Effectiveness of Aerobic Exercise–Based Interventions in Children Exposed to Sexual Abuse*

Tuğçe BİLGİÇ**, Ali KARAAĞAÇ***, Caner MUTLU****, Ebru KAYA MUTLU*****

Abstract

Aim: Child sexual abuse exerts severe psychological and physiological effects on victims, frequently resulting in enduring and complex mental health difficulties throughout the lifespan. For this purpose, we examined the impact of physiotherapy-based aerobic exercise interventions on selected indicators of post-traumatic stress, physical activity levels and flexibility in children who have experienced sexual abuse.

Method: The study was designed with three groups, comprising a total of 34 participants. The groups included a control group, a home-exercise group, and a physiotherapist-guided exercise group, each receiving a 12-week intervention. Post-traumatic stress symptoms (Adolescent Dissociative Experiences Scale, A-DES), physical activity level (Physical Activity Questionnaire for Older Children, PAQ-C) and flexibility (Trunk Lateral Flexion Test) were assessed both before and after the intervention period.

Results: Statistically significant improvements were observed in the Trunk Lateral Flexion Test in all groups ($p<0.05$). However, no statistically significant intra- or intergroup differences were found for dissociative experiences or physical activity levels ($p>0.05$).

Conclusion: While no significant effects were observed on dissociative symptoms or physical activity levels, the findings may suggest that aerobic exercise has the potential to be integrated as a supportive component of multidisciplinary treatment approaches, particularly in future studies involving larger and more heterogeneous samples.

Keywords: Sexual abuse, children, aerobic exercise, post-traumatic stress.

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ETHICAL STATEMENTS: Ethical approval was obtained from the Clinical Research Ethics Committee of Istanbul Bakırköy Prof. Dr. Mazhar Osman Mental Health and Neurological Diseases Training and Research Hospital with the approval number of 2018/234, and written informed consent was obtained from all participating children before enrollment.

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Cinsel İstismara Maruz Kalan Çocuklarda Aerobik Egzersize Dayalı Müdahalelerin Etkinliği

Öz

Amaç: Çocuk cinsel istismarı, ciddi psikolojik ve fizyolojik sonuçlara yol açabilen ve sıklıkla yaşam boyu süren karmaşık ruh sağlığı sorunlarıyla ilişkili bir travmadır. Bu çalışmanın amacı, cinsel istismara maruz kalmış çocuklarda fizyoterapi temelli aerobik egzersiz müdahalelerinin travma sonrası stres belirtileri, fiziksel aktivite düzeyi ve esneklik üzerindeki etkilerini incelemektir.

Yöntem: Çalışma, toplam 34 katılımcı ile 12 haftalık bir müdahale süreci boyunca izlenen kontrol grubu, ev egzersiz programı grubu ve fizyoterapist rehberliğinde aerobik egzersiz uygulanan gruptan oluşmaktaydı. Travma sonrası stres belirtileri (Ergen Dissosiyatif Yaşantılar Ölçeği, A-DES), fiziksel aktivite düzeyi (Çocuklar İçin Fiziksel Aktivite Anketi, PAQ-C) ve esneklik (Gövde lateral Fleksiyon Testi) müdahale öncesinde ve sonrasında değerlendirildi.

Bulgular: Tüm gruplarda Gövde Lateral Fleksiyon Testi sonuçlarında istatistiksel olarak anlamlı iyileşmeler saptandı ($p<0,05$). Dissosiyatif yaşantılar ve fiziksel aktivite düzeyleri açısından grup içi ya da gruplar arası istatistiksel olarak anlamlı bir fark bulunmadı ($p>0,05$).

Sonuç: Bulgular, dissosiyatif belirtiler ve fiziksel aktivite düzeyleri üzerinde anlamlı bir etki göstermemekle birlikte, aerobik egzersizin daha geniş popülasyonlarda yapılacak çalışmalar kapsamında multidisipliner tedavi yaklaşımlarında destekleyici bir bileşen olarak değerlendirilebileceğini düşündürmektedir.

Anahtar Sözcükler: Cinsel istismar, çocuklar, aerobik egzersiz, travma-sonrası stres.

