




## The Effect of Skating on Balance and Functional Mobility of Children with Autism Disorder in Kerman

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### ABSTRACT

**Purpose:** This study aimed to investigate the effects of an 8-week skating intervention on balance and functional mobility in children with ASD in Kerman, Iran.

**Methods and Materials:** A semi-experimental pretest–posttest design with a control group was employed. Twenty children aged 7–8 years with ASD were randomly assigned to either an experimental group (n=10) or a control group (n=10). The experimental group participated in supervised skating sessions three times per week for eight weeks. Assessments included static balance (modified Stork test), dynamic balance (heel-to-toe walking test), Timed Up and Go (TUG), Six-Minute Walk Test (6MWT), and Timed Floor-to-Stand (TFTS). Measurements were taken at baseline and after the intervention. Data were analyzed using paired t-tests and ANCOVA, with a significance level set at  $p < 0.05$ .

**Findings:** Post-intervention, the experimental group demonstrated significant improvements in static balance, dynamic balance, TUG performance (reduced time), 6MWT (increased distance), and TFTS (reduced time), while the control group showed no significant changes. Between-group analyses confirmed statistically significant differences in favor of the experimental group.

**Conclusions:** Skating exercises significantly enhance balance and functional mobility in children with ASD. Skating is recommended as an accessible, engaging, and cost-effective intervention within rehabilitation programs for this population. Future studies should explore the long-term cognitive, psychological, and social effects of skating interventions.

**Keywords:** Autism spectrum disorder, Balance, Children, Functional mobility, Skating.

### 1. Introduction

Adolescence is a critical developmental period marked by rapid emotional, cognitive, and physical changes. Amid these transitions, adolescents often experience

increased vulnerability to self-harming behaviors, difficulties in emotion regulation, and disturbances in body image perception. Non-suicidal self-injury (NSSI), defined as the deliberate destruction of body tissue without suicidal intent, has become alarmingly prevalent among adolescents

and is closely associated with emotional dysregulation and negative self-perceptions (Cleare et al., 2019; Xavier et al., 2016). Research increasingly highlights that NSSI is not merely a symptom but a maladaptive coping strategy often intertwined with inner experiences of shame, self-criticism, and body dissatisfaction (Erol & Inozu, 2023; Gregory et al., 2017).

A key psychological mechanism that contributes to both emotion dysregulation and negative body image is low self-compassion. Adolescents who engage in self-harm tend to exhibit high levels of self-judgment and harsh self-criticism, often in response to unmet emotional needs or social rejection (Geng et al., 2022; Nagy et al., 2021). In contrast, self-compassion—defined as treating oneself with kindness, recognizing shared human experiences, and maintaining mindful awareness in the face of suffering—has emerged as a robust protective factor against various forms of psychological distress (Johnson et al., 2023; Suh & Jeong, 2021). Studies indicate that adolescents with higher levels of self-compassion exhibit greater emotional resilience, fewer self-harming behaviors, and more positive body image evaluations (Fan et al., 2022; Gobin et al., 2022).

The relevance of self-compassion is particularly evident in the context of emotional regulation. Emotion dysregulation has been identified as both a precursor and a maintaining factor of self-injury in youth (Gu et al., 2023; Rezaei et al., 2022). Therapeutic interventions that enhance self-compassion have shown promising outcomes in helping adolescents manage intense emotions and reduce the need for maladaptive coping strategies such as NSSI (Damavandian et al., 2022; Shabani et al., 2024). For instance, interventions based on compassion-focused therapy have demonstrated efficacy in improving emotional self-regulation and reducing aggression and self-harm among delinquent adolescents (Damavandian et al., 2022). Similarly, mindfulness-based interventions have been found to buffer the effects of peer victimization and body image dissatisfaction, especially when mediated by self-compassion and emotional awareness (Faura-Garcia et al., 2021; Norman et al., 2021).

The significance of body image disturbance as a co-occurring factor in adolescents with self-injurious behaviors cannot be overlooked. Negative body image is both a risk factor and an outcome of repeated self-harm, particularly among girls (Alizadeh & Mohammadi, 2021; Türk et al., 2021). Body image concerns often stem from social comparison processes, internalized beauty standards, and traumatic relational experiences that impact self-concept

formation during adolescence (Seekis & Kennedy, 2023; Ziarat et al., 2021). Emerging research suggests that body image dissatisfaction in adolescents is closely linked to shame and self-loathing, factors that self-compassion can directly address (Peymannia et al., 2018; Rostami et al., 2017). Furthermore, mindfulness and self-compassion-based interventions appear to be particularly effective in fostering more accepting attitudes toward the body and reducing appearance-based shame and anxiety (Bahreini et al., 2022; Gobin et al., 2022).

In Iran, where cultural and societal pressures can amplify adolescent distress regarding bodily appearance and emotional expression, the integration of self-compassion into psychological interventions for youth has garnered increasing empirical support (Asghari & Aghili, 2022; Izakian et al., 2019). For instance, studies have shown that self-compassion mediates the relationship between eating disorders and self-harming behaviors in Iranian female students (Asghari & Aghili, 2022), while others highlight its predictive role in emotional resilience and general well-being among adolescent girls (Ziarat et al., 2023). These findings underscore the cross-cultural relevance of self-compassion and validate its application in Eastern adolescent populations. Moreover, research conducted on Iranian adolescents demonstrates that combining mindfulness techniques with compassion-based strategies enhances emotion regulation skills and contributes to healthier coping mechanisms in the face of adversity (Kamarati et al., 2022; Osareh et al., 2024).

Mindfulness, another core element of the intervention used in this study, offers adolescents an alternative way of relating to their inner experiences—one characterized by nonjudgmental awareness and acceptance. When practiced consistently, mindfulness reduces emotional reactivity and fosters cognitive flexibility, enabling adolescents to pause before acting on harmful urges (Liu et al., 2024; Rehman et al., 2024). Its integration with self-compassion has been found to significantly lower psychological distress, particularly in the context of trauma, eating disorders, and self-hatred (Vidal et al., 2024; Wild et al., 2025). Moreover, evidence suggests that the combined effect of mindfulness and self-compassion provides adolescents with powerful tools to break cycles of shame, improve self-soothing capacities, and rebuild fragmented identities (Cleare et al., 2019; Suh & Jeong, 2021).

