

Article

Effect of a Service-Learning Program on the Active Lifestyle of Children with Autism Spectrum Disorder: A Pilot Study

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Abstract: Background: active lifestyles and Physical Activity (PA) are closely related to health. Healthy habits such as being physically active should be consolidated during childhood. Children with Autism Spectrum Disorders (ASD) present fewer opportunities to be involved in PA. For this reason, we conducted a Service-Learning (SL) program to enhance the possibility of participating ASD children enjoying PA sessions. The aim of this study was to analyze and describe the evolution in terms of the frequency and intensity of PA performed by ASD children who participated in the SL program. Methods: we used a quasi-experimental design. The sample was formed by 26 children with ASD (Experimental group: $n = 16$; 4 girls, 12 boys) (Control group: $n = 10$; 1 girl, 9 boys) with ASD level 1. Results: after the intervention program, moderate PA during the week increased significantly (Pre-Median: 92.04, Range: 35.71–126.47 min; Post-Median: 212.67, Range: 99.75, 271.04 min) ($p \leq 0.001$). When comparing both groups, the tendency to do PA in the Experimental group remained more stable. Also, the improvements in moderate intensities were higher in the Experimental group after the intervention. Conclusion: a six-month SL program improved the moderate PA routines of ASD children. However, longer programs and longitudinal studies are required.

Keywords: autism spectrum disorders; physical activity; service learning; accelerometers; health

1. Introduction

As stated by the WHO [1], health is not only the absence of illness but the quality of life that we add to our days. Childhood and adolescence are particularly sensitive periods during which environmental factors may influence individuals' present and future health [2]. According to Sallis [3], behavior is one of the factors that has the greatest effect on lifelong health. It is therefore fundamental to establish healthy habits during childhood, which will become ingrained throughout the child's lifetime [4]. Active lifestyles and Physical Activity (PA) are closely related to health, so it is important that children practice moderate or vigorous PA regularly. In other words, children should become more physically active during their days because this may lead to improvements in their quality of life. For instance, this can be achieved by increasing their social interactions through PA or even by including active displacements to the study center [5]. It is therefore a matter of enhancing the quality of their lives, not just analyzing their performance or intensity at specific moments.

The practice of PA, inside and outside the school context, is a fundamental tool for enhancing an active lifestyle. This is one of the most highlighted objectives and a general concern of today's society, especially with the aim to prevent the emergence of weight-related illnesses, such as type 2 diabetes mellitus [6].

Children with Autism Spectrum Disorders (ASD), in particular, are characterized as displaying stereotyped repetitive behaviors, lower spontaneous social interactions and restricted interests in comparison to Typically Developing (TD) children [7,8]. Social constrictions are highlighted as one of the most restricted parameters that influences ASD children's participation during PA [9]. This is something that research has shown by analyzing strategies to increase the interactions of ASD children with their peers at school [10–12], as well as their physical fitness, motor skills [13,14], and participation in after-school activities [15,16].

PA is also a fundamental factor in their social relationships [17]. While doing PA, children have the opportunity to use different materials and engage in spontaneous interactions in standardized contexts [18], therefore reducing restricted, stereotyped, and repetitive behaviors [19] and enhancing motor skill proficiency [20]. In this regard, social activities favor self-regulation [21], which consists of performing actions in response to the social information perceived in a certain context, thus increasing their emotional state and reducing rigid encounters.

Accelerometers are one of the objective instruments for measuring PA most widely described in the literature. This instrument facilitates the description of the frequency and intensity of PA practice [22]. Different studies have aimed to describe the PA levels of children with ASD [12,23–25]. However, to date, very few studies have reported the quantity and quality of PA in children with ASD after a physical education intervention. It is important to bear in mind that people with ASD tend to have over- or under-sensitivity, and it is necessary to consider how the technologies they may use can affect them [26].

The intervention program, the effects of which are analyzed in this study, was implemented as a Service-Learning (SL) initiative carried out in a Physical Education Teacher Education (PETE) program. SL is defined as a teaching methodology that seeks to develop academic and professional skills in the students involved. In PETE programs, SL involves physical interaction and active participation of both the PETE students and the people receiving the service, in this case children with ASD [27–29].

Previous research reveals SL as an optimal innovative proposal for implementing PA programs in disadvantaged populations, which combine and integrate the service into the community with formal learning [30,31], developing the necessary social and professional skills in the area of physical education and sports [32]. In this respect, participation in an SL program might lead to higher PA intensity and frequency, as children with ASD might show greater interaction with their peers and also with the participants who perform the service.