Introduction

Child sexual abuse (CSA) is a common and significant issue that affects children worldwide, leading to deeply and often long-lasting psychological, physical, and social consequences. A study indicated that the overall CSA was %12.7 in self-report studies and %0.4 in informant-based research, with females exhibiting higher rates than males[1]. Previous research has consistently shown that exposure to sexual abuse during childhood is associated with numerous adverse psychosocial and health related consequences, encompassing emotional and behavioral challenges, self-injurious behaviors, various psychiatric conditions, and long-term obesity-like physical health problems[2-4].

Eye Movement Desensitization and Reprocessing and Trauma Focused Cognitive Behavioral Therapy are among the most consistently supported therapeutic approaches for both children and adults, demonstrating effectiveness in reducing symptoms of Post-traumatic Stress Disorder (PTSD), depression, and anxiety[5]. Expressive arts therapies (including art, music, and dance) as well as massage therapy also appear promising, particularly for individuals who have difficulty expressing themselves verbally; however, more rigorous research is still needed to substantiate their effectiveness[6,7]. In another study, after the clasical massage practising to a group who had experienced sexual abuse, analyses of saliva and urine samples indicated a statistically significant elevation in activating neurotransmitter levels. —an average increase of 28% in serotonin and 31% in dopamine—alongside a marked reduction in cortisol levels[8]. In another study where the effects of body awareness therapy on stress disorders following sexual abuse kinds of

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traumas were assessed, participants showed notable decrease in the severity of physical symptoms, as well as a tendency toward dissociative symptoms reduction compared to the control group[9]. Despite varying treatment approaches among individuals, none of the interventions has shown clear superiority over others especially for depression and chronic pain. This finding is expected based on the heterogeneous nature of sexual abuse cases, which vary according to factors such as the child's age, the type, severity, and duration of the abuse, the relationship between the child and the perpetrator, and the level of family support. Therefore, there is a clear need for the development of child-centered therapy approaches especially designed for sexual abuse victims[10]. Physical activity not only helps to reduce the physical problems associated with a sedentary lifestyle but also improves occupational productivity and cognitive functions. These benefits mostly occur through the effects on the central nervous system, particularly via hormones such as dopamine and serotonin that regulate emotional processes[11]. For this reason, performing aerobic exercises—defined as prolonged, submaximal-intensity activities—may be challenging for individuals experiencing depressive symptoms. Therefore, aerobic exercise has been increasingly used as an additional tool to psychotherapy in treatment programs [12]. For this purpose, Shors and colleagues (2018) compared mental and physical (MAP™) training, which combines specific mental exercises with meditation and aerobic exercises, to groups receiving only meditation combined with aerobic exercise in individuals who had experienced sexual abuse. Their results showed that exercise or meditation alone did not significantly reduce trauma-related cognitions and ruminations. However, better outcomes were observed when both components were combined within the MAP™ training[13].

In the light of these findings, we hypothesized that the antidepressant effects of physiotherapy-based aerobic exercises could provide significant improvements by decreasing persistent post-traumatic symptoms and by increasing certain physical fitness parameters. The purpose of our study is to examine the effects of physiotherapy-based aerobic exercise on post-traumatic stress symptoms, physical activity levels and flexibility in children who experienced sexual abuse.

Material and Methods

Participants

This randomized controlled study was conducted with children at the Child Monitoring Center and the Adolescent Psychıatry Clinic in Istanbul Bakirköy Prof. Dr. Mazhar Osman Training Research Hospital between October 2018 to August 2019.

Inclusion criteria required participants to be girls between 8 and 17 years of age who had experienced sexual abuse and who voluntarily agreed—along with their families—to participate after the study aims and assessment procedures had been fully explained. Since these participants were children from the Child Monitoring Center involved in ongoing forensic/legal processes, all of them were already receiving routine psychiatric evaluation and treatment in accordance with institutional procedures and legal regulations. This information has been clarified in the revised manuscript to provide a

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better understanding of the participants' clinical background and concomitant treatments. Exclusion criteria included the presence of any physical and/or psychological condition that could limit participation in exercise, as well as any circumstance that could prevent the child from completing self report measures during the evaluation (e.g., difficulties in understanding the forms, physical impairments, or illiteracy). The number of children to be included was calculated using the "Rasoft Sample Size Calculator." Assuming a child sexual abuse incidence rate of 1.4% within a population of 20,000 and an 80% confidence interval, the required sample size was determined to be 10 children per group[14]. Considering possible dropouts, 14 children were included in each of the three groups and randomly assigned to three groups equally. Allocation was performed using "Research Randomiser," program[15]. The interventions were conducted by the same physiotherapist, while evaluations were conducted by a different therapist. Both the children and the outcome assessor were blinded to group allocation.

