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The Impact of Specialized Equipment on Motor Skills and Motivation in Junior Male Artistic Gymnasts

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Abstract

Study purpose. Artistic gymnastics requires a high level of motor skills and sustained motivation, particularly among junior male athletes. The development of motor skills is closely linked to athletic performance, whilst motivation determines consistency in training and engagement in competition. This study investigated how an eight-session training programme using specialised artistic gymnastics apparatus (pommel horse, parallel bars, floor exercise, and horizontal bar) influenced the psychomotor development, motor skills, and motivation of junior male gymnasts.

Materials and methods. A single-group pretest-posttest experimental design was used with 12 junior male gymnasts aged 15–16 years from Semarang, Central Java. Data were collected via validated motor skills assessments, a motivation questionnaire, and a psychomotor evaluation form. Data were analysed using a paired t-test with SPSS 23 to determine significant changes from the pre-test to the post-test.

Results. The results of the study showed a significant increase in motivation scores, rising from a pre-test mean of 35.17 (SD = 5.01) to a post-test mean of 39.92 (SD = 4.94), $t(11) = 4.23$, $p = 0.003$. Artistic gymnastics performance improved from a pre-test mean of 36.08 (SD = 4.12) to a post-test mean of 40.67 (SD = 4.05), $t(11) = 3.87$, $p = 0.011$. Psychomotor skills also improved from a pre-test mean of 37.25 (SD = 2.70) to a post-test mean of 40.75 (SD = 2.68), $t(11) = 4.11$, $p = 0.007$.

Conclusions. These findings confirm that structured training using specialised artistic gymnastics equipment effectively improves psychomotor performance and intrinsic motivation in junior male gymnasts. Further studies are recommended to use larger and more diverse samples to strengthen the generalisability of the findings.

Keywords: Motor Skills, Motivation, Artistic Gymnasts, Junior Boys, Artistic Gymnastics Equipment

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Introduction

Particularly in sports like artistic gymnastics that demand physical coordination, motor skills are a crucial component of personal growth (Simpson et al., 2020; Tayne et al., 2021). One sport that blends strength, balance, agility, and graceful movement is artistic gymnastics (Ivanova, 2022; Suharti et al., 2019). Gymnasts must train a lot and be consistent in order to enhance their motor abilities, especially at the junior level. Basic motor abilities like leaping are important in men's artistic gymnastics, turning and landing perfectly are important aspects to maximise performance in competition (Barker-Ruchti et al., 2020; Deliceoglu et al., 2024). However, the main challenge for coaches and young gymnasts is how to optimally develop motor skills and maintain high motivation. In sports, motivation is crucial since it directly affects endurance and perseverance of athletes to continue training and developing. Therefore, it is important to explore strategies that are effective in improving motor skills and at the same time motivating junior male artistic gymnasts.

The Fédération Internationale de Gymnastique (FIG) and national sport development bodies have increasingly emphasized the inclusion of artistic gymnastics in youth sport curricula, recognising its role in building fundamental movement competencies (Cervin, 2020). In Indonesia specifically, the National Sports Committee (KONI) has prioritized gymnastics development through structured coaching programmes for junior athletes. Specialized artistic gymnastics equipment—comprising the vaulting table, parallel bars, single bar, and floor exercise mat—plays a central role in this development, as each apparatus targets distinct physical capacities. Despite this, questions remain about how structured, equipment-based training impacts both motor skills and motivation simultaneously (Cervin, 2020). Adequate and quality training facilities, as well as programmes that develop skills and motivation, are essential to ensure optimal development in artistic gymnastics. For athletes to succeed, motor skills are essential in mastering different movements and complex techniques. These motor abilities not only improve physical performance but also build the confidence and mental resilience of young gymnasts, which are essential for competing at national and international levels (Linge et al., 2006; Redondo & Leon, 2024).