Despite growing evidence for the effectiveness of compassion- and mindfulness-based approaches, many existing interventions lack direct alignment with the lived

experiences of adolescents engaged in self-injury. Generic protocols often overlook the complex interplay between emotional dysregulation, identity confusion, and body-related shame specific to this age group. Recent scholarship calls for tailored, experiential interventions that incorporate youth narratives, cultural sensitivity, and developmentally appropriate strategies (Motale et al., 2024; Rezaei et al., 2022). In response to this gap, the present study introduces a mindfulness-based self-compassion protocol co-developed through insights drawn from adolescents' lived experiences of self-injury. This personalized approach aims to create a therapeutic space that is emotionally safe, empowering, and conducive to long-term transformation.

The theoretical underpinnings of the intervention are grounded in emotion-focused and acceptance-based models of therapy, which prioritize emotional awareness, acceptance, and self-kindness as central to behavioral change (Shafiabady et al., 2023; Yari et al., 2020). Studies comparing emotion-focused cognitive-behavioral therapy with mindfulness-based cognitive therapy have consistently demonstrated their impact on reducing body dissatisfaction and improving emotion regulation, especially in female adolescents seeking cosmetic procedures or presenting with body dysmorphic symptoms (Shafiabady et al., 2023; Yari et al., 2020). These therapeutic outcomes are supported by findings indicating that when adolescents learn to identify and compassionately respond to their emotional triggers, the frequency and severity of self-harming episodes decrease substantially (Gu et al., 2023; Rasouli et al., 2024).

The conceptual model guiding this intervention also draws from empirical studies linking self-compassion to broader indicators of mental health, including psychological flexibility, hope, social functioning, and subjective well-being (Rezagholyan et al., 2025; Syafitri et al., 2024). In particular, the mediating role of self-compassion in the relationship between psychological adversity and flourishing mental states has been documented across diverse adolescent populations (Liu et al., 2024; Rehman et al., 2024). Such findings further validate the integrative design of this protocol, which combines mindfulness practices, compassion-building exercises, and identity-reconstruction activities in a structured, group-based format.

In light of this evidence, the present study seeks to evaluate the effectiveness of a researcher-designed, mindfulness-based self-compassion protocol on improving emotion regulation and body image in adolescents with a history of non-suicidal self-injury.

## 2. Methods and Materials

### 2.1. Study Design and Participants

This study employed a semi-experimental pretest–posttest design with a control group to investigate the effects of skating exercises on balance and functional mobility in children with autism spectrum disorder (ASD) in Kerman, Iran. A total of 20 children with ASD (mean age =  $7.0 \pm 0.78$  years) were recruited from autism support and rehabilitation centers in Kerman. All participants had a confirmed diagnosis of ASD by a child psychiatrist, with no history of chronic physical illnesses (e.g., cardiac, respiratory, or musculoskeletal conditions) and no regular engagement in other exercise programs. Using convenience sampling, eligible participants were randomly assigned to either the experimental group ( $n = 10$ ) or the control group ( $n = 10$ ). The purpose, procedures, and conditions of the study were fully explained to the participants' parents or guardians, and written informed consent was obtained after confirming their complete understanding.

The experimental group participated in an 8-week roller-skating training program, consisting of three 45-minute sessions per week. All sessions were supervised by a certified skating coach and conducted in a safe, controlled environment. During the first two weeks, the focus was on familiarization with skating equipment, acquisition of basic skating skills (e.g., standing, maintaining balance, slow walking, and safe stopping), and promoting both psychological and physical adaptation to the activity. From the third week onward, specialized exercises adapted from the protocol developed by Thomas et al. (2016) for children with ASD were implemented. (Thomas et al., 2016) for children with ASD were implemented. These exercises targeted improvements in motor control and body coordination through static and dynamic balance activities, incorporating both straight and curved skating paths. To enhance proprioception and challenge balance, participants navigated simple obstacle courses using cones, ropes, and hoops. Shuttle skating drills were included to strengthen trunk stability and lower limb musculature, thereby improving overall postural control. In addition, simple movement games—such as following predetermined paths or aiming for visual targets—were used to increase motivation and attentional engagement. Speed and sudden-stop drills were introduced to develop motor reactivity and neuromuscular responsiveness. Each session adhered strictly to safety protocols, requiring participants to wear protective gear including helmets, wrist guards, knee pads, and elbow

pads. Sessions concluded with stretching and muscle relaxation exercises. The control group did not participate in any training or receive any form of intervention during the study period.

## 2.2. Measures

Multiple instruments were employed to assess anthropometric parameters, balance, and functional mobility in children with ASD. Height and weight were measured using a calibrated digital scale and a standard stadiometer to evaluate the participants' baseline physical condition. Static balance was assessed using the modified Stork test. In this test, the child was instructed to stand on either the dominant or non-dominant leg, raise the free leg approximately 10 cm off the ground, cross the arms over the chest, and fix their gaze on a point 3 meters ahead while attempting to maintain balance. The assessment was conducted under both eyes-open and eyes-closed conditions. The duration for which the posture was sustained was recorded as the static balance index (Mostafa Ali Mohammadi, 2016; Thomas et al., 2016; Zhao et al., 2020). Each child completed three trials, and the average time was calculated and used as the final score. The reliability of this test has been reported at 0.87.

Dynamic balance was assessed using the heel-to-toe walking test. In this procedure, participants were instructed to complete 15 consecutive heel-to-toe steps along a straight line, ensuring that the heel of one foot made contact with the toes of the other with each step. The test was terminated if the participant lost balance or deviated from the line. The total number of correctly executed steps was recorded as the final score. Two trials were conducted, and the higher of the two scores was used for analysis. This test has demonstrated high reliability, with a reported reliability coefficient of 0.89 (Baldwin et al., 2024). To assess functional mobility, three standard tests were used. First, the Timed Up and Go (TUG) test, where the child rises from a seated position, walks 3 meters forward, turns around, returns, and sits down. The total time was recorded as an index of motor performance (Martín-Díaz et al., 2023; Podsiadlo & Richardson, 1991).

This test is considered a valid and reliable indicator of dynamic balance, walking speed, and functional mobility (Shumway-Cook et al., 2000). Second, the six-minute walk test (6MWT) was used. The child walked back and forth along a 30-meter path for 6 minutes, and the total distance covered was recorded as an index of aerobic endurance and functional capacity (Du et al., 2009; Enright, 2003). Finally, the Timed Floor to Stand (TFTS) test was performed. The child sat on the floor and was asked to stand up without using hands or external support. The time required to complete this task was measured as an indicator of lower limb strength, trunk control, and motor coordination.

