O MUNDO DA SAÚDE

DOI: 10.15343/0104-7809.202448e16272024I

Performance of Male Athletes in the Brazilian National Handball Team: Youth Category

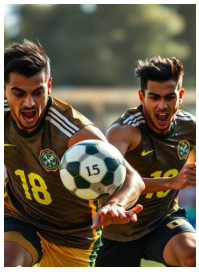
Max dos Santos-Afonso[1,4] Luciano Garcia Lourenção[2] Mirelle de Oliveira Saes[1] Rafaela da Silva Ratto[3]
Marla dos Santos Afonso[2] Vinícius de Moraes[4]

[1]Programa de Pós-graduação em Ciências da Saúde, Faculdade de Medicina, Universidade Federal do Rio Grande – FAMED/FURG. Rio Grande/RS, Brasil.
[2]Programa de Pós-graduação em Enfermagem, Escola de Enfermagem, Universidade Federal do Rio Grande - EEnf/FURG. Rio Grande/RS, Brasil.
[3]Curso de Nutrição, Faculdade Anhanguera de Pelotas. Pelotas/RS, Brasil.
[4]Curso de Medicina, Universidade Católica de Pelotas – UCPel. Pelotas/RS, Brasil.
E-mail: max.afonso@hotmail.com

Graphical abstract

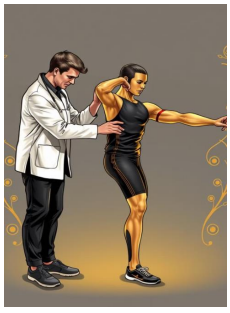
Evaluation of Stability and Flexibility in Male Handball Athletes

This manuscript analyzed the performance of male athletes from the Brazilian youth handball team during the National Development and Technical Improvement Camp.



OBJECTIVE

- ✓ **To analyze the muscular stability and flexibility performance of athletes selected for the Brazilian youth handball team, who participated in the National Development and Technical Improvement Camp.**



DISCUSSION

Flexibility and stability are essential for:

- ✓ **Motor Performance:** Improvement in athletic skills.
- ✓ **Injury Prevention:** Reduced risk of muscle and joint injuries.

Professional Relevance

- ✓ Health professionals play an important role in ensuring safe and effective training.

METHODOLOGY

EVALUATION

- ✓ Beginning and end of the Camp.

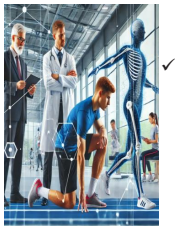
TESTS CONDUCTED

- ✓ **Shoulder Stability:** Closed kinetic chain tests.
- ✓ **Flexibility:** Sit-and-reach test.

RESULTS

Significant improvement in range of motion

- ✓ **Flexibility**: Increased from 35.5 cm to 39.6 cm in the average reach.
- ✓ **Shoulder Stability**: Increased from 31.8 to 35.4 movements, on average.



CONCLUSION

- ✓ **The integration of flexibility and stability assessments can optimize athletic performance and reduce the risk of injuries, highlighting the importance of a multidisciplinary approach in athlete training.**

DOI: 10.15343/0104-7809.202448e16272024I

Abstract

Injuries and strain in the sports world are caused by the rigidity of training and competitions, combined with the pressure for excellent performance, which can result in musculoskeletal damage. The objective of this study was to analyze the stability and muscle flexibility performance of athletes selected for the Brazilian youth handball team, who participated in the National Development and Technical Improvement Camp. The event included training sessions, video analysis, games, a lecture with a senior national team athlete, and activities such as the official photo and an outing. The athletes were evaluated upon arrival at the camp and after 10 days of immersion in sports activities. A total of 20 athletes, aged 13 and 14, participated, and the effect of pre- and post-training exercises was assessed through the modified sit-and-reach flexibility test and the upper extremity closed kinetic chain stability test. There was a significant improvement in range of motion in most cases, demonstrating a real gain in musculotendinous plasticity and an enhancement in motor performance after the exercise period. Strengthening exercises for the rotator cuff and stretching are crucial to maximizing these gains. Furthermore, the involvement of health professionals, such as physiotherapists and nutritionists, is essential to ensure safe and effective training.

Keywords: Athletic Performance. Athletes. Youth Sports. Occupational Health.

