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Effects of Intensive Training on Sitting Height Growth between Age 14-17 Among Male Professional and Non-Professional Gymnasts

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Abstract

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Keywords: Artistic Gymnastics, International Federation of Gymnastics, Intensive Training, Sitting Height

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Title

Effects of Intensive Training on Sitting Height Growth between Ages 14-17 Among Male Professional and Non-Professional Gymnasts

Abstract

This study was to explore the effects of intensive training on sitting height growth between professional and non-professional gymnasts. The study contained both groups; 40 professional and 40 non-professional male artistic gymnasts. Professional gymnasts experienced a lower rise in sitting height growth (SHG) following rigorous training (RT) intervention than non-professional gymnasts. Professionals' mean and SD scores for the pre-test and post-test were 80.99 ±9.06 and 80.73 ±12.98, respectively. The mean difference -0.26% for both tests and the p>0.91 suggests that the differences are statistically significant. Non-professional mean and SD scores for the pre and post-tests were 80.28±9.14 and 82.87±5.83, respectively. The tests also showed a mean difference of 2.59% in both cases, and p<0.01 indicated that the differences were statistically significant. The finding, in comparison to non-professional groups, the SHG of male artistic gymnasts (ages 14–17) was more adversely impacted by RT in professional gymnasts.

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Keywords: Artistic Gymnastics, International Federation of Gymnastics, Intensive Training, Sitting Height

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Introduction

Physical activity is the primary driver of physical fitness and plays a fundamental role in growth and development, especially during childhood and adolescence. Physical activity comprises a vast range of physical movements that may be incorporated into daily life through activities such as active commuting, gardening, and housework (Kobernyk et al., 2020). Furthermore, regular exercise is important for preserving a healthy body weight, boosting cardiovascular and muscular fitness, and promoting bone health (Khan et al., 2023; Obidovna & Sulaymonovich, 2022). Sport is concerning the exertion of the body in which the body is exercised according to its aptitude, and capacity, and at the same time, the people who take part in it enjoy this physical system (Berryman et al.,

2019). Sports are planned and organized endeavors that feature competitive play and are regulated by regulations and rules of engagement. They are frequently performed in teams or individually (McCardle et al., 2017). Contemporary gymnastics is credited to Friedrich Ludwig Jahn, a German physical education instructor recognized as the "Father of Gymnastics".Jahn created "Turnen," a regimen of exercises that included calisthenics, acrobatics, and equipment work, in the early nineteenth century.

Balyi et al. (2013) gymnastics distinguishes among sports as an uncommon discipline that mixes athleticism with artistic expression. Gymnastics developed from traditional physical training routines into a formalized discipline that requires precision, strength, flexibility, and imagination. Gymnastics truly takes athletes to new heights. Competitors perform amazing trampoline performances, doing high-flying somersaults, twists, and turns with exceptional accuracy and control. Gymnasts seek maximum height and perform sophisticated aerial routines, which demand tremendous force, timing, and spatial awareness (Fryar et al., 2023).

Farana et al., (2023) the dynamic and complicated sport of AG necessitates a special synthesis of physical prowess, creative expression, and flexibility. Additionally, Bryan et al. (2017) exploring the mental toughness, confidence, and resilience required to succeed in high-stress competitive contexts have drawn attention to the psychological side of sport. While AG has drawn attention for its beauty and grace, researchers like Turner and McCarthy (2017) have emphasized the potential harms of intensive training on developing athletes and stressed the significance of finding a balance between both. It is remarkably widely recognized and prominent in the field of study in artistic gymnastics blends strength, flexibility, and aesthetic expression in routines performed on various equipment.

Bouamra et al. (2022) and Giessing et al. (2016) indicate that intense training may result in considerable gains in performance, body composition, and general health. To minimize the danger of injuries and assure long-term success, however, careful planning, competent coaching, and attention to recuperation are required.

Hypotheses

H_0: There is no significant effect of intensive training on the siting height growth in male professional and non-professional gymnasts in Artistic Gymnastics.

H_{1A}: There is significant of intensive training on the siting height growth in male professional and non-professional gymnasts in Artistic Gymnastics.

Research Objective

To analyze the possessions of intensive exercise on the sitting height growth of male professional and non-professional gymnasts in Artistic Gymnastics.