Outcome Measures

All participants' demographic and clinical characteristics were assessed using a Socio-demographic Characteristics Questionnaire. Following this, several standardized measures were applied at baseline and after 3 months. The Adolescent Dissociative Experiences Scale (A-DES) was used to evaluate psychiatric symptoms that may arise following sexual abuse; the Physical Activity Questionnairee for Older Children (PAQ-C) was preferred to assess physical activity levels; and the Trunk Lateral Flexion Test was conducted to evaluate flexibility as a parameter of physical fitness.

The Adolescent Dissociative Experiences Scale (A-DES): Developed to identify dissociative symptoms in children aged 11 to 17 years. Dissociative experiences are classified into four domains: amnesia, absorption, derealization/ depersonalization, and imaginative involvement. The scale consists of 30 items, and responses rate each item on a scale from 0 to 10. Each item is rated on a scale with a maximum score of 10, where higher scores reflect greater severity of dissociative symptoms. For scoring purposes, the sum of all item scores is divided by the total number of items to obtain the overall score[16]. The scale was adapted into the Turkish version by Zoroğlu et al[17].

The Physical Activity Questionnaire for Older Children (PAQ-C): Developed to assess the physical activity levels of children and adolescents, as well as the frequency of these activities. The questionnaire consists of nine items that evaluate activities performed during the previous seven days. Responses are scored using a five-point Likert scale, with each item receiving a minimum score of 1 and a maximum score of 5. Thus, total scores range from 9 to 45, with higher scores indicating greater levels of physical activity and the scale typically requires approximately 40 minutes to complete. Validity and reliability for use in Türkiye were established by Sert et al. (2014)[18,19].

For the ***Trunk Lateral Flexion Test***, children were instructed to stand with their feet slightly apart and parallel, with their arms resting alongside the body. First, the location reached by the distal tip of the third finger on the thigh was marked. The child was then

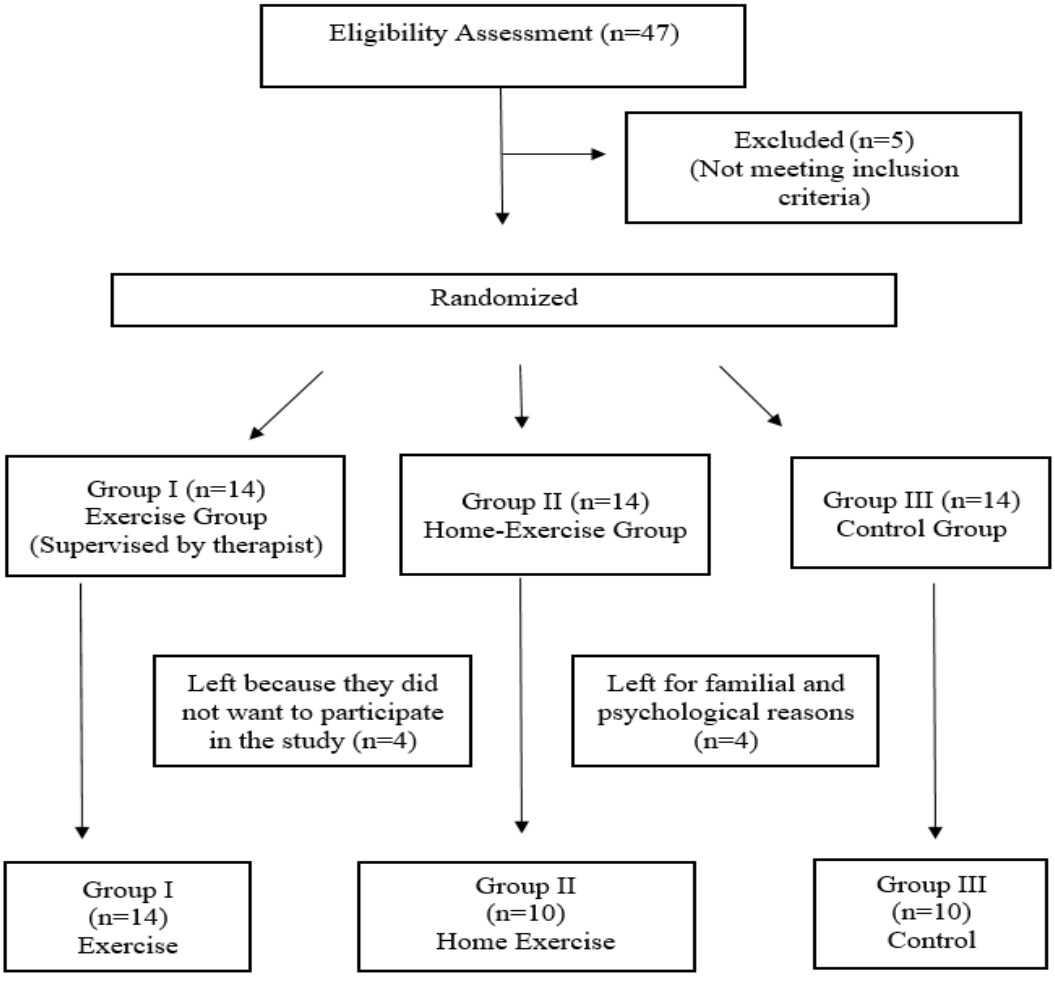
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asked to perform lateral flexion, and the new position of the fingertip was marked. The distance between the two points was measured using a tape measure[20]. The assessment was conducted at two time points, namely prior to the intervention and upon completion of the treatment, and changes between these measurements were subsequently documented.