## 2.3. Data Analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) for Windows, version 26.0, and Microsoft Office 2016. Data are presented as mean  $\pm$  standard deviation (SD). The Shapiro–Wilk test was used to assess the normality of data distribution, while Levene's test was employed to examine the homogeneity of variances. Between-group differences at post-test, controlling for baseline scores, were analyzed using analysis of covariance (ANCOVA). Within-group changes from pre-test to post-test were evaluated using paired t-tests. A significance level of  $p < 0.05$  was adopted for all statistical tests.

## 3. Findings and Results

This section presents the results of the analysis examining the effects of roller skating on balance and functional mobility in children with autism spectrum disorder (ASD). Both descriptive and inferential statistical methods were employed. Descriptive statistics were used to summarize the baseline characteristics of participants in the experimental and control groups, while inferential analyses evaluated changes within and between groups following the intervention. A summary of the participants' demographic and baseline characteristics is provided in Table 1.

**Table 1**

*Participant demographics*

Variable	Mean $\pm$ SD
Age (years)	7.00 $\pm$ 0.78
Body Mass (kg)	22.78 $\pm$ 2.04
Height (cm)	118.71 $\pm$ 3.42

Data are shown as the mean  $\pm$  SD. \*Significance level  $p < 0.05$

To ensure the appropriateness of the statistical procedures, assumptions of normality and homogeneity of variances were tested and confirmed using the Shapiro–Wilk and Levene’s tests, respectively ( $p > 0.05$ ), thereby justifying the use of parametric analyses. The effects of the roller-skating intervention on balance and functional mobility in children with ASD were examined through a

two-step analytical approach. First, within-group comparisons were conducted using paired t-tests to assess pre- and post-intervention changes. Subsequently, analysis of covariance (ANCOVA), controlling for baseline scores, was performed to evaluate between-group differences at post-test. The detailed results of these analyses are presented in Tables 2 and 3.

**Table 2**

*Descriptive distribution and paired t-test results for the variables*

Variable	Group	N	Pre-Test Mean $\pm$ SD	Post-Test Mean $\pm$ SD	<i>t</i>	<i>p</i>
Dynamic Balance	Skating	7	12.42 $\pm$ 0.97	7.42 $\pm$ 0.95	8.101	0.001
	Control	7	12.71 $\pm$ 1.11	13.28 $\pm$ 0.75	0.549	0.172
Static Balance	Skating	7	4.71 $\pm$ 0.76	8.85 $\pm$ 1.34	-7.488	0.001
	Control	7	4.85 $\pm$ 0.89	5.28 $\pm$ 0.75	-1.000	0.356
TUG	Skating	7	9.14 $\pm$ 0.89	5.85 $\pm$ 0.69	7.813	0.001
	Control	7	9.00 $\pm$ 1.15	9.23 $\pm$ 0.75	-0.420	0.689
6MWT (meters)	Skating	7	53.00 $\pm$ 7.16	76.57 $\pm$ 9.94	-4.060	0.007
	Control	7	52.00 $\pm$ 7.68	50.57 $\pm$ 7.74	1.594	0.162
TFTS	Skating	7	12.00 $\pm$ 1.41	7.57 $\pm$ 1.13	6.819	0.001
	Control	7	12.57 $\pm$ 1.71	12.42 $\pm$ 1.51	0.736	0.354

Data are shown as the mean  $\pm$  SD.

**Table 3**

*ANCOVA results for the variables*

Variable	Source	SS	df	MS	F	<i>p</i>
Dynamic Balance	Group	117.268	1	117.268	14.184	0.001
Static Balance	Group	44.690	1	44.690	34.704	0.001
TUG	Group	38.637	1	38.637	66.623	0.001
6MWT	Group	2330.913	1	2330.913	27.189	0.001
TFTS	Group	71.368	1	71.368	50.687	0.001

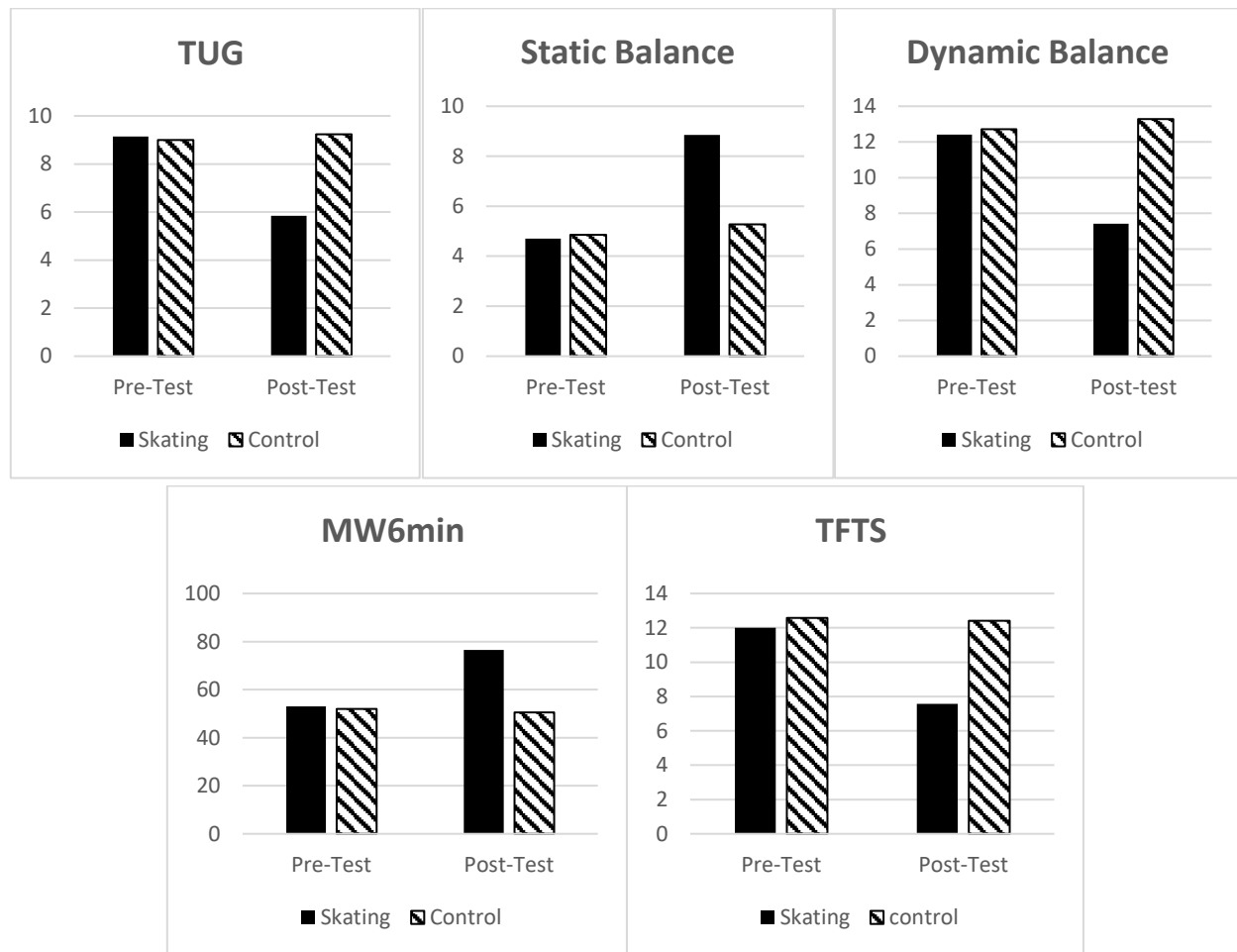
In the dynamic balance index, the experimental group demonstrated a significant improvement from pre-test to post-test, whereas no change was observed in the control group. ANCOVA further confirmed a statistically significant difference between the two groups. Similarly, in the static balance index, a significant improvement was observed only in the experimental group, with between-group analysis also revealing a significant difference in favor of the intervention. Performance on the Timed Up and Go (TUG) test significantly improved in the experimental group, reflected by a reduction in execution time, while no