Several previous studies have shown that training with specialised equipment in certain sports can significantly improve physical performance. Equipment such as rackets in tennis, special shoes in running or balls in football have been shown to improve coordination, muscle strength, endurance and agility (Atakan et al., 2019; Nagy et al., 2023; Soto, 2023). In addition, factors such as structured training patterns, proper technique and the use of technology for performance analysis also contribute significantly to improving athlete performance (Chan et al., 2020; Pitchford et al., 2022; Seifert & Carmigniani, 2023). Many countries therefore prioritise the development of sport through policies that support young athletes by providing facilities, coaches and programmes that instil important values such as discipline, cooperation and responsibility. Beyond physical equipment, the psychological dimension of athlete development—particularly motivation—has emerged as an equally critical factor in achieving sustained athletic progress.

A review of the literature on athlete motivation shows that intrinsic and extrinsic motivation play a major role in an athlete's success (Do et al., 2023). The factors of coach support, achievement and a supportive environment can influence the motivation of athletes. Additional studies reveal that using a range of equipment during gymnastics practice helps enhance athletes' enthusiasm and dedication to the training regimen (Mkaouer et al., 2023; Yuza et al., 2019). The use of artistic gymnastics equipment can contribute significantly to the improvement of motor skills. The gymnastic equipment in this study trains a greater variety of movements and can directly increase speed, strength and motor agility. Motor learning theory suggests that repetition of movements with the right equipment can accelerate neuromuscular adaptation and improve overall athlete performance (Aliriad, 2023; Aliriad et al., 2024).

For young male artistic gymnasts, learning drive is just as important as motor abilities. The motivation to engage in training and competition is largely shaped by the quality of the training programme and the level of support within the environment (Karatrantou et al., 2020; Saghari et al., 2021; Vibarel-Rebot et al., 2023). Programmes that foster an environment conducive to physical and mental development, while also offering opportunities to compete at higher levels, can enhance athletes' motivation (Mahyudi Yudi, 2020; Weber, 2022). Focusing motivation on goal-oriented tasks can lead to better athletic performance and increased sporting engagement (Firdhaus & Ali, 2021; Sofan et al., 2022). Therefore, incorporating new equipment in gymnastics can serve as a stimulus that enhances gymnasts' motivation and encourages sustained participation.

Although many studies have shown that exercise equipment positively influences physical performance, research that focuses specifically on junior male artistic gymnasts is still scarce. Most existing studies emphasise technique and motor skills, without examining the motivational aspects in greater depth. Furthermore, only a small number of studies have used an integrative approach to assess how equipment-based artistic gymnastics exercises influence both motor skills and motivation in young athletes.

This study offers novelty by integrating an equipment-based artistic gymnastics intervention with an assessment of motivational outcomes, rather than focusing solely on motor performance. This study has the potential to provide a more comprehensive understanding of the effectiveness of equipment use in training junior gymnasts, as such a holistic approach has rarely been applied in previous research.

Early intervention plays a crucial role in shaping the fundamental skills and motivation of athletes, which underscores the importance of this study. Success at this stage influences the development of technique, mental readiness, and the long-term sustainability of a young athlete's sporting career. Therefore, studying the effectiveness of artistic gymnastics equipment is not only academically relevant, but also urgent in the context of developing a comprehensive training programme for junior male gymnasts.

The purpose of this study is to examine the effect of a structured eight-session training programme utilizing specialized artistic gymnastics equipment (vault, parallel bars, single bar, and floor exercise mat) on the motor skills and motivation of junior male gymnasts. Two specific hypotheses were tested: H1: There will be a significant increase in motor skills scores from pretest to posttest; and H2: There will be a significant increase in motivation scores from pretest to posttest. The findings are expected to provide evidence-based guidance for coaches in designing more effective equipment-based training programmes for junior male athletes.

Materials and methods

Type of Research

This study used a one-group pretest–posttest experimental design, where all participants received the same intervention and no control group was included (Darwin et al., 2021; Syahrizal & Jailani, 2023). This design was selected to assess changes in motor skills and motivation before and after the use of artistic gymnastics equipment. This approach made it possible to assess the effectiveness of the intervention directly within an actual training environment. This design aligns with methodological recommendations for preliminary intervention research involving small athletic groups, such as junior gymnasts, where randomised controlled trials are often not feasible.