Procedures

The process of participant inclusion was given in Figure 1. In the first group including 14 children, therapist-supervised sessions were applied twice weekly for 12 weeks, each lasting 40 minutes and including a 10 minute warm-up, a 20 minute aerobic exercise program, and a 10 minute cool down. The second group, including 10 children, received the same exercises as home-based intervention and was provided with instructional brochures. The initial sessions were conducted with a physiotherapist to ensure proper instruction, and adherence was monitored using a checklist. The third group, also including 10 children, served as the control group, in which only the assessment scales and tests were administered at baseline and after 12 weeks.

Figure 1. Clinical Diagram of the Study



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Exercise Programme

The exercise program was scheduled for two sessions per week over a 12-weeks period. Each session lasted 40 minutes and included a 10 minutes warm up, 20 minutes of aerobic exercise, and a 10 minutes cool down (stretching), all conducted under the supervision of a physical therapist. The aerobic exercise program was structured as circuit-based exercises performed under the supervision of a physical therapist. During the first 6 weeks, each exercise was performed for 8 repetitions, while during the following 6 weeks the repetitions were increased to 10 in order to provide gradual progression according to participants' adaptation and tolerance. During exercises, breathing control was emphasized throughout all exercises, and rest periods were provided between exercise transitions to prevent excessive fatigue and ensure participant safety.

Adherence to the supervised exercise program was high, and no participant dropout occurred in the physiotherapist-supervised exercise group, whereas some dropout was observed in the home exercise group. In cases where participants missed a session, a compensatory session was scheduled on another day within the same week. Additionally, no complications or adverse effects related to the intervention were observed during the study period. Detailed illustrations and names of the exercises are also provided in Appendix 1 (Appendix 1).

Ethical Statements

Ethical approval was obtained from the Clinical Research Ethics Committee of İstanbul Bakırköy Prof. Dr. Mazhar Osman Mental Health and Neurological Diseases Training and Research Hospital with the approval number of 2018/234, and written informed consent was obtained from all participating children before enrollment. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki governing research involving human participants.

Statistical Analysis

SPSS version 20.0 for Windows was used in all statistical analyses. The normality for the data distribution was assessed using the Kolmogorov–Smirnov test. As many variables did not meet the assumptions of normal distribution, non-parametric tests were employed. Categorical variables were compared using the Chi-square test. Demographic and clinical characteristics of the groups were evaluated with the KruskalWallis test. The Wilcoxon Signed Ranks Test was used to compare pre- and post-treatment values within each group. Between-group comparisons were conducted using the KruskalWallis test, and when significant differences were identified, the Mann Whitney U test with Bonferroni correction was applied. The error level for post hoc analyses was set at $p<0.01$, and the overall statistical significance level was accepted as $p<0.05$.