significant change occurred in the control group; this difference was statistically significant between groups. In the Six-Minute Walk Test (6MWT), the experimental group exhibited a significant increase in walking distance post-intervention, with no change detected in the control group; the between-group difference for this index was also significant. Lastly, in the Timed Floor-to-Stand (TFTS) test, execution time significantly decreased in the experimental group, while the control group showed no improvement. ANCOVA confirmed a significant between-group difference for this measure as well.



**Figure 1**

*Mean Comparisons*



#### 4. Discussion and Conclusion

The findings of this study demonstrate that an eight-week structured skating intervention can lead to significant improvements in static balance, dynamic balance, and functional mobility—including Timed Up and Go (TUG), Six-Minute Walk Test (6MWT), and Timed Floor-to-Stand (TSTS)—among children with autism spectrum disorder (ASD). These results are consistent with and extend the growing body of literature advocating for the use of physical activity-based interventions as effective therapeutic modalities for enhancing motor performance in children with neurodevelopmental conditions (Li et al., 2023; Suárez-Manzano et al., 2024; Xing & Wu, 2025).

From a motor development perspective, the observed improvements in balance (both static and dynamic) align with previous studies emphasizing the positive impact of physical activity on postural control and proprioceptive

functioning in children with ASD. For example, Casey et al. (2015) reported significant enhancements in balance and motor planning following a therapeutic skating program among autistic children (Casey et al., 2015), while Baldwin et al. (2024) confirmed the reliability and clinical value of field-based static and dynamic balance tests in assessing motor improvement among children with ASD (Baldwin et al., 2024). These motor enhancements are also supported by sensory integration theories which posit that balance-related exercises stimulate the vestibular and somatosensory systems, fostering improved postural control and neuromuscular coordination in children with developmental challenges (Lang et al., 2012; Roberge & Crasta, 2022).

The results of the TUG test in the present study, which showed a significant reduction in completion time following the intervention, further corroborate the role of skating in enhancing functional mobility. The Timed Up and Go test has been extensively validated in pediatric populations with ASD as a reliable measure of dynamic balance and

functional independence (Martín-Díaz et al., 2023; Podsiadlo & Richardson, 1991). Similarly, the observed gains in the 6MWT and TFTS indicate enhanced muscular endurance and trunk-lower limb coordination, respectively, supporting the premise that skating, through repetitive dynamic movement and controlled transitions, can improve cardiovascular fitness and lower-body strength in children with ASD (Du et al., 2009; Enright, 2003; Weingarten & Kaplan, 2015). These outcomes are in line with findings by Zhao et al. (2020), whose meta-analysis confirmed the benefits of roller skating in promoting physical health and endurance in children and adolescents (Zhao et al., 2020).

The motor benefits observed in this study may also be understood in relation to neuromuscular regulation and sensory processing, both of which are known to be atypical in children with ASD (Behrouzmanesh et al., 2023). Skating requires continuous sensory feedback integration, postural adjustments, and rhythmical motion—all of which challenge and reinforce underlying sensorimotor pathways. This is supported by findings from Wen and Wu (2025), who showed that sensory-integration-based sports interventions significantly enhanced motor and social skills in children with ASD (Wen & Wu, 2025). Grosprêtre et al. (2024) similarly emphasized that interventions involving complex, coordinated movements—as seen in sports like skating—improve not only motor functioning but also cognitive-emotional regulation in autistic populations (Grosprêtre et al., 2024).

Furthermore, the increased distance achieved in the 6MWT post-intervention suggests a significant gain in aerobic capacity and functional endurance. These improvements are critical for fostering greater autonomy in daily activities and increasing children's capacity to participate in structured social environments. This aligns with the findings of Morales et al. (2022), who demonstrated that adapted sports interventions—specifically judo—can positively influence both physical stamina and psychosocial functioning in children with ASD (Morales et al., 2022). Skating, like martial arts, demands rhythmic control, spatial awareness, and persistence, making it an effective conduit for improving functional mobility and resilience. Likewise, a study by Guan et al. (2022) revealed that adaptive roller-skating improved emotion regulation in children with autism, further suggesting that the physical improvements observed may also contribute to broader emotional and behavioral outcomes (Guan et al., 2022).

The improvement in TFTS time in this study supports the hypothesis that skating enhances gross motor transitions and

musculoskeletal responsiveness. Ng et al. (2023) showed that the supine-to-stand task is a valid indicator of trunk and lower limb functionality, which are both targeted in skating routines (Ng et al., 2023). The balance between trunk control and lower-body coordination is central to skating, particularly during multidirectional changes, obstacle navigation, and sudden stops—skills that were explicitly practiced during the intervention in this study. The observed changes in functional mobility are consistent with the notion that skating, beyond being a recreational activity, functions as a neuromotor training protocol when structured appropriately (Christ et al., 2024; Thomas et al., 2016).