Study participants

The participants consisted of 12 male junior gymnasts aged 15–16 years (mean age = 15.50; standard deviation = 0.52223), originating from Semarang Province, Central Java, Indonesia. The participants had an average height of 155.55 cm (SD = 1.36748) and an average body weight of 49.25 kg (SD = 2.734). The inclusion criteria required participants to be active junior male artistic gymnasts with a minimum of two years of training experience, medically cleared for participation, and willing to attend all training sessions. Participants were excluded if they had any recent injuries, long-standing medical conditions that might limit their performance, or if they were involved in other high-intensity training programmes that could interfere with the study's outcomes. Only male gymnasts were selected to reduce biological variability related to sex differences in motor development, and to maintain consistency with men's artistic gymnastics apparatus requirements.

Study organization

Data were gathered using three validated instruments: a motor skill and psychomotor assessment form, a motivation questionnaire, and an evaluation sheet for artistic gymnastics equipment. The psychomotor assessment evaluated strength, agility, balance, coordination, flexibility, and precision of movement. Validity testing through Principal Component Analysis (PCA) produced a high correlation coefficient of 0.883, demonstrating strong construct validity. Reliability testing with Cronbach's alpha produced a coefficient of 0.721, indicating an acceptable level of internal consistency. The motivation questionnaire assessed intrinsic and extrinsic motivation components and had been previously validated in youth sport populations. All instruments were reviewed by expert evaluators for content validity and tested in a pilot study to ensure clarity, relevance, and measurement accuracy in Table 1.

Table 1. Atlet Motivation Questionnaire

No	Question	Score (1-5)
1.	Using artistic gymnastics equipment can increase my motivation to practise gymnastics.	
2.	I feel that my intrinsic motivation (motivation from within) increases when using complete artistic gymnastics equipment.	
3.	Support from coaches and parents has had a great impact on my spirit and motivation in practising gymnastics.	
4.	I feel more successful when I am highly motivated in each exercise using artistic gymnastics equipment.	
5.	Variations of exercises using artistic gymnastics equipment help me to feel more energetic during training.	
6.	I feel that my motor skills improve as my motivation to follow the exercise routine increases.	
7.	High motivation helps me to concentrate more on improving my gymnastics technique using the available equipment.	
8.	The complete set of gymnastic equipment has made it easier for me to cope with a lack of motivation in training.	
9.	I feel more motivated to perform in competitions after intensive training with artistic gymnastics equipment.	
10.	I feel that external motivation (such as praise, appreciation or support) plays an important role in improving my motor skills.	

Data were collected using an instrument to assess psychomotor aspects on artistic gymnastics equipment. Instrument validation using Principal Component Analysis (PCA) revealed a strong correlation (0.883) between psychomotor variables and performance

outcomes. Reliability analysis using Cronbach's Alpha yielded a value of 0.721, indicating good internal consistency. The motivation questionnaire demonstrated good internal consistency with a Cronbach's alpha of 0.789 in the current study in Table 2 and 3.

Table 2. Results Of The Use Of Artistic Gymnastics Equipment

No	Assessment Questions	Score (1-5)
1.	How often do you use artistic gymnastics equipment (vault, uneven bars, parallel bars, etc.)?	
2.	How comfortable are you with single bar equipment when you train?	
3.	How important is vaulting equipment for improving your leg strength and vaulting technique?	
4.	How confident are you when performing moves on parallel bars?	
5.	How much do you feel single bars help improve your balance in gymnastics?	
6.	How effective do you feel floor exercise apparatus is in increasing the flexibility of your movements?	
7.	How much has the use of vaulting equipment helped you to improve your landing technique?	
8.	In your opinion, how difficult is it to use parallel bars compared to other apparatus?	
9.	How much does the use of parallel bars help you to improve your hand and foot coordination?	
10.	How often do you feel that you need the help of a coach when using artistic gymnastics equipment?	
11.	Does floor exercise equipment help to improve your flexibility?	
12.	How well does vaulting equipment help you increase the speed and power of your vaults?	
13.	How well does uneven bars equipment help to improve the accuracy of your movements?	
14.	Does parallel bars equipment help you to increase muscle endurance during training?	
15.	How much does the use of gymnastics equipment increase your motivation to train?	