Therefore, from a combined physiological and a social perspective centered on promoting the active lifestyle of children with ASD, the aim of this study was to analyze and describe the frequency and intensity of the PA practice of children with ASD before and after participating in a 6-month active program using SL methodology. Our hypotheses were that: (1) ASD children would have better results in moderate and vigorous activity parameters during the week and weekend after implementation of this program, and (2) ASD children who participated in the intervention program would show a stronger increase in PA levels in comparison with the Control group.

2. Methodology

2.1. Design

The study used a quasi-experimental design of two non-equivalent groups (Experimental and Control), with pre-test and post-test measures, to compare how participation in an SL program based on PA promotion affected children with ASD.

2.2. Sample

The researchers contacted entities that serve children with ASD and schools throughout Castellón's region to recruit study participants. They were informed about the research and the criteria for participating. All participants had a clinical diagnosis (made by trained professionals) based on the diagnostic standards for ASD established in the DSM-IV-TR [33] or DSM-V-TR [34], as well as an IQ > 70 and some degree of functionality in communicating, understanding and following instructions. Among the types of ASD that exist, level 1 is the mildest because its symptoms are not acute or deep. Usually, children diagnosed with this condition have a good memory capacity. However, they tend to have mental rigidity and ideas associated with obsession, which may be accompanied by motor clumsiness.

The sample was formed by 26 children (Experimental group: $n = 16$; 4 girls, 12 boys; age: 10.46 ± 2.47 years; height: 138.29 ± 14.09 cm; body mass: 38.20 ± 17.03 kg; BMI: 19.70 ± 6.42 ; ~75th percentile) (Control group: $n = 10$; 1 girl, 9 boys; age: 10.13 ± 3.09 years; height: 140.13 ± 17.18 cm; body mass: 37.21 ± 16 kg; BMI: 18.17 ± 5.30 ; 75th–85th percentile) with ASD level 1. The samples were previously compared in order to verify that they were not significantly different (age: $p = 0.809$, height: $p = 0.692$, body mass: $p = 0.189$). Figure 1 shows the participants' flow chart.

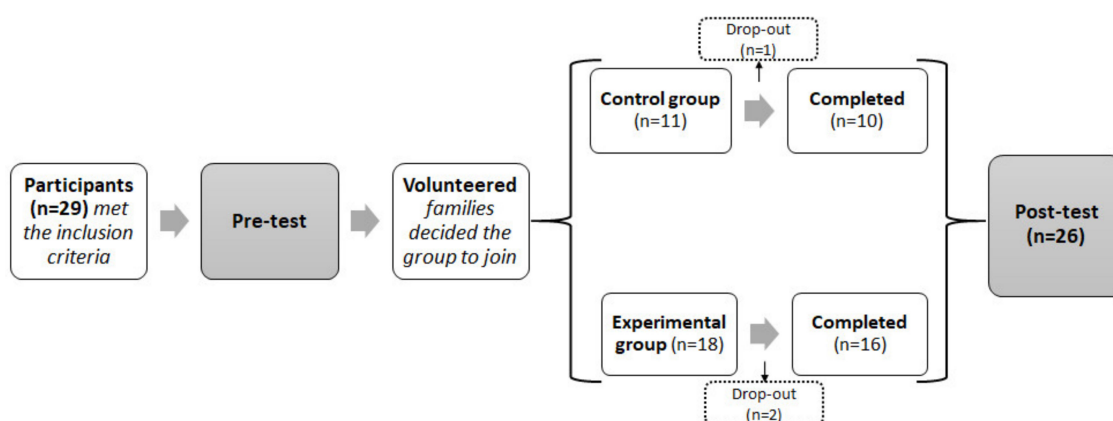


Figure 1. Participants' flow chart.