Additionally, this study's findings should be contextualized within the broader public health challenge of sedentary behavior among children with ASD. Kwofie et al. (2025) and Rostami Haji Abadi et al. (2023) found that children with autism engage in substantially less moderate-to-vigorous physical activity than their typically developing peers, contributing to health disparities and poorer physical outcomes (Kwofie et al., 2025; Rostami Haji Abadi et al., 2023). Introducing skating into rehabilitation protocols offers a viable solution that combines physical, sensory, and motivational elements. The motivational aspect is particularly noteworthy, as children with ASD often display low intrinsic interest in conventional exercise formats. As Grosprêtre et al. (2024) note, the enjoyment and novelty of activities like skating can significantly increase adherence and therapeutic engagement (Grosprêtre et al., 2024).

The broader literature also supports the multisystemic benefits of physical activity in children with ASD. Meta-analyses and systematic reviews have shown that such interventions not only improve motor function but also facilitate cognitive processing, social interaction, and emotional regulation (Li et al., 2023; Pacheco et al., 2025; Qi et al., 2024). Suárez-Manzano et al. (2024) emphasized the holistic nature of physical activity interventions, arguing that gains in one domain—such as motor control—can indirectly stimulate improvements in attention and communication (Suárez-Manzano et al., 2024). Although this study focused on motor outcomes, the qualitative reports from instructors and parents suggested secondary gains in children's self-confidence and engagement—areas worth further investigation in future studies.

In sum, this study contributes to a growing evidence base advocating for the integration of structured, enjoyable, and developmentally appropriate physical activity—such as skating—into therapeutic regimens for children with ASD. The statistically and clinically significant improvements in

balance and functional mobility validate the intervention as both effective and feasible in non-Western settings. These findings are particularly valuable given the scarcity of culturally contextualized intervention studies in Iranian and Middle Eastern populations, as noted by Shakarami et al. (2020) and Mostafa Ali Mohammadi (2016) (Mostafa Ali Mohammadi, 2016; Shakarami et al., 2020). The current study thus not only reinforces established global findings but also provides region-specific empirical data to support local health and education policymakers.

Despite its promising results, this study has several limitations that must be acknowledged. First, the sample size was relatively small ( $n=20$ ), limiting the generalizability of the findings. While the statistical analyses indicated robust within- and between-group effects, a larger sample would enhance statistical power and external validity. Second, the study duration was limited to eight weeks, and no long-term follow-up was conducted to assess the sustainability of the observed improvements. Third, the intervention focused solely on physical outcomes; cognitive, behavioral, and social domains—though potentially affected—were not directly measured. Moreover, the reliance on convenience sampling and the absence of blinding for outcome assessors could introduce bias. Finally, although efforts were made to standardize the skating sessions, variations in participant motivation and learning pace may have influenced individual outcomes.

Future research should address the limitations of the present study through larger, multicenter trials with extended follow-up periods. Incorporating longitudinal designs would help evaluate the long-term impact and sustainability of skating interventions in ASD populations. In addition, future studies should explore the effects of skating on other developmental domains such as executive function, emotion regulation, social responsiveness, and academic performance. Neuroimaging or neurophysiological methods could be employed to explore underlying neural mechanisms contributing to motor improvements. Comparative studies evaluating skating against other physical activities—such as swimming, martial arts, or dance—may also clarify its relative effectiveness. Finally, integrating qualitative methodologies, including interviews with children, parents, and therapists, could provide valuable insights into subjective experiences and perceived benefits, informing the development of more tailored intervention protocols.

Based on the results of this study, skating can be recommended as a low-cost, engaging, and functionally beneficial intervention for children with autism. Therapists

and special educators should consider incorporating skating sessions into comprehensive motor rehabilitation and adaptive physical education programs. Skating requires minimal infrastructure and, with appropriate safety measures, can be implemented in schools, community centers, or rehabilitation clinics. Practitioners should ensure gradual progression, use of protective gear, and emphasis on enjoyment to enhance motivation. Training physical education staff and therapists in sensory integration principles and inclusive pedagogy will further improve the quality and inclusivity of skating interventions. Overall, promoting physical activity through engaging formats like skating may not only improve motor outcomes but also enhance social participation, self-esteem, and quality of life in children with ASD.

### Authors' Contributions

All authors significantly contributed to this study.

### Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

### Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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### Declaration of Interest

The authors report no conflict of interest.

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### Ethical Considerations

In this study, to observe ethical considerations, participants were informed about the goals and importance of the research before the start of the study and participated in the research with informed consent.