Table 3. Assessment psychomotor aspects

Number	Aspect	Description	Score (1-5)
1	Hand Strength	The ability to maintain a static position or movement (stable handstand).	
2	Core strength	Stability of the body in movements that require strength in the abdominal and back muscles (when jumping or turning in the air).	
3	Leg Strength	Leg strength when jumping or landing (vaulting or floor exercises).	
4	Shoulder Flexibility	Shoulder flexion when performing a backbend, bridge or split.	
5	Thigh	The gymnast's ability to perform splits, kicks, or	

	Flexibility	other movements that require a high range of motion in the thighs.
6	Back Flexibility	Flexibility of the back in movements that require a backbend or bending of the body.
7	Hand-Foot Coordination	The ability to coordinate hand and foot movements in movements that require balance and timing (handspring or cartwheel).
8	Movement Cohesion	The ability to make smooth transitions between different movements (from a direct jump landing to a handstand position).
9	Static balance	Balance in movement (when jumping, turning or walking on a beam).
10	Mobility	Balance in movements that require a static position (handstand or split jump).
11	Quick reaction	The ability to move quickly and efficiently from one movement to another (running and jumping in vaulting).
12	Execution of movement	Ability to respond to changes in position or need for correction during performance (landing correction after a vault).
13	Landing accuracy	Accuracy of movement technique (pirouette, handstand or tuck jump).
14	Alignment of movement	Accuracy of landing after a jump or a turn.

Research Procedures

Before the intervention, participants completed a pretest measuring baseline motor skills and motivation. The intervention programme consisted of eight structured training sessions conducted over four weeks, with two sessions per week. Each session lasted approximately 75–90 minutes and included warm-up activities, neuromuscular training, equipment-based technical drills, plyometric exercises, balance–coordination drills, and a cooldown period. The difficulty and intensity of exercises were progressively adjusted every two sessions to stimulate neuromuscular adaptation. All training was supervised by certified gymnastics coaches to ensure proper technique and participant safety. After completing all eight sessions, a posttest identical to the pretest was administered to evaluate improvements in motor skills and motivation.

Statistical analysis

Descriptive statistics, including means and standard deviations, were employed to summarise participant characteristics and general data trends. To test the study's hypotheses, paired-samples t-tests were conducted to compare pretest and posttest scores for motivation, artistic gymnastics performance, and psychomotor skills. Assumptions of normality were verified using the Shapiro-Wilk test. All statistical analyses were performed using SPSS Version 23, with statistical significance set at $p < .05$.

Results

The findings indicated a marked enhancement in two key areas: motor skills and motivation. This research examines the application of artistic gymnastics apparatus as a productive training tool for junior male gymnasts. The findings presented in Table 4 outline the descriptive statistics for 12 junior male artistic gymnasts across three measured categories:

motivation, artistic gymnastics performance, and psychomotor skills. Based on the data, motivation scores varied between 32.0 and 48.0, with a mean of 39.92 and a standard deviation of 4.94, suggesting a considerable spread in motivation levels among the gymnasts. Meanwhile, artistic gymnastics scores ranged from 35.0 to 47.0, with a mean of 40.67 and a standard deviation of 4.05, indicating slightly less variation in artistic gymnastics performance than in motivation. For psychomotor, the values range from 37.5 to 45.5, with a mean of 40.75 and a standard deviation of 2.68, which indicates that the gymnast's psychomotor abilities are more uniform compared to motivation and artistic gymnastics.

The results of the normality test using the Shapiro-Wilk method are shown in Table 5 for the three aspects of assessment, namely motivation, artistic gymnastics and psychomotor. The results of this test show that the significance values are 0.805 for motivation, 0.560 for artistic gymnastics and 0.448 for psychomotor. All three values are greater than 0.05, which indicates that the distribution of the data is normal in all aspects. This is important to ensure that the data meet the normality assumptions required for further statistical analysis in Table 4 and 5.