2.3. Intervention Program

The Experimental group undertook a PA program twice a week for a duration of one hour each session between November and May. The program was implemented at Universitat Jaume I in Castellón (Spain). The sessions were led by PETE students who were guided and supervised by their educators. These students had been learning how to implement inclusive physical education sessions and how to adapt them specifically to ASD children. Therefore, thanks to the SL program, they were able to put into practice the theoretical concepts and teaching skills learned in class, complementing and deepening them. The aim of the program was to promote active life-styles by implementing long-lasting and autonomous PA habits in children with ASD. Participants showed a high adherence to the program (91.2% average attendance). The sessions' design was previously sent to the families so they could help the children anticipate the tasks at home. All sessions had a very simple structure, focusing on providing the children with opportunities for future practice of healthy, recreational and educational PA: 5 to 10 min of simple warm-up activities, 45 min of activities or games focusing on motor skills and body expression, and a dynamic cool-down to finish the session. Each session was composed of both group dynamics based on social interaction (e.g., parachute games, teamwork and dancing games), which were carried out mainly during the warm-up and cool-down parts of the session, and analytical activities in groups of three or four children based on age ranges (e.g., manipulative skills, balance and gross coordination). The SL tasks followed some of the guidelines that had been used in previous SL programs [35]. Each PE session was supported by a number of PETE

students, which made it possible for the ratio of children to staff to be between 3 and 5, depending on each session and age group. On the other hand, the children in the Control group did not carry out extracurricular activities that involved PA, as reported during interviews with the families.

2.4. Materials and Procedure

PA intensity and frequency was assessed using triaxial accelerometers (Actigraph, xGT3X-BT, Pensacola, FL, USA). This is a small device (size: 4.6 cm × 3.3 cm × 1.5 cm; weight: 19 g) that measures PA in three planes at an epoch length of 10 s. Specifically, it was placed on the children's right hip for seven days. Specific guidelines were offered to the families on how to use the accelerometer so that it did not affect the children sensorially. Data were collected between October and first week of June, before and after the intervention program, respectively.

2.5. Physical Activity Data Reduction

The data obtained from the accelerometers were processed using Actilife software (version 6.13.3, Actigraph), selecting the criteria of Troiano [36]. Non-wear time period was considered over 60 min. From these data, we obtained the minutes per day and percentage of time that each child performed PA at different intensities.

2.6. Data Analysis

The data obtained from the accelerometers were exported to Excel (version 10 for Windows, Microsoft). We performed statistical analysis using SPSS software (version 26, Chicago, IL, USA). Descriptive values were used for characterization of the sample (mean ± standard deviation). Median and Interquartile Range (IQR) counts per minute were examined in the categories of Sedentary, Light, Moderate, Vigorous and Very Vigorous. We only examined moderate and vigorous intensities, as they are the ones reported in specialized literature. After performing the normality test, the data were compared using a T-Wilcoxon to assess the Pre and Post conditions, considering the differences significant when they were $p \leq 0.05$. Mann-Whitney tests were performed to compare the differences between Pre and Post for the Experimental and Control group characteristics and results, at a level of significance of $p \leq 0.05$. Moreover, Spearman's bivariate correlations were analyzed ($p \leq 0.05$).

2.7. Ethical Considerations

All parents or legal guardians of the children signed an informed consent form during an informative session prior to the start of this study. During this informative session, the researchers provided information about the data they were going to analyze. This study was approved by the University's Institutional Review Board. All the researchers followed the ethical guidelines established in the Declaration of Helsinki [37].

In order to counteract ethical issues, the families of the participating children could decide whether to be included in the Experimental or the Control group, so that everyone had the opportunity to attend to the PA program. Likewise, the following academic year a similar program was repeated without restriction of access.

3. Results

According to the results observed in our study, the participants of the 6-month intervention program showed a significant increase in the number of minutes of PA performed at a moderate intensity during the week (Pre-Median: 92.04, IQR: 35.71–126.47 min; Post-Median: 212.67, IQR: 99.75–271.04 min) ($p \leq 0.001$). Non-significant improvements were also observed in the weekend moderate (Pre: 146.25, IQR: 89.50–259.13 min), weekend vigorous (Pre-Median: 1.25, IQR: 0.13–11.00 min; Post-Median: 3.00, IQR: 0.50–6.88 min) and during the week vigorous intensities (Pre-Median: 1.42, IQR: 0.20–8.60 min; Post-Median: 5.33, IQR: 0.83–12.00 min) (Figure 2). Therefore, the first hypothesis was partially

confirmed since there was a general improvement, but statistically significant results were only found in some outcomes.