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Results

A total of 47 children were evaluated, of whom 5 were excluded for not meeting the inclusion criteria, and the remaining were randomly assigned to three groups. Following randomization, 4 children declined participation and 4 discontinued due to family or psychological reasons. Consequently, 34 of them completed the study: 14 in the physiotherapist-guided exercise group (Group 1), 10 in the home-exercise group (Group 2), and 10 in the control group (Group 3). All children in the exercise groups attended their scheduled treatment sessions twice weekly for twelve weeks in the clinical setting.

There were no statistically significant differences in mean age among the groups (14.86±1.51 for group 1, 14.60±2.01 for group 2, and 14.60±2.12 for group 3; p=0.83). Similarly, no significant differences were found between the groups regarding other socio-demographic or clinical data, including school attendance, family structure, the educational and mental health status of parents (p>0.05) (Table 1).

Table 1. Distribution of the cases according to age, school attendance, family structure, educational and mental status of parents.

		Group 1	**Group 2**	**Group 3**	**p**
Child Age (Year) (Mean±SD)		14.86±1.51	14.60±2.01	14.60±2.12	0.83
School Attendance n(%)	No	1 (%7.1)	3 (%30)	2 (%20)	
	Yes	13 (%92.9)	7 (%70)	8 (%80)	0.34
Family Structure n(%)	Small	8 (%57.1)	8 (%80)	8 (%80)	
	One Parent	4 (%28.6)	2 (%20)	1 (%10)	
	Step Mother/ Father	2 (%14.3)	-	1 (%10)	0.56
Mother Education n(%)	Illiterate	2 (%14.3)	-	-	
	Literate	3 (%21.4)	1 (%10)	1 (%10)	
	Primary education	4 (%28.6)	3 (%30)	3 (%30)	
	Secondary education	3 (%21.4)	2 (%20)	5 (%50)	
	High School	2 (%14.3)	3 (%30)	1 (%10)	0.50
	University	-	1 (%10)	-	
Father Education n(%)	Illiterate	1 (%7.1)	-	-	
	Literate	1 (%7.1)	1 (%10)	-	

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	Primary education	5 (%35.7)	3 (%30)	2 (%20)	0.25
	Secondary education	6 (%42.9)	1 (%10)	2 (%20)	
	High School	1 (%7.1)	5 (%50)	5 (%50)	
	University	-	-	1 (%10)	
Mother Mental Problem n(%)	Yes	3 (%21.4)	3 (%30)	3 (%30)	0.86
	No	11 (%78.6)	7 (%70)	7 (%70)	
Father Mental Problem n(%)	Yes	1 (%7.1)	2 (%20)	1 (%10)	0.62
	No	13 (%92.9)	8(%80)	9 (%90)	

Group 1= Exercise Group; Group 2= Home Exercise Group; Group 3= Control Group; SD: Standart Deviation; p<0.05

According to the results of the Physical Activity Questionnaire for Older Children (PAQ-C), no statistically significant differences were observed either within groups or between groups (p>0.05) (Table 2). Although all groups demonstrated statistically significant improvements in the trunk lateral flexion test (p<0.05), no group showed superiority over the others in the intergroup comparisons (p>0.05) (Table 2).

Table 2. Comparison of the mean values of PAQ-C and Trunk lateral flexion within and between groups.

	Pre-test Mean±SD	**Post-test Mean±SD**	**Willcoxon Signed Ranks p**	**Intra-group Difference Mean [%95CI]**	**Kruskal-Wallis**		
					P	**Bonferonni**	
						Grup	**p***
The Physical Activity Questionnaire for Older Children (PAQ-C)							
Group 1	18.70±742	19.29±5.79	0.97	-0.59[-5,09-3,91]		1-3	0.41
Group 2	18.49±5,92	17.93±3.54	0.91	0.56[-2,84-3,96]	0.77	2-3	0.77
Group 3	22.54±6.42	20.83±6.99	0.11	1.71[-0,45-3,88]		1-2	0.49
Trunk Lateral Flexion Test							
Group 1	10.82±2.58	12.00±2.45	**0.01**	-1.18[-1.91-(-0.45)]		1-3	0.24
Group 2	11.10±2.56	12.80±2.49	**0.007**	-1.70[-2.53-(-0.87)]	0.38	2-3	0.38
Group 3	10.60±2.22	12.40±1.84	**0.005**	-1.80[-2.36-(-1.24)]		1-2	0.54