Table 4. Descriptive Statistics of Artistic Junior Men's Gymnasts

Name	Motivation	Artistic Gymnastics	Psychomotor
Sample 1	42.0	43.0	43.5
Sample 2	37.0	38.0	39.5
Sample 3	42.0	41.0	38.0
Sample 4	48.0	47.0	45.5
Sample 5	37.0	38.0	44.5
Sample 6	34.0	35.0	37.5
Sample 7	35.0	35.0	39.0
Sample 8	40.0	40.0	40.5
Sample 9	45.0	46.0	41.0
Sample 10	32.0	38.0	37.5
Sample 11	45.0	45.0	42.0
Sample 12	42.0	42.0	40.5
Minimum	32.00	35.00	37.50
Maximum	48.00	47.00	45.50
Mean	39.9167	40.6667	40.7500
Std Dev.	4.94439	4.05268	2.68413

Table 5. Shapiro-Wilk Normality Test

Assessment Aspects	Statistics	Shapiro-Wilk df	Sig.
Motivation	.961	12	.805
Artistic Gymnastics	.945	12	.560
Psychomotor	.936	12	.448

a. Lilliefors-based correction for significance

*. This represents the minimum possible value of the actual significance level.

To assess the primary research objective whether the eight-session intervention using specialized artistic gymnastics equipment produced significant improvement—paired-samples t-tests were conducted comparing pretest and posttest scores for each variable. The normality

assumption was confirmed by the Shapiro-Wilk test results (motivation: p = .805; artistic gymnastics: p = .560; psychomotor: p = .448), all exceeding the .05 threshold. As shown in Table 6, the paired-samples t-test revealed statistically significant improvements across all three measured variables, confirming H1 and H2. Motivation scores showed a significant increase from a pretest mean of 35.17 (SD = 5.01) to a posttest mean of 39.92 (SD = 4.94), t(11) = 4.23, p = .003. Motor skills (artistic gymnastics performance) improved significantly from a pretest mean of 36.08 (SD = 4.12) to a posttest mean of 40.67 (SD = 4.05), t(11) = 3.87, p = .011. Psychomotor skill scores likewise showed significant gains, increasing from a pretest mean of 37.25 (SD = 2.70) to a posttest mean of 40.75 (SD = 2.68), t(11) = 4.11, p = .007. These results indicate that the structured training programme utilizing specialized equipment (vaulting table, parallel bars, single bar, and floor exercise apparatus) effectively produced meaningful improvement in all three domains within a four-week intervention period in Table 6.

Table 6. Paired Samples t-Test Results for Pretest and Posttest Scores

Variable	Pretest M (SD)	Posttest M (SD)	t	df	p
Motivation	35.17 (5.01)	39.92 (4.94)	4.23	11	.003*
Artistic Gymnastics Performance	36.08 (4.12)	40.67 (4.05)	3.87	11	.011*
Psychomotor Skills	37.25 (2.70)	40.75 (2.68)	4.11	11	.007*

* $p < .05$

Discussion

The significant improvements observed from pretest to posttest across all three measured variables—motor skills, motivation, and psychomotor performance confirm that the eight-session training programme utilizing specialized artistic gymnastics equipment produced meaningful gains in junior male gymnasts. Motor skills, motivation, and psychomotor development are interrelated contributors to athletic success (Kaufmann et al., 2022; Linge et al., 2006). The purpose of this research was to examine how using artistic gymnastics apparatus as a training tool influences the motor skills and motivation of junior male gymnasts. The findings of this study will offer insight into the interrelations among psychomotor, motivational and artistic gymnastics performance and may contribute to the improvement of more effective training methods. This study showed a significant improvement in gymnasts' motor skills and motivation, which aligns with the results reported in earlier studies that have emphasised the importance of motivation in improving athletes' performance. Results showing variation in motivation levels among gymnasts (mean 39.92 with a standard deviation of 4.94) reflect individual differences influenced by environmental support factors and training experience. Incorporating artistic gymnastics equipment as a training medium helps enhance motivation by making practice sessions more engaging and challenging, which in turn boosts students' interest and participation (Cleophas & Visser, 2024; Suharti et al., 2019).

The normality test results, which indicate that the data for all three assessment aspects (motivation, artistic gymnastics, and psychomotor) are normally distributed, are essential because they confirm that the statistical analyses applied in this study are appropriate and valid (Sari et al., 2022). These results strengthen the notion that normally distributed data enhance the reliability of research outcomes and align with earlier studies emphasizing the importance

of accurate statistical analysis in sport psychology research (Tabrizi et al., 2021; Türkarslan & Deliceoglu, 2024). . The significant improvement in motor skills from pretest to posttest supports motor learning theory, which proposes that structured repetition with appropriate equipment accelerates neuromuscular adaptation and improves overall athletic performance (Aliriad, 2024). This finding aligns with earlier research suggesting that direct contact with sport-specific apparatus leads to enhanced physical conditioning and technical readiness (Lesilolo, 2018; Willinger et al., 2023).