### References



- Alizadeh, K., & Mohammadi, Y. N. (2021). *Effectiveness of mindfulness-based cognitive therapy on rumination, shame, and body image in obese girls* Bushehr: Payame Noor University]. <https://www.researchgate.net/publication/379498871>
- Asghari, A., & Aghili, M. (2022). The mediating role of self-compassion in the relationship between eating disorders and self-harming behaviors in female students. *Psychological Models and Methods*, 13(47), 117-128. <https://doi.org/10.30495/jpmm.2022.29177.3517>
- Bahreini, Z., Kahrazei, F., & Nikmanesh, Z. (2022). Effectiveness of Mindfulness-Based Cognitive Therapy on Body Image Anxiety and Suicidal Ideation of Adolescent Girls with Body Dysmorphic Disorder. *Avicenna Journal Neuro Psycho Physiology*, 9(1), 5-10. <https://doi.org/10.32592/ajnp.2022.9.1.101>
- Baldwin, E., Kinsella, S., & Byrne, P. J. (2024). The Reliability of Field-Based Static and Dynamic Balance Tests in Primary School-Aged Autistic Children. *Behavioral Sciences*, 14(8), 640. <https://www.mdpi.com/2076-328X/14/8/640>
- Behrouzmanesh, P., Naderi, F., Bakhtiarpour, S., & Hafezi, F. (2023). Effect of Sensory Integration-based Training on the Sensory Profile of Male Children with High-Performance Autism. *Scientific Journal of Rehabilitation Medicine*, 12, 760-773. <https://doi.org/10.32598/SJRM.12.4.14>
- Casey, A. F., Quenneville-Himbeault, G., Normore, A., Davis, H., & Martell, S. G. (2015). A therapeutic skating intervention for children with autism spectrum disorder. *Pediatr Phys Ther*, 27(2), 170-177. <https://doi.org/10.1097/pep.0000000000000139>
- Christ, T., Boström, K. J., Ohrmann, P., Britz, H., Wagner, H., & Bohn, C. (2024). The effects of a four-month skateboarding intervention on motor, cognitive, and symptom levels in children with ADHD. *Frontiers in Pediatrics*, 12. <https://doi.org/10.3389/fped.2024.1452851>
- Cleare, S., Gumley, A., & O'Connor, R. C. (2019). Self-compassion, self-forgiveness, suicidal ideation, and self-harm: a systematic review. *Clinical Psychology & Psychotherapy*, 26(5), 511-530. <https://doi.org/10.1002/cpp.2372>
- Damavandian, A., Golshani, F., Saffarinia, M., & Baghdasarians, A. (2022). Effectiveness of compassion-focused therapy on aggression, self-harm behaviors, and emotional self-regulation in delinquent adolescents. *Journal-of-Psychological-Science*, 21(112), 797-818. <https://doi.org/10.52547/JPS.21.112.797>
- Du, H., Newton, P. J., Salamonson, Y., Carrieri-Kohlman, V. L., & Davidson, P. M. (2009). A review of the six-minute walk test: its implication as a self-administered assessment tool. *Eur J Cardiovasc Nurs*, 8(1), 2-8. <https://doi.org/10.1016/j.ejcnurse.2008.07.001>
- Enright, P. L. (2003). The six-minute walk test. *Respir Care*, 48(8), 783-785. <https://pubmed.ncbi.nlm.nih.gov/12890299/>
- Erol, Y., & Inozu, M. (2023). An investigation of the mediating roles of emotion regulation difficulties, distress tolerance, self-compassion, and self-disgust in the association between childhood trauma and nonsuicidal self-injury. *Archives of Suicide Research*, 1-15. <https://doi.org/10.1080/13811118.2023.2237083>
- Fan, Q., Li, Y., Gao, Y., Nazari, N., & Griffiths, M. D. (2022). Self-Compassion Moderates the Association Between Body Dissatisfaction and Suicidal Ideation in Adolescents: A Cross-Sectional Study. *Int J Ment Health Addict*, 1-18. <https://doi.org/10.1007/s11469-021-00727-4>
- Faura-Garcia, J., Orue, I., & Calvete, E. (2021). Cyberbullying victimization and nonsuicidal self-injury in adolescents: the role of maladaptive schemas and dispositional mindfulness. *Child abuse & neglect*, 118, 105135. <https://doi.org/10.1016/j.chiabu.2021.105135>
- Geng, J., Wang, J., Wang, Y., Wang, X., Lei, L., & Wang, P. (2022). Relationship Between Cyberbullying Victimization and Non-Suicidal Self-Injury: Roles of Basic Psychological Needs Satisfaction and Self-Compassion. *Social Science Computer Review*, 41(4), 1276-1295. <https://doi.org/10.1177/08944393221074602>
- Gobin, K. C., McComb, S. E., & Mills, J. S. (2022). Testing a self-compassion micro-intervention before appearance-based social media use: Implications for body image. *Body Image*, 40, 200-206. <https://doi.org/10.1016/j.bodyim.2021.12.011>
- Gregory, W. E., Glazer, J. V., & Berenson, K. R. (2017). Self-Compassion, Self-Injury, and Pain. *Cognitive therapy and research*, 41(5), 777-786. <https://doi.org/10.1007/s10608-017-9846-9>
- Grosprêtre, S., Ruffino, C., Derguy, C., & Gueugneau, N. (2024). Sport and Autism: What Do We Know so Far? A Review. *Sports Medicine - Open*, 10(1), 107. <https://doi.org/10.1186/s40798-024-00765-x>
- Gu, H., Fang, L., & Yang, C. (2023). Peer victimization and adolescent non-suicidal self-injury: The mediating role of alienation and moderating role of mindfulness. *Journal of interpersonal violence*, 38(3-4), 3864-3882. <https://doi.org/10.1177/08862605221109903>
- Guan, W., Tang, B., & Wang, Q. F. (2022). A practical study regarding the effect of adaptive roller-skating on emotion regulation ability of autistic children. *European Review for Medical and Pharmacological Sciences*, 26, 6487-6496. [https://doi.org/10.26355/eurev\\_202209\\_29747](https://doi.org/10.26355/eurev_202209_29747)
- Izadian, S., Mirzaian, B., & Hosseini, S. H. (2019). The Effectiveness of Acceptance and Commitment Therapy on Emotion Dysregulation and Self-Compassion Among Self-Harm Students. *Journal of thought & behavior in clinical psychology*, 14(53), 17-26. <https://www.sid.ir/paper/363300/en>
- Johnson, K. L., Cormier, D. L., Kowalski, K. C., & Mosewich, A. D. (2023). Exploring the Relationship Between Mental Toughness and Self-Compassion in the Context of Sport Injury. *Journal of Sport Rehabilitation*, 32(3), 256-264. <https://doi.org/10.1123/jsr.2022-0100>
- Kamarati, M., Zanganeh Motlagh, F., & Pirani, Z. (2022). Comparing the effectiveness of acceptance and commitment therapy and mindfulness on emotion regulation in adolescents with self-harming behaviors. *Journal of Psychological Sciences*, 21(120), 2474-2486. <https://doi.org/10.52547/JPS.21.120.2469>
- Kwofie, N. A., Suherman, A., Florindo, A. A., Staiano, A., Ha, A. S., Okely, A. D., Hamdouchi, A. E., Pham, B. N., Draper, C. E., Tanaka, C., Koh, D., Kim, D. H., Webster, E. K., Guan, H., Tang, H. K., Reilly, J. J., Chong, K. H., Löf, M., Tremblay, M. S., & Janssen, X. (2025). Associations Between Sedentary Behaviour and Fine and Gross Motor Skills in 3- to 4-Year-Olds: A Secondary Data Analysis From Sunrise International Study Pilot Studies. *Child Care Health Dev*, 51(3), e70092. <https://doi.org/10.1111/cch.70092>
- Lang, R., O'Reilly, M., Healy, O., Rispoli, M., Lydon, H., Streusand, W., Davis, T., Kang, S., Sigafos, J., Lancioni, G., Didden, R., & Giesbers, S. (2012). Sensory integration therapy for autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders*, 6(3), 1004-1018. <https://doi.org/10.1016/j.rasd.2012.01.006>
- Li, Y., Feng, Y., Zhong, J., Zou, Z., Lan, W., Shen, Y., Gong, J., Zhao, B., Tong, C., Sit, C. H. P., & Hou, X. (2023). The Effects of Physical Activity Interventions in Children with