INTRODUCTION

Injuries and strain in the sports world are caused by the rigidity of training and competitions, and they are classified according to the mechanism and the affected region. The biological type of each athlete varies, and this can be seen through factors such as sex, age, flexibility, and muscle strength[1]. The competitive sports environment introduces a range of new responsibilities for youth athletes. Moreover, there is increasing pressure from family, peers, and coaches for them to perform exceptionally. This pressure, combined with an intense physical training load, often leads to pain, fatigue, and exhaustion, which can result in musculoskeletal injuries and mental burnout[2].

Performance, the prevention and treatment of musculoskeletal injuries, as well as athletes' mental health, are currently some of the main concerns for coaches, sports science professionals, and the athletes themselves[3]. This concern gained visibility after the withdrawal of athletes such as gymnast Simone Biles at the Tokyo Olympics (2021) and tennis player Naomi Osaka, who pulled out of Wimbledon and Roland Garros tournaments in the same year[4].

In elite sports, special tests for upper and lower limbs are used to monitor muscle strength reductions and serve as potential indicators of residual or accumulated fatigue. Among Olympic sports, handball ranks as one of those with the highest injury rates for athletes (82.2%)[5]. In this sport, shoulder injuries, lower limb injuries, and mental health issues are responsible for many absences from the court and have a high likelihood of recurrence[6], which can even lead to athletes abandoning the sport. Under these circumstances, the abandonment of sports careers due to overtraining and/or overuse has a significant impact on talent development[7].

With the goal of detecting young talents to represent Brazilian handball, the Brazilian Handball Confederation (CBHb) organizes an annual National Development and Technical Improvement Camp. The event includes regional phases that precede the national phase. During the Regional Camps, the CBHb sends specialists responsible for establishing technical handball standards across the country and identifying the most promising talents to participate in the National Camp, with the aim of selecting athletes to represent Brazil at the 2024 and 2028 Olympic Games. In addition to technical and tactical activities, the focus is also on injury prevention, increasing muscle strength, and performing functional tests[4].

Closed kinetic chain tests for the upper

DOI: 10.15343/0104-7809.202448e16272024I

body and flexibility tests are useful for monitoring neuromuscular performance of the shoulder joint and lower limbs in sports that involve contact and overload, such as handball[8]. This monitoring is important for the health of competitors, as 30% of sports injuries among young throwing athletes occur in the shoulder joint, which is the most frequently injured region[9,10].

As a sport involving intense physical contact, handball requires agility, speed, constant jumping, sudden changes of direction by the athletes, as well as throwing and blocking the opponents' actions. The intense physical demands require players to have the ability to handle these challenges during training[11] and to adapt quickly and unpredictably. As a result, players become vulnerable to physical and psychological strain caused by these physical demands and the high levels of anxiety and tension, which can lead to extreme stress[12].

In this context, examining flexibility and evaluating athletes' performance can be beneficial for planning health promotion and injury prevention actions at the grassroots level of sports. Therefore, this study aimed to analyze the stability and muscle flexibility performance of athletes selected for the Brazilian youth handball team, who participated in the National Development and Technical Improvement Camp.

METHODOLOGY

This is a before-and-after cross-sectional study conducted with 20 youth athletes (13 and 14 years old) who were selected to join the Brazilian men's handball team after participating in an immersion period at the National Handball Development and Technical Improvement Camp, located in São Bernardo do Campo, São Paulo, in 2018.

The Development and Technical Improvement Camp, organized annually by the Brazilian Handball Confederation (CBHb), aims to select athletes to join the Brazilian handball teams. This event follows the regional stages, in which the most talented athletes are nominated to participate in the National Camp. During the 10-day camp, participants engage in training sessions, video analysis sessions, and games. One day is dedicated to a lecture, usually given by a senior national team athlete, in addition to an official photo session and an afternoon outing[13].

Upon arrival at the National Handball Development Center Prof. José Maria Passos, in the city of São Bernardo do Campo, the athletes were evaluated. This evaluation was repeated at the end of the event, after 10 days of participation in the National Camp activities. Data were collected using an instrument that included sociodemographic and professional information about the athletes, as well as data from the shoulder stability and flexibility tests.

To assess shoulder joint stability, the closed kinetic chain upper extremity stability test (CKCUES test), adapted by Roush *et al.*[14], was used. This test does not require advanced technology and can be performed in sports or clinical settings[15]. Despite reliable and validated results in the adult population[16,17], the CKCUES test is still rarely used in the youth population[18].