Gap Analysis

Malina et al. (2013) determination of this study was to figure out the role of intensive exercise in the growth and maturation of artistic gymnastics. To date, the causal connections between training and growth have not been established due to data limitations, inadequate training specifications, neglect of additional factors influencing maturation and development, and failure to address biological criteria for causality. The subsequent conclusions were accepted after taking into account the mentioned limitations: 1) Intense gymnastics training does not appear to impair the adult height or almost adult height of male and female artistic gymnasts; 2) Gymnastics training does not appear to reduce the sitting height growth (SHG) of body segment lengths. Therefore, the author analyzed the effects of intensive training on sitting height in children aged 14-17 years through this study. Because the growth rate in children of this age (14-17 years) is much higher than in adolescence and young adulthood.

Literature Review

Nurmasitoh (2015) conducted a study on the activity of high intensity of exercise and the low intensity of exercise increases the same amount of immune system. For this purpose, low-intensity exercise such as yoga was taken and studied which indicated that low-intensity exercise increased immunity as compared to high-intensity exercise. For example, if you take Gymnastics which is a high-intensity exercise as compared to yoga which is a low-intensity exercise then there is much evidence that gymnasts will have better immune levels. Yoga only helps to keep the body's muscles relaxed (Salchow et al., 2021).

Sports Training

Jose et al. (2021) concluded that cognitive control and relaxation techniques are an important part of any athlete's training that can be practiced psychologically. The power of the players' emotional intelligence is used to keep the players emotionally motivated and emotionally balanced. Therefore, the effects of slow breathing on the cardiac may be affected but information

may be required to know the psychological benefits (Silva et al., 2020). Kim et al. (2021) found that coordination and focus are also required as an integral part of many sports. For instance, Archery requires psychological training, and it explains how to improve the player's performance and psychological skills with the help of training. The result stated that psychological intervention has a significant effect on archery. It is important for them to choose the place and time which can have a negative or positive effect on the performance of the player psychologically.

Intensive Training

Núñez et al., (2018) athletes, fitness enthusiasts, and professionals in a variety of sports and athletic professions frequently use rigorous training. While difficult, intense training may result in considerable gains in performance, body composition, and general health. To minimize the danger of injuries and assure long-term success, however, careful planning, competent coaching, and attention to recuperation are required. Keeping in mind the demand of specific sports, one has to prepare for it in the training field. If an athlete has to compete in sports having rigorous intensity moves, he has to be trained hard for it. Plyometric training has been used to look into these reasons. The use of which gives athletes a variety of range of motion (high jumps, sprint, speed, explosiveness, range of motion, muscular strength, and agility) to improve their body over a wide range of physical strength (Rico-González et al., 2021).

Artistic Gymnastics

Kilijanek and Sanchez (2019) reported that gymnastics can be divided into different disciplines, including AG, RG, TG, Ar-G, and Ac-G, each with its exclusive set of BMs. Menegaldo et al. (2023) also concluded that rhythmic gymnastics is a unique and artistic sport that combines elements of dance, and gymnastics which does allow for the development of more joint mobility, whereas AG enhances more strength, balance, and endurance. They recommended that further research using bigger samples should replicate the results rather than relying on the study's limited sample size. Maszczyk et al. (2018) looked at the disparities in peak torque development and flexion/extension ratios among non-athletes and gymnasts at pre- and post-pubertal ages. The results not only show the consequences of long-term gymnastic training, but, they also highlight the disparity that exists between the arm's agonists and antagonists, which increases the risk of injury.

Physical Growth

Alves and Alves (2019) conducted their study on the "Effects of PA on Children's Growth". These topics included height growth, bone and muscle tissue growth, and bone density. They discovered that practically all research supported the safety of aerobic and anaerobic workouts for kids and teenagers that are mild to moderate in intensity. Similarly, Chan et al. (2022) also reveal that while some studies showed an increase in bone and muscle tissue growth in child and adolescent athletes, retrieve studies did not show that playing sports or engaging in PA, particularly Basketball and floor gymnastics, affected the linear growth of children or adolescents. From fetal life to adolescence, they concluded that the data seemed to support the assumption that PA is safe for both the pregnant mother and the unborn child, even though there were not enough studies with adequate methodology, particularly randomized clinical trials. According to research, PA promotes a child's linear growth and helps with healthy skeletal and muscular development, perhaps having a good lifetime impact. (Dallolio et al., 2022).