Group 1= Exercise Group; Group 2= Home Exercise Group; Group 3= Control Group; SD: Standart Deviation; CI: Confidence Interval; p<0.05

The Adolescent Dissociative Experiences Scale (A-DES) scores showed no statistically significant changes from pre- to post-treatment within any of the groups, nor were any significant differences observed in comparisons between the groups (p>0.05) (Table 3).

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Table 3. Comparison of the mean values of A-DES within and between groups.

	Pre-test Mean±SD	Post-test Mean±SD	Willcoxon Signed Ranks p	Intra-group Difference Mean [%95CI]	Kruskal-Wallis		
					P	Bonferonni	
						Group	p*
The Adolescent Dissociative Experiences Scale (A-DES)							
Group 1	3.46±2.22	3.24±2.27	0.47	0.23[-0.53-0.99]		1-3	0.97
Group 2	3.13±1.45	2.82±1.49	0.07	0.32[-0.03-0.66]	0.83	2-3	0.83
Group 3	3.09±2.52	2.91±2.59	0.28	0.17[-0.49-0.85]		1-2	0.85

Group 1=Exercise Group; Group 2=Home Exercise Group; Group 3=Control Group; SD: Standart Deviation; CI: Confidence Interval; p<0.05

Discussion

The aim of our study was to investigate the effects of physiotherapy-based aerobic exercises on post-traumatic stress–related outcomes such as dissociative experiences, physical activity level and physical fitness in children who had experienced sexual abuse. We hypothesized that the antidepressant effects of aerobic exercise would lead to meaningful improvements in persistent post-traumatic symptoms and in selected physical fitness parameters. Although within-group improvements were observed particularly in flexibility, as reflected in lateral flexion values, aerobic exercise did not demonstrate superiority over the other groups in dissociative experiences or physical activity levels. Thus, the null hypothesis was accepted.

Research has shown that physical activity may exert a protective influence on the association between adverse childhood experiences and subsequent health outcomes[4,21,22]. In a study involving women with a history of childhood sexual abuse, heart rates were measured both before and after treadmill exercise. The findings indicated that individuals with a history of abuse were unable to achieve the expected rate of transition from an immobilized state to movement through sudden vagal activation, nor could they return to resting heart rate at the anticipated speed. This suggests that individuals with a history of abuse yield delays in the timing of fight or flight responses during stress[23]. In another study where individuals were diagnosed with major depression, an eight-week aerobic exercise program led to improvements in reaction times, focusing on the positive effect of aerobic exercise on cognitive control[24]. Another study closely aligned with ours, children aged 8–11 years who had experienced sexual abuse were included, and an eight-week physical exercise program was reported to produce significant improvements—particularly in anxiety and several related parameters—when compared with the control group[25]. These kinds of studies indicate that survivors of sexual abuse show not only psychological but also physiological symptoms, stating the need to integrate physical interventions into their treatment. In

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our study, aerobic exercises adapted for children were performed with shorter session durations and included warm-up and cool-down periods minimizing the risk of sudden increases in heart rate. Physical activity levels were assessed before and after the exercise protocol using the Physical Activity Questionnaire for Older Children (PAQ-C), as recommended by Voss et al. (2017) in their study on 84 children with congenital heart disease and by Erdim et al. (2019) in their application of the scale among 784 children aged 9–14 years in Türkiye[26,27]. Scale results indicated the increases in physical activity levels were not found to be significant either within or between groups. The lack of significant differences may be due to the fact that the form assesses only activities performed during the previous seven days, with the initial evaluations coinciding with the school term and the final evaluations occurring during the summer holiday period.