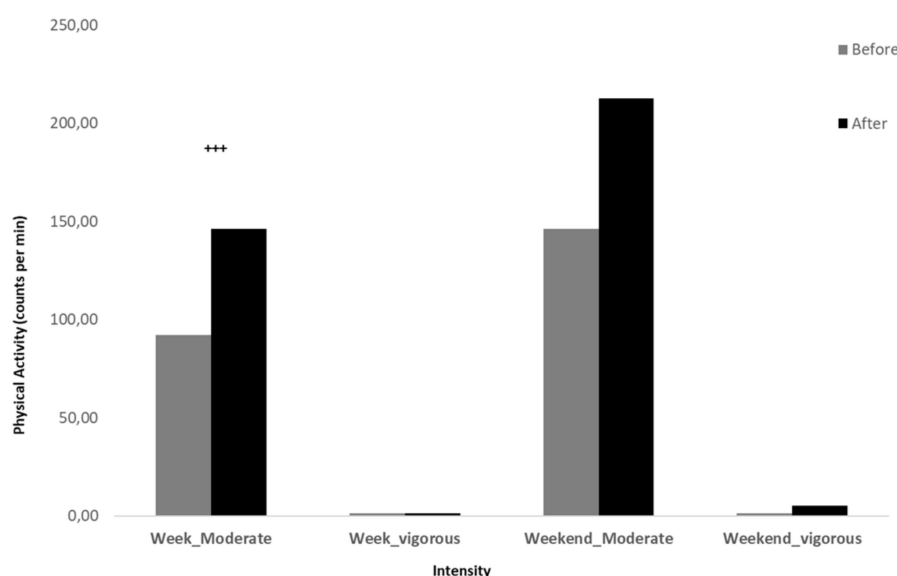
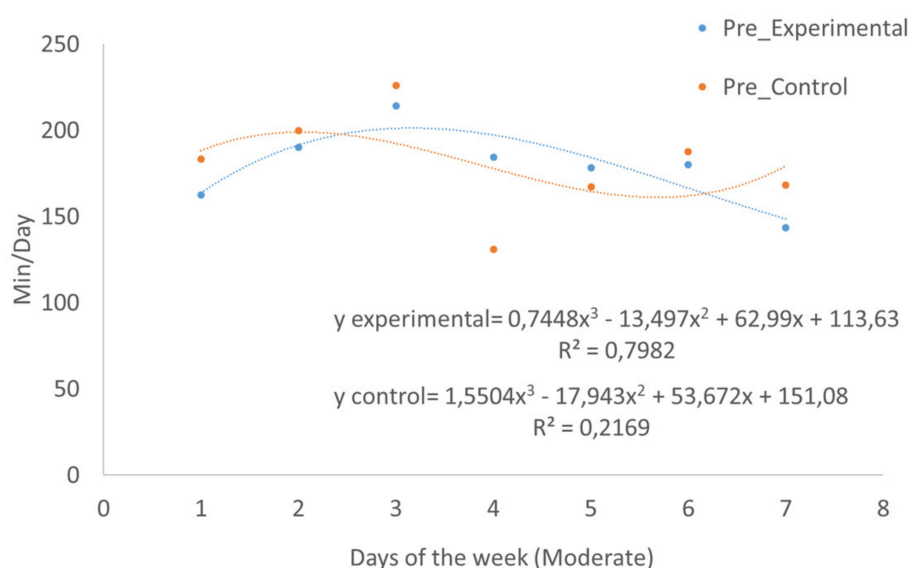


Figure 2. Number of minutes of PA at moderate and vigorous intensities during the week and weekend performed by the participants of the 6-month intervention SL program. ***: $p \leq 0.001$.

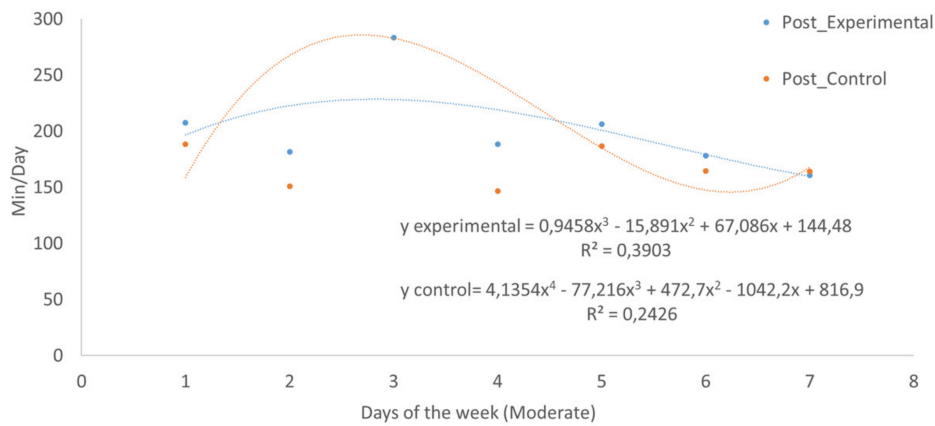
The number of hours of PA correlated, in all cases, during the weeks and weekends and at moderate and vigorous intensities. The results from the Pre moderate intensity during the week correlated with the week vigorous ($r = 0.84, p < 0.001$) and weekend vigorous ($r = 0.58, p < 0.05$). The results from the Post week moderate intensity correlated with the week vigorous ($r = 0.74, p < 0.010$) and very vigorous ($r = 0.63, p < 0.010$).