Methodology:

Study Design

The research design used for the study under review was a Randomized Control Trial (RCT). The data for this study were gathered using the RCT data-collecting approach. After that, the gymnasts who volunteered to participate in the study provided the data. There were three phases to the data collection process: 1) Before the intervention stage; 2) During the intervention stage and 3) After the intervention stage.

Study Setting

According to the FIG rules, artistic gymnastics (AG) is one sort of apparatus floor exercise used in this study. 80 gymnasts from Multan and Lahore, two sizable regions of Pakistan, were chosen as 4-AGs in order to perform these physical movements on the gymnastics apparatus. Through intervention, the gymnasts' strength, agility, balance, coordination, and flexibility were evaluated.

Population

Gymnasts ranging in age from 7 to 26 were registered as participants (N = 225) at these clubs. Respondents volunteered for this study, and four gymnastics clubs from the Lahore and Multan districts were chosen at random.

Table 1

Total Population of Study

Sr. #	Gymnasts Categories	Male Gymnasts (age 7-26)
1	Professional	80
2	Non- Professional	133
	Total	225

Table 1 lists the people involved in this study, who were aged 7–26 and were split into two groups: professional (n = 80) and non-professional (n = 133) gymnasts from four carefully chosen artistic gymnastics.

Target Population

Table 2

Age-wise Population of Study

Sr. #	Gymnasts Categories	14-15 Age	16-17 Age	Total
1	Professional	45	40	85
2	Non- Professional	40	22	62
	Total	85	62	147

Table 2 demonstrates that the study's inclusion criteria called for the targeted group to be gymnasts between the ages of 14 and 17, both professional and non-professional. As per the study's requirements, the researcher categorized 147 gymnasts between the ages of 14 and 17; these included 62 non-professional and 85 professional gymnasts, as indicated in the table above.

Sampling

For this investigation, a Convenient Sampling Technique was applied. Selecting gymnasts between the ages of 14 and 17 from their different clubs proved to be difficult because Pakistan has a very small number of AG clubs.

Table 3

Sample Size of Professional and Non-Professional Gymnasts

Sr. #	Gymnasts Categories	Total Population (14-17 Age)	Sample (14-17 Age)	Sample (14-17 Age)	Total Sample Size
1	Professional	85	20	20	40
2	Non- Professional	62	20	20	40
Total		147	40	40	80

Table 3 above displays the population and total sample size according to professional and non-professional groups, from which 40 professionals and 40 non-professionals were derived.

Data Collection Procedure

Gymnasts who volunteered to participate in this study provided the data. Three distinct periods were used to gather the data: the start, middle, and end of the three-month period. Two phases make up the technique and procedure for gathering data: 1) Pre-intervention; and 2) Post-intervention.

Measure

The anthropometrical indicators (sitting height) of gymnasts were measured using a 1-parameter by Claessens, A. L (1991). In this study, variables were measured using the following anthropometric measuring tools, which are interpreted as follows: i) Stadiometer for height; ii) Flat bench for sitting.

Statistical Analysis Tools

Utilizing SPSS v.25 and MS Excel v.10, which are frequently used in investigations of this kind, statistical data was calculated to obtain frequencies, percentages, mean, SD score, and other information for this investigation.

Data Analysis and Result:

Data Type

The pre-test/post-test method was used in this study to gather primary data for the following three sections: i) Demographic Information; ii) Anthropometric Sitting Height; and iii) Body Movements through Floor Exercises under FIG HP4, HP5.

Quantitative Data Analysis

The following tables show the results regarding the anthropometric indicators (sitting height) of professional and non-professional gymnasts along with the comparison between both types of gymnasts in pre-test and post-test data through mean score, standard deviation, and significant difference. Similarly, the below tables also indicate the impacts of proper application of intensive training on body movements on 20-professional and 20-non-professional gymnasts in floor exercises through HP4 (Age=14-15) and HP5 (age=16-17) in high performance stream.

Demographic Characteristics

The demographic features of the study participants as of right now, include gender, age, club name, location, and group type.

Table 4

Age-wise Participants

		Age				Total
		14	15	16	17	
Professional	Count	10	10	10	10	40
	%	50%	50%	50%	50%	50.0%
Non-Professional	Count	10	10	10	10	40
	%	50%	50%	50%	50%	50.0%
Total	Count	20	20	20	20	80
	%	25.0%	25.0%	25.0%	25.0%	100.0%

Professional and non-professional gymnasts from all gymnastics clubs participated in this study at equal rates (20, 25.0%), as indicated by the frequencies and percentages in Table 4.