- Autism Spectrum Disorder: a Systematic Review and Network Meta-analysis. *Review Journal of Autism and Developmental Disorders*. <https://doi.org/10.1007/s40489-023-00418-x>
- Liu, C., Lin, P. T., & Xiong, Z. (2024). Self-Compassion and Psychological Flourishing Among College Students: The Mediating Role of Hope and the Moderating Role of Emotion Regulation. *Behavioral Sciences*, 14(12), 1149. <https://doi.org/10.3390/bs14121149>
- Martín-Díaz, P., Carratalá-Tejada, M., Molina-Rueda, F., & Cuesta-Gómez, A. (2023). Reliability and agreement of the timed up and go test in children and teenagers with autism spectrum disorder. *European Journal of Pediatrics*, 182(8), 3577-3585. <https://doi.org/10.1007/s00431-023-05027-8>
- Morales, J., Pierantozzi, E., Fukuda, D. H., Garcia, V., Guerra-Balic, M., Sevilla-Sánchez, M., & Carballeira, E. (2022). Improving motor skills and psychosocial behaviors in children with autism spectrum disorder through an adapted judo program. *Front Psychol*, 13, 1067310. <https://doi.org/10.3389/fpsyg.2022.1067310>
- Mostafa Ali Mohammadi, P. (2016). *The effect of skate therapy on children with autism spectrum disorder* <https://skate.blog.ir/post/A%20therapeutic%20skating%20intervention%20for%20children%20with%20autism%20spectrum%20disorder>
- Motale, M., Hosseini, S. V., & Roshandel, A. (2024). Self-harm behaviours prediction based on frustration intolerance and self-compassion in adolescent girls. *Iranian Journal of Psychiatric Nursing*, 12(1), 30-39. [https://ijpn.ir/browse.php?a\\_code=A-10-2336-1&sid=1&slc\\_lang=en](https://ijpn.ir/browse.php?a_code=A-10-2336-1&sid=1&slc_lang=en)
- Nagy, L. M., Shanahan, M. L., & Baer, R. A. (2021). An experimental investigation of the effects of self-criticism and self-compassion on implicit associations with non-suicidal self-injury. *Behaviour Research and Therapy*, 139, 103819. <https://doi.org/10.1016/j.brat.2021.103819>
- Ng, S. S. M., Chen, P., Chan, T. C. W., Chang, C. H. L., Cheng, R. H. Y., Chow, K. K. L., Yeung, A. F. M., Liu, T. W., Ho, L. Y. W., Yeung, J. W. F., Xu, R. H., & Tse, M. M. Y. (2023). Reliability and validity of the supine-to-stand test in people with stroke. *J Rehabil Med*, 55, jrm12372. <https://doi.org/10.2340/jrm.v55.12372>
- Norman, H., Marzano, L., Oskis, A., & Coulson, M. (2021). The Relationship Between Alexithymia and Self-Harm: The Mediating Role of Mindfulness. *Current Psychology*. <https://doi.org/10.1007/s12144-021-01553-6>
- Osareh, N., Pirani, Z., & ZanganehMolagh, F. (2024). Evaluating the effectiveness of cognitive self-compassion and emotion regulation training on motivational self-regulation and social and adaptive functioning of female students with anxiety. *school psychology and institution*, 13(1), 63-76. [https://journal.uma.ac.ir/article\\_2907.html?lang=en](https://journal.uma.ac.ir/article_2907.html?lang=en)
- Pacheco, C., Culkin, V., Putkaradze, A., & Zeng, N. (2025). Effects of movement behaviors on preschoolers' cognition: a systematic review of randomized controlled trials. *Int J Behav Nutr Phys Act*, 22(1), 12. <https://doi.org/10.1186/s12966-025-01705-y>
- Peymannia, B., Hamid, N., & Mahmudalilu, M. (2018). The Effectiveness of ACT Matrix with compassion on self-injury behaviors and quality of life of Students with symptoms of Borderline Personality Disorders. *Psychological Achievements*, 25(1), 23-44. <https://doi.org/10.22055/psy.2018.23581.1905>
- Podsiadlo, D., & Richardson, S. (1991). The timed "Up & Go": a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc*, 39(2), 142-148. <https://doi.org/10.1111/j.1532-5415.1991.tb01616.x>
- Qi, K., Wang, X., Xu, Q., Hu, B., Wang, Z., & Białas, M. (2024). Effect of physical activity on social communication impairments in children with autism spectrum disorder: A meta-analysis. *Heliyon*, 10(20), e39053. <https://doi.org/10.1016/j.heliyon.2024.e39053>
- Rasouli, M., Khazaie, H., & Yarahmadi, Y. (2024). Predicting Sexual Distress Based on Self-Compassion in Women With a History of Mastectomy: Investigation of the Mediating Role of Body Image and Difficulties in Emotion Regulation. *Middle East Journal of Rehabilitation and Health Studies*, 11(4). <https://doi.org/10.5812/mejrh-144890>
- Rehman, S., Addas, A., Rehman, E., & Khan, M. A. (2024). The Mediating Roles of Self-Compassion and Emotion Regulation in the Relationship Between Psychological Resilience and Mental Health Among College Teachers. *Psychology research and behavior management*, Volume 17, 4119-4133. <https://doi.org/10.2147/prbm.s491822>
- Rezaei, M., Mohammad Khani, P., & Jafari Roshan, M. (2022). Comparison of the Effectiveness of Mindfulness-Based Cognitive Therapy and Emotion-Based Therapy on Body Image Dissatisfaction in People with Eating Disorder Symptoms. *Quarterly Journal of Psychological Studies*, 17(3), 95-114. <https://www.magiran.com/paper/2381706>
- Rezagholyan, M., Nemati, F., & Hashemi, T. (2025). Development of a Model of Students' Subjective Well-Being Based on Attachment Styles, Self-Compassion, and Emotion Regulation Styles with the Mediating Role of Quality of Life. *Journal of Adolescent and Youth Psychological Studies (JAYPS)*, 6(1), 21-33. <https://doi.org/10.61838/>
- Roberge, N., & Crasta, J. E. (2022). A Systematic Review of Sensory Interventions for Children With Autism: The Effects on Attention and Self-Regulation. *The American journal of occupational therapy*, 76(Supplement\_1), 7610510189p7610510181-7610510189p7610510181. <https://doi.org/10.5014/ajot.2022.76S1-PO189>
- Rostami Haji Abadi, M., Zheng, Y., Wharton, T., Dell, C., Vatanparast, H., Johnston, J., & Kontulainen, S. (2023). Children with Autism Spectrum Disorder Spent 30 Min Less Daily Time in Moderate-to-Vigorous Physical Activity than Typically Developing Peers: a Meta-Analysis of Cross-sectional Data. *Review Journal of Autism and Developmental Disorders*, 10(1), 144-157. <https://doi.org/10.1007/s40489-021-00262-x>
- Rostami, M., Saadati, N., & Abdi, M. (2017). Relationship between childhood abuse and self-compassion with stress-coping strategies in women [Original Article]. *Journal of Research and Health*, 7(4), 962-970. <http://jrjh.gmu.ac.ir/article-1-708-en.html>
- Seekis, V., & Kennedy, R. (2023). The impact of beauty and self-compassion TikTok videos on young women's appearance shame and anxiety, self-compassion, mood, and comparison processes. *Body Image*, 45, 117-125. <https://doi.org/10.1016/j.bodyim.2023.02.006>
- Shabani, J., Fani, R., & Badleh Shamuski, M. T. (2024). The effectiveness of group-based mindfulness training on resilience and high-risk behaviors among students with a history of self-harm in Raz and Jargalan County. *Journal of Social Welfare*, 24(93), 339-366. <https://doi.org/10.32598/refahj.24.93.4135.1>
- Shafiabady, A., Hasani, J., & Yari, M. (2023). Comparing effectiveness of emotion-focused cognitive-behavioral therapy and mindfulness based cognitive therapy on body image and cognitive emotion regulation in adolescent girls