When specifically analyzing the results observed in the Experimental and Control groups for moderate PA, we observed that in both groups the values increased. However, the values in the Experimental group remained more stable throughout the days assessed (Figure 3a,b) in comparison to the Control group.



(a)

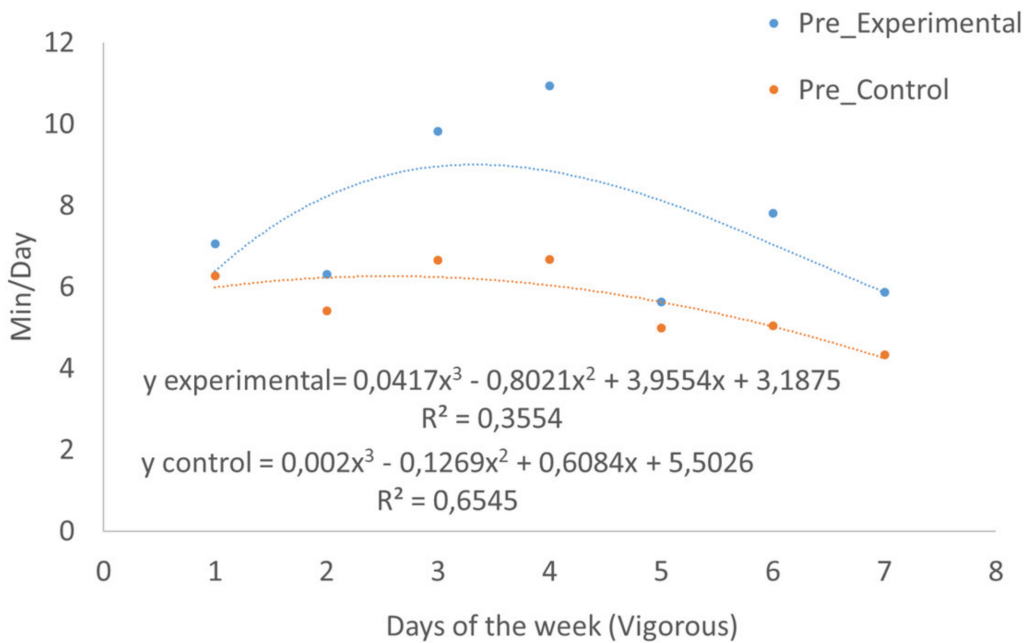
Figure 3. Cont.



(b)

Figure 3. (a) Moderate intensity PA performed by the Experimental and Control groups before participation in the program. We show the adjustment equation; (b) Moderate intensity PA performed by the Experimental and Control groups after the 6-month intervention program. We show the adjustment equation.

For vigorous intensity, we also observed that the Experimental group tended to participate in more minutes at vigorous intensities (Figure 4a,b). Moreover, this tendency was more stable in the Experimental group after the intervention program, in comparison with the Control group.



(a)

Figure 4. Cont.

