of participation in the PECS intervention on PA levels of children with autism, the findings of this study align with previous research (35) and indicate a beneficial effect of the PECS method in PE on enhancing PA levels of these children. Furthermore, the results of this study revealed that the PECS intervention contributed to improvements in social skills among children with autism, which is consistent with earlier findings. It is noteworthy that previous studies were conducted in settings outside of PE, and this research adds new insights to the existing literature by implementing the PECS intervention within a PE context.

To interpret these findings, it can be stated that a notable feature of the PECS is its emphasis on the tangible exchange of images within an interactive setting, which enhances the interaction and social communication abilities of children diagnosed with autism (29). Children with autism often exhibit reduced motivation towards social communication responses, such as verbal praise, in contrast to more concrete and discernible reactions, like receiving a desired object. Furthermore, the PECS serves to initiate communication and foster social interaction skills by engaging children with autism through objects or activities that capture their interest (30). The implementation of PECS has also been associated with an increase in spontaneous language use, as well as the ability to make requests and express opinions through both visual symbols and spoken language across various contexts (31).

Impairments in various aspects of communication and social interaction, coupled with difficulties in emotional regulation, adversely affect a child's capacity to meet and respond appropriately to both personal and external expectations (32). Consequently, this leads to an increased susceptibility to maladaptive behaviors. Numerous studies have provided substantial evidence regarding the emotional experiences and competencies of children with autism; however, these individuals tend to exhibit heightened negative emotions and insufficient emotional regulation. The emotional challenges faced by children with autism are significant, with a notable deficiency in their ability to regulate, express, and recognize emotions (33). These difficulties pose considerable barriers to forming close relationships and developing social connections. By acquiring strategies for managing and regulating emotional experiences, individuals with autism can enhance their communication abilities, thereby alleviating stress in various contexts (34). Implementing a communication system that utilizes image exchange, along with modifying the environment to facilitate interactions and increase communication opportunities, can also

promote the rapid development of social skills and improve adaptation to their surroundings in children with autism. It can be asserted that the PECS, with its primary emphasis on fostering initiation in communication through a system of reinforcers and incentives, may effectively contribute to the enhancement of spontaneous communication in children with autism (32,33). As a result, improvements in social skills and increased motivation to engage in physical activities have been observed within the experimental group.

This study faced several limitations that should be acknowledged. The absence of a follow-up assessment conducted after the intervention limits the evaluation of the long-term effects of PECS interventions in PE. To better understand these impacts, future research should include follow-up assessments over extended periods. However, a significant strength of this study is its application of PECS interventions within PE, providing valuable insights that can inform strategies to improve PA among children.

4.1. Conclusion

The findings of the current study indicate that the implementation of the PECS method facilitates the enhancement of communication abilities and increases PA levels among children with autism. This advancement in skills enables these children to achieve better control and regulation of their emotions and feelings. Consequently, this method can be regarded as an effective strategy for fostering emotion regulation skills and enhancing both social skills and PA in children with autism.

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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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