- interested in cosmetic surgery. *Psychological Achievements*, 30(1), 19-36. <https://doi.org/10.22055/psy.2022.34239.2569>
- Shakarami, R., Nikravan, E., & Rezaei, F. (2020). The effect of parent-assisted sensory-motor integration exercises on balance in children with autism. *Motor Learning and Sport Development*, 11(4), 413-428. <https://doi.org/10.22059/jmlm.2020.263130.1399>
- Shumway-Cook, A., Brauer, S., & Woollacott, M. (2000). *Predicting the probability for falls in community-dwelling older adults using the Timed Up & Go Test* (Vol. 80). <https://pubmed.ncbi.nlm.nih.gov/10960937/>
- Suárez-Manzano, S., Ruiz-Ariza, A., de Loureiro, N. E. M., & Martínez-López, E. J. (2024). Effects of Physical Activity on Cognition, Behavior, and Motor Skills in Youth with Autism Spectrum Disorder: A Systematic Review of Intervention Studies. *Behavioral Sciences*, 14(4), 330. <https://pubmed.ncbi.nlm.nih.gov/38667126/>
- Suh, H., & Jeong, J. (2021). Association of self-compassion with suicidal thoughts and behaviors and non-suicidal self-injury: a meta-analysis. *Front. Psychol.*, 12, 1487. <https://doi.org/10.3389/fpsyg.2021.633482>
- Syafitri, N., Lubis, R., Indrawan, Y. F., & Choong, T. C. (2024). Self-Compassion: Unveiling Mental Health Through Emotion Regulation in High-School Students. *Tazkiya Journal of Psychology*, 12(1), 1-16. <https://doi.org/10.15408/tazkiya.v12i1.37794>
- Thomas, B. R., Lafasakis, M., & Spector, V. (2016). Brief Report: Using Behavioral Skills Training to Teach Skateboarding Skills to a Child with Autism Spectrum Disorder. *J Autism Dev Disord*, 46(12), 3824. <https://doi.org/10.1007/s10803-016-2900-8>
- Türk, F., Kellett, S., & Waller, G. (2021). Determining the Potential Link of Self-Compassion With Eating Pathology and Body Image Among Women: A Longitudinal Mediation Study. *Eating and Weight Disorders - Studies on Anorexia Bulimia and Obesity*, 26(8), 2683-2691. <https://doi.org/10.1007/s40519-021-01144-1>
- Vidal, J., Ciudad-Fernández, V., Navarrete, J., Soler, J., Schmidt, C., Molinari, G., & Cebolla, A. (2024). From Self-Criticism to Self-Compassion: Exploring the Mediating Role of Two Emotion Dysregulation Variables in Their Relationship to Depressive Symptoms. *Current Psychology*. <https://doi.org/10.1007/s12144-024-06325-6>
- Weingarten, G., & Kaplan, S. (2015). Reliability and validity of the Timed Floor To Stand Test-Natural in school-aged children. *Pediatr Phys Ther*, 27(2), 113-118. <https://doi.org/10.1097/pep.000000000000118>
- Wen, L., & Wu, Z. (2025). The impact of sensory integration based sports training on motor and social skill development in children with autism spectrum disorder. *Sci Rep*, 15(1), 19974. <https://doi.org/10.1038/s41598-025-05393-3>
- Wild, M. G., Coppin, J. D., Mendoza, C., Metts, A., Pearson, R., & Creech, S. K. (2025). Self-compassion, mindfulness, and emotion regulation predict multiple dimensions of quality of life in US post-9/11 veterans. *Quality of Life Research*, 1-10. <https://doi.org/10.1007/s11136-025-03908->
- Xavier, A., Pinto Gouveia, J., & Cunha, M. (2016). Non-suicidal self-injury in adolescence: The role of shame, self-criticism and fear of self-compassion. *Child & Youth Care Forum*, 45, 1-15. <https://doi.org/10.1007/s10566-016-9346-1>
- Xing, Y., & Wu, X. (2025). Effects of Motor Skills and Physical Activity Interventions on Motor Development in Children with Autism Spectrum Disorder: A Systematic Review. *Healthcare*, 13(5), 489. <https://pubmed.ncbi.nlm.nih.gov/40077051/>
- Yari, M., Shafiabady, A., & Hasani, J. (2020). Comparing the efficacy of emotion-focused cognitive-behavioral therapy with mindfulness based cognitive therapy on body image and cognitive fusion in adolescent girls interested in cosmetic surgery [Research]. *Dermatology and Cosmetic*, 11(2), 107-118. <http://jdc.tums.ac.ir/article-1-5459-en.html>  
<http://jdc.tums.ac.ir/article-1-5459-en.pdf>
- Zhao, W., Wang, C., & Hou, L. (2020). Roller Skating Promotes the Physical Health of Children and Adolescents: A Systematic Review and Meta-analysis. In.
- Ziarat, S. K. A., Taheri, A., & Abolmaali, K. (2021). Prediction of Mental Well-Being and General Health Based on Perceived Stress and Body Image With Mediating the Role of Self-Compassion in Women Athletes in Tehran. *International Journal of Motor Control and Learning*, 3(2), 32-47. <https://doi.org/10.52547/ijmcl.3.2.32>
- Ziarat, S. K. A., Taheri, A., & Abolmaali, K. (2023). Prediction of Mental Well-Being and General Health Based on Body Image Mediating Self-Compassion in Female Athletes. *Aftj*, 4(4), 350-363. <https://doi.org/10.61838/kman.aftj.4.4.20>