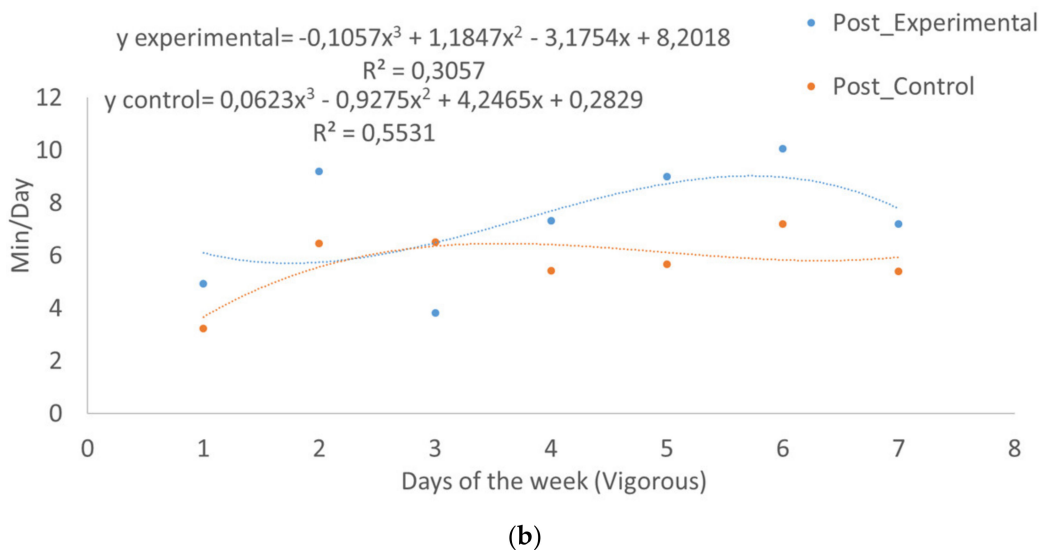


Figure 4. (a) Vigorous intensity PA performed by the Experimental and Control groups before participation in the program. Adjustment equations are shown; (b) Vigorous intensity PA performed by the Experimental and Control groups after the 6-month intervention program. Adjustment equations are shown.

From these values, we observed significant differences in the intensities of PA performed by the Experimental and Control groups. Differences between Pre and Post were especially significant for day 3 ($p = 0.017$) and 4 ($p = 0.006$) at a moderate intensity, (Figure 5a) and for day 4 at a vigorous intensity ($p = 0.041$), as well as day 6 ($p = 0.015$) and day 7 ($p = 0.005$) (Figure 5b).

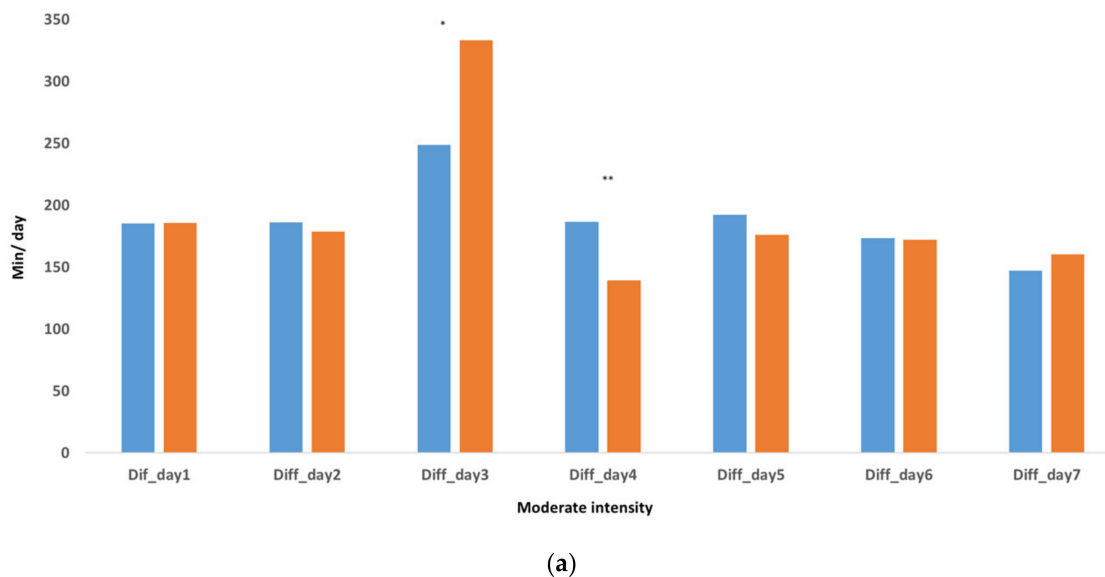


Figure 5. Cont.