Anthropometric Indicator Siting Height (cm) and F.I.G authorised Body Movements (floor elements HP4 & HP5)

Table 5

Shapiro-Wilk Test Results for Normality of Data in Anthropometric Indicator

Sr.#		Shapiro-Wilk		
		Statistic	Df	P
1	Sitting Height	0.84	80	0.00*
2	BM-HP4	0.94	40	0.04*
3	BM-HP5	0.89	40	0.00*

The Shapiro-Wilk statistics of one anthropometric indicator and two-floor elements related to their normal distribution are displayed in the above table; an item where the significance (P-value) is less than 0.05 indicates that it does not follow a normal distribution, and 3 items have lower significant values ($p<0.05$) indicating that they do not follow the normality of the data distribution. The test statistics for each item are displayed in the statistics against it, and the "df" values indicate the degree of freedom associated with each test.

Table 6

Collected and derived data of examined Professional and Non-professional gymnasts. Data are expressed as mean ±SD and p values express differences between Professional and Non-professional gymnasts (14-17 before and after 12 weeks of rigorous training (RT).

Variables	Professional Gymnasts (n=40)			Non-professional Gymnasts (n=40)		
	Mean	SD	P	Mean	SD	P

Variables	Professional Gymnasts (n=40)			Non-professional Gymnasts (n=40)		
Sitting Height before intervention	80.99	9.06		80.28	9.14	
Sitting Height after intervention	80.73	12.98		82.87	5.83	
Δ Before - After interview Sitting Height	-0.26	3.92	0.91	2.59	-3.31	0.01
RST-HP4 before intervention	0.28	0.31		1.19	0.22	
RST-HP4 after intervention	3.06	0.29		2.39	0.28	
Δ Before - After interview RST-HP4	2.78	-0.02	<0.001	1.2	0.06	0.11
RST-HP5 before intervention	0.35	0.39		0.3	0.2	
RST-HP5 after intervention	3.13	0.34		0.34	0.27	
Δ Before - After interview RST-HP5	2.78	-0.05	<0.001	0.04	0.07	0.21

The professionals' sitting height (cm) is displayed in the above table for both the pre-and post-tests. The mean and SD scores were 80.99 ±9.06 for the pre-test and 80.73 ±12.98 for the post-test, respectively. The Mean % Dif. (-0.26) for both tests and the p-value (0.91>0.05) shows that the differences are statistically significant. The height data of non-professionals in the pre-and post-test are displayed in the above table, together with the mean and standard deviation of the results. The difference is statistically significant in both the pre-and post-tests, as shown by the scores of 80.28±9.14 in the pre-test and 82.87±5.83 in the post-test, as well as the Mean % Dif. (2.59) in both tests and the P-value (0.01<0.05). The mean difference between both groups shows that non-professional gymnasts have higher sitting height as compared to professional gymnasts after the intervention.

The above table shows the statistics of Body Movement (HP4) of professionals in the pre-test and post-test which indicates mean and SD scores were found 2.78±0.02 in the pre-test and 3.06±0.29 in the post-test. The Mean % Dif. (0.14) in both tests and *P*-value (0.001<0.05) indicate that the difference is statistically significant in both pre & post-tests. And above table shows the statistics of Body Movement (HP4) of non-professionals in the pre-test and post-test which indicates mean and SD scores were found 1.19±0.22 in the pre-test and 2.39±0.28 in the post-test. The mean % Dif. (0.08) in both tests and *P*-value (0.11>0.05) indicate that the difference is statistically significant in both pre & post-tests. The mean difference between both groups shows that professional gymnasts have greater body movement in HP4 as compared to non-professional gymnasts after RT intervention.

The above table shows the statistics of Body Movement (HP5) of professionals in the pre-test and post-test which indicates mean and SD scores were found 0.35±0.39 in the pre-test and 3.13±0.34 in the post-test. The Mean % Dif. (2.14) in both tests and *the P*-value (0.001<0.05) indicates that the difference is statistically significant in both pre & post-tests. And above table shows the statistics of Body Movement (HP5) of non-professionals in the pre-test and post-test which indicates mean and SD scores were found 0.3±0.2 in the pre-test and 0.34±0.27 in the post-test. The mean % Dif. (0.03) in both tests and *P*-value (0.21>0.05) indicate that the difference is statistically significant in both pre & post-tests. The mean difference between both groups shows that professional gymnasts have greater body movement in HP5 as compared to non-professional gymnasts after RT intervention.