Because of the severe psychological stress experienced following traumas such as sexual abuse, the resulting reduction in activity levels may lead to muscle shortening and increased stiffness, finally lowering overall flexibility[28]. Supporting the evidence reported by researchers such as Czaprowski (2015) and Nakata et al. (2017), who examined physical fitness parameters in children and adolescents, the Trunk Lateral Flexion Test was also used in our study to assess flexibility[29,30]. After the initial and final assessments, although all groups demonstrated significant improvements in Trunk Lateral Flexion values, no group showed a statistically superior change compared with the others. Several factors may be the reasons for these significant within-group gains in Trunk Lateral Flexion values together with the absence of statistically meaningful differences between groups. First, flexibility is known to be highly responsive to even low-intensity physical activity, daily functional movements, or the natural maturation process in children and adolescents; therefore, improvements may have occurred regardless of group allocation. Furthermore, the 12-week duration of the intervention, although sufficient to elicit measurable flexibility gains within groups, may not have been long enough to produce divergent trajectories strong enough to yield between-group significance. Finally, the aerobic exercise program performed may have been primarily oriented toward cardiovascular and psychological outcomes, with limited inclusion of stretching components specifically designed to enhance flexibility.

Dissociative identity disorder is defined in modern psychiatry as a chronic and polysymptomatic dissociative condition, in which childhood psychological trauma is considered to play a major etiological role[31]. The disorder may present with symptoms such as speaking as if one is a different person, inability to speak, fainting, amnesia, and disturbances in identity and consciousness. In a study conducted with women survivors of child sexual abuse, dance therapy was applied for the purpose of fostering reconnection with their bodies, enhancing bodily closeness, and creating a sense of freedom; the ones who received psychotherapy alongside dance therapy reported feeling more motivated and emotionally stronger than those in the control group[32]. In another study, the Dissociative Experiences Scale was administered to eight sexually abused women before and after an eight-session body awareness training program (one hour per session), and significant reductions in dissociative symptoms were observed following the intervention[33]. Additionally, a previous research on Mental and Physical (MAP)

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Training suggested that combining meditation with aerobic exercise reduced trauma-related cognitions and ruminations more effectively than either component alone[13]. These findings indicated that multicomponent interventions targeting both cognitive–emotional processes and physiological arousal might have been more effective in modifying dissociative or trauma-linked symptoms than exercise-only protocols. In this study, no significant differences were observed in the Adolescent Dissociative Experiences Scale scores either within or between the groups. This outcome may have been affected by the difficulty of resolving disturbances in consciousness, memory, and identity within a relatively short 12-week intervention period with exercise alone, as well as by the possibility that children avoided responding accurately due to concerns about being judged or had difficulty understanding some of the items.

The main limitation of this study is the small sample size, which resulted from the limited number of children with sexual abuse who could be reached and made robust randomization difficult. In addition, only female participants were included, and all participants were recruited from a single center and region, which limits the generalizability of the findings. Some eligible individuals also declined to participate or dropped out during the intervention, leading to further sample loss. Another limitation is that the assessments reflect only short-term outcomes. Moreover, differences in symptom severity and the interaction between the physiotherapist and the child may have influenced the results. As a final limitation, trauma-related characteristics of the participants, such as the identity of the perpetrator and the presence of penetration, could not be accessed due to institutional procedures, ethical considerations, and legal confidentiality regulations. Therefore, these variables could not be included in the analyses or evaluated as potential influencing factors. Although these limitations are important, this study contributes to the limited randomized controlled research examining both psychiatric and physical fitness outcomes of aerobic exercise interventions in children who have experienced sexual abuse.

Conclusion

This randomized controlled study examined the effects of physiotherapy-based aerobic exercise delivered under supervision or as a home program on dissociative symptoms, physical activity level and flexibility in children who were exposed to sexual abuse. Improvements in trunk lateral flexion were observed across all groups, suggesting a general effect that may not be specific to the exercise intervention. In contrast, no significant changes were detected in dissociative experiences or physical activity levels, possibly reflecting the complexity of trauma-related symptoms and the limitations of short-term interventions. Overall, these results suggest that aerobic exercise, particularly when integrated into treatment programs, may serve as a supportive approach to improve quality of life in this population. Future studies with larger samples, broader inclusion criteria, and longer follow-up periods are warranted to better clarify its role within multimodal treatment strategies.

Declaration of Interest Statement: There were no conflicts of interest.

Data Availability: Data will be made available on request.

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