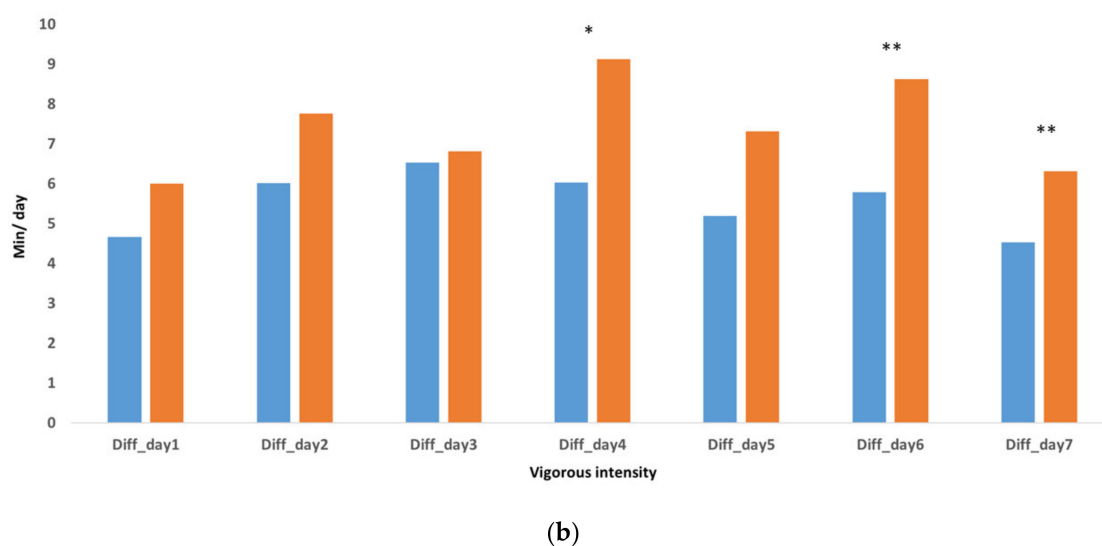


Figure 5. (a) Differences between Pre and Post for moderate intensity of the Experimental and Control groups. Significant differences are also shown. *: $p \leq 0.05$, **: $p \leq 0.010$, ***: $p \leq 0.001$; (b) Differences between Pre and Post for vigorous intensity of the Experimental and Control groups. Significant differences are also shown. *: $p \leq 0.05$, **: $p \leq 0.010$, ***: $p \leq 0.001$.

4. Discussion

The goal of the investigation was to analyze and describe the frequency and intensity of PA levels in children with ASD, before and after they participated in a 6-month intervention program using SL methodology. The main findings were consistent with our hypotheses: (1) ASD children have better results in moderate and vigorous PA parameters after the implementation of this program, and (2) the group that participated in the program shows greater differences in moderate and vigorous PA levels when pre- and post-test measures are compared.

It is fundamental to establish healthy habits during childhood in order to promote a better quality of life [4], and active lifestyles are essential in this regard [38]. For example, a recent systematic review and meta-analysis found that PA has a significant overall effect on mental health in children and adolescents [2]. Despite the literature regarding the PA participation of people with ASD being inconclusive [39–41], several authors claim that more exercise programs should be carried out in order to enhance the quality of life of this population [12].

In this vein, regarding the first hypothesis, the SL program presented in this study entailed an increase in PA levels when the pre- and post-test measures of the Experimental group were compared. Specifically, this increase was significant for moderate intensity during weekdays and more moderate for the vigorous intensity weekdays, as well as the weekend moderate and vigorous intensities. Our findings are consistent with those of García, Leahy, et al. [42]. They examined the efficacy of an 8-week judo program among young people with ASD, and the percentage of time spent in moderate and vigorous PA significantly increased after their participation. However, interventions do not always show such clear increases in moderate and vigorous PA levels [43]. For instance, some studies claim that young people with ASD record higher PA counts on weekdays compared to weekends [44,45]. However, the results obtained by García Pastor et al. [46] indicate that normal-weight ASD children and adolescents tend to record more moderate and vigorous PA during weekends. Finally, the overall findings of a systematic review suggest no differences in PA between weekdays and weekends [39]. The conflict between these viewpoints might be related to the age of the ASD participants because younger children seem to be more active at the weekend than they are during weekdays, while the opposite seems to be true for older children [25].

Also, our results may be explained by the fact that many ASD children seem to go straight home after school and engage in sedentary, technology-based activities that contribute to inactivity [16].

Therefore, it is not surprising that before the program, moderate and vigorous PA levels were low. However, the children's participation in the SL program seems to have changed this reality and their routines, because after the program was developed their PA levels significantly increased on weekdays. Thus, our results suggest that the SL program has not only helped promote the participants' physical health but has also helped improve their physically active lifestyle. This is the reason why free time on weekdays and at weekends is an appropriate target when promoting PA in ASD children [25].