Table 7

Test Statistics of Wilcoxon Rank Test of Sitting Height (cm) of the Participants of both Groups (n=80) in Pre-test & Post-test.

Participant ID		PG in Pre & Post Test
Professional Group	Z	-3.28[b]
	P. (2-tailed)	<.001
Non-Professional Group	Z	-3.27[b]
	P. (2-tailed)	<.001

a=Wilcoxon Signed Ranks Test. b=Based on positive ranks.

To determine the significant variations in Siting Height between the two groups' participants in the pre-and post-test, the Wilcoxon Rank test was used to generate Z-scores. Based on positive ranks under their physical progress, Table 7 displays Z-scores of -3.28 for the professional group and -3.27 for the non-professional group. The two groups' Sig (2-tailed) values are less than 0.001, indicating that both groups' p values for PG are

more than zero. Z-score shows that following RT intervention, there was a considerable drop in PG in both groups because of positive ranks.

Discussion

One hypothesis (1 null hypothesis and 1 alternative hypothesis) on the impact of RT on the sitting height of male professional and non-professional gymnasts in AG between the ages of 14 and 17 was developed in this study in light of earlier research. The next section discusses data analysis results that contradict the study's two hypotheses.

Eighty male professional and non-professional gymnasts participated in this study, and pre-and post-tests were administered before and after the 12-week RT intervention in order to quantify and compare the variations in sitting height growth (SHG). Mean percentage differences and significant levels were determined by comparing SHG to mean scores, standard deviation, and p-values; sitting height indicates a portion of participants' physical growth level. In terms of SHG, professional and non-professional artistic gymnasts' mean percent difference in SHG before and after RT was found to be -0.26 and 2.59 centimeters, respectively. This suggests that professional gymnasts' increase in sitting height following RT intervention is smaller than that of non-professional gymnasts.

Rico-González et al. (2021) concluded the same that if an athlete has to compete in sports having rigorous intensity moves, he has to train hard for it. Plyometric training has been used to look into these reasons. The use of which gives athletes a variety of range of motion (high jumps, sprint, speed, explosiveness, range of motion, muscular strength, and agility) to improve their body over a wide range of physical strength. Tao and Li (2023) also found that sometimes physical activity and body movement involve high-intensity exercises that are intended to enhance strength, endurance, flexibility, and overall fitness. Athletes, fitness enthusiasts, and professionals in a variety of sports and athletic professions frequently use rigorous training. Although gymnastics is expected to increase an athlete's personality in the same way that other sports enhance a person's personality, nowadays in Gymnastics, it is seen that the athletes who participate in training from the beginning, as they get older, as they move towards the peak level of Gymnastics; their physical growth starts to stagnate.

Similarly, Bai et al. (2022) discovered that moderate to intensive training interventions have the potential to positively impact BM and motor skills in children and adolescents. However, the specific effects can vary depending on factors such as age, duration, intensity, and individual differences. To maximize the benefits, it's important to design interventions that are age-appropriate, engaging, and tailored to the needs of the participants. Likewise, Benson and Campbell (2007) also concluded the same results that there is a significant and positive relationship between vigorous body movement, aerobic fitness, the brain, cognitive performance, mental health, and academic attainment during adolescence. These abilities encompass a wide range of physical skills, including flexibility, strength, coordination, balance, agility, endurance, and motor control.

Conclusion

This study's main goal was to investigate the effects of intensive training on sitting height growth (SHG) in gymnasts, both professional and non-professional, between the ages of 14 and 17. In order to achieve this, a randomized control trial (RCT)-based study design was used, with 80 participants recruited from four artistic gymnastic clubs located in several Punjabi cities in Pakistan. Primary data about the SHG (RT under FIG Codes of HP4 & HP5 de Gymnastique 2019) of male artistic gymnasts, both professional and amateur, were gathered through a 12-week intensive training intervention. This phase has taken into account the overall effectiveness of RT and then discussed how this study might advance our theoretical and practical knowledge of artistic gymnasts' SHG and RT.

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