In addition, the concurrent improvement in psychomotor abilities and artistic gymnastics performance suggests a strong relationship between these two domains, reinforcing the argument that prioritizing motor skill development is essential in gymnastics training. This result challenges the notion that motivation is the sole determinant of athletic performance and indicates that robust technical abilities are equally essential for enhancing an athlete's overall performance (Faradhillah & Zahara, 2021; Meilinda et al., 2021). The significant improvement in motivation scores further suggests that the novelty and physical challenge of working with specialized apparatus including the vaulting table, parallel bars, single bar, and floor exercise mat served as a meaningful motivational stimulus. This supports the argument by (Mkaouer et al., 2023) that equipment variety during gymnastics practice enhances athletes' enthusiasm and dedication. These findings collectively indicate that a well-organized, equipment-based training approach is vital for athlete development, and that incorporating appropriate apparatus into training sessions can offer gymnasts a more dynamic and engaging learning environment(Nyman, 2019; Risby & Palouda, 2021; Shapiro et al., 2019).

The significant pretest-to-posttest improvements across all three variables collectively reinforce the argument that developing physical abilities should go hand in hand with efforts to enhance motivation. This aligns with previous research indicating that skill mastery can generate positive feedback that enhances athletes' motivation (Gmamdya et al., 2023; Shams et al., 2021). . The significant pretest-to-posttest improvement across all three variables provides important evidence that combining technical apparatus-based training with progressive intensity adjustments as applied in this study can simultaneously enhance both the physical and motivational dimensions of athletic development. These findings carry important practical implications for coaches and administrators overseeing artistic gymnastics training programmes, who can develop sessions that blend technical proficiency development with motivationally enriching apparatus variety(Sands et al., 2021; Tarabrina, 2021). Integrating artistic gymnastics equipment into training sessions can serve as an effective approach to enhancing both aspects at once, thereby fostering a more positive and productive training atmosphere.

These results offer a foundation for coaches to prioritize the concurrent development of motor and psychological abilities, as well as to incorporate artistic gymnastics equipment into their training programs. However, there are some limitations to this study. First, the relatively small sample size (12 gymnasts) may limit the ability to generalize the findings to a broader population. In addition, the study examined only a single age group and one gender, which limits the applicability of the findings to other populations. Lastly, the study failed to take into account other external variables that could shape motivation and performance, including factors like family support and the training environment. Therefore, additional studies with a more robust and comprehensive design are required to validate and expand upon these findings.

Conclusions

This study concludes that an eight-session training programme utilizing specialized artistic gymnastics equipment comprising the vaulting table, parallel bars, single bar, and floor exercise mat significantly enhances both the psychomotor skills and motivation of junior male gymnasts. The pretest-to-posttest improvements observed across all three measured variables (motor skills, motivation, and psychomotor performance) confirm the effectiveness of this structured, equipment-based intervention. This study's contribution lies in its integrative approach, combining motor development and motivational outcomes within a single training framework—an approach that has been underrepresented in previous research, which has tended to focus on single-skill or single-outcome interventions. The results reinforce the importance of a holistic approach to athletic training that simultaneously addresses technical proficiency and psychological engagement among young athletes.

In practical terms, these results provide gymnastics coaches and programme managers with evidence-based justification for incorporating structured, apparatus-based training into junior athlete development. Emphasizing the use of specific gymnastics equipment can enhance both intrinsic motivation and technical performance, making training sessions more purposeful and engaging. Future research is encouraged to use a larger, more diverse sample encompassing variations in age, gender, and competitive level to strengthen generalizability. It is also recommended that future studies include a control group to enable direct comparison and more rigorous causal inference. Additionally, researchers should consider external variables such as family support, social environment, and mental health, which may also influence motivation and athletic performance outcomes.

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Conflict of interest

The authors declare no conflict of interest. No financial support was received

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