In relation to the second hypothesis, we observed that in both groups, the values increased for moderate and vigorous PA intensities. However, improvement in the Experimental group was higher. This improvement was observed at both moderate and vigorous intensities. Nevertheless, the differences were stronger in the category of moderate weekday intensity. Usually, ASD children spend more time in moderate PA than in vigorous PA and, in fact, there is general concern because studies suggest that they spend a very small portion of time at vigorous PA levels, particularly after school [24]. In this regard, our results suggest that participation in the SL program may be related to the improvement in the time spent at moderate and, especially, vigorous PA levels.

In general, there is a lack of opportunities for engaging in PA or sports programs that are aimed specifically at ASD children. This means that families may be limited to few options for their children [40]. However, programs should be carefully planned and implemented. In other words, the quality of the interventions should be ensured because the enjoyment of participating ASD children could be decisive for their future lifestyle and quality of life. It is essential to establish healthy habits during childhood. Our results show more stable values of moderate and vigorous PA during the week for the Experimental group. This means that, despite the sessions of the SL program being implemented twice a week, they displayed similar levels of moderate and vigorous PA on the other days. Therefore, participating children might have got used to active lifestyles thanks to the SL program [4]. Further research could analyze whether this trend continues after a longer period of time in order to find out whether active lifestyles really do become consolidated.

In this regard, some studies state that there is a substantial reduction in PA levels across the adolescent years in ASD because they are significantly more physically inactive [12,24]. If ASD teenagers do not develop participation in PA as a regular health behavior, they will probably become increasingly sedentary and predisposed to develop certain chronic diseases [16]. Therefore, there is a need for further research to analyze PA levels among ASD adolescents who have carried out PA since they were young, in order to uncover if they continue displaying active lifestyles that promote their health and quality of life.

On the other hand, the results obtained also show that both the Control and Experimental groups met or exceeded the WHO recommendations for 60 min of moderate and vigorous PA per day [47]. Although some studies state that ASD populations are at least capable of reaching the PA guidelines for TD individuals [40,41,48], others claim that children and adolescents with ASD are less likely to meet these guidelines for PA [39,49]. Since PA can be a tool for enhancing health-related quality of life [36], it is fundamental to provide motor programs as part of early intervention in young ASD populations [39,50]. In this regard, the SL program may have helped meet PA recommendations for the Experimental group as well as improving their social skills and social performance [51], thus helping to improve their physically active lifestyle.

5. Conclusions

Although the practice of PA is crucial for healthy growth, there are many barriers to doing moderate to vigorous PA after school for children with ASD. The current study analyzed and described the frequency and intensity of PA in children with ASD after participating in a 6-month SL program that tried to promote it. Overall, the application of the program had a positive impact on the PA of children with ASD. Specifically, participants of the program reported a significant increase in the number of minutes of PA performed at a moderate intensity during the week. In fact, it was figure moderate PA values increased, the values in the Experimental group remained more stable throughout the days

assessed. In addition, for the vigorous intensity, the Experimental group showed a greater and more stable tendency. In conclusion, the results obtained provide relevant information and interesting lines of research that favor the well-being of children with ASD. However, future research is needed to increase our understanding of PA programs that aim to promote active lifestyles in children with ASD, especially evaluation of interventions.

Regarding the limitations of the study, although promising results have been obtained, the sample size is an important limitation to consider. However, this is a common issue in research that attempts to uncover intervention programs [52]. In addition, studies with ASD populations usually rely on data gathered with a similar number of participants [40]. In this regard, the quasi-experimental design this study used attenuates this limitation. In any case, replicating the training with the Control group and reevaluating both groups might have yielded more useful information. Another possible limitation is that the specific period in which the measures were taken (towards the end of spring and the beginning of summer) could have increased opportunities to practice PA due to better weather conditions. In the same vein, an element that could also distort the amount of PA is children walking to and from school, which also might occur more frequently in summer and on weekdays rather than weekends. Finally, the fact that the children in both groups came from similar social contexts could have required some children from the Experimental group to share their PAs with those from the Control group. This could have increased the PA of the Control group, concealing positive results of the intervention. Regardless, we are convinced that by highlighting the results and sharing the quantitative measures obtained, this work has contributed to knowledge in this field.

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Conflicts of Interest: The authors declare that the research was conducted in the absence of any potential conflict of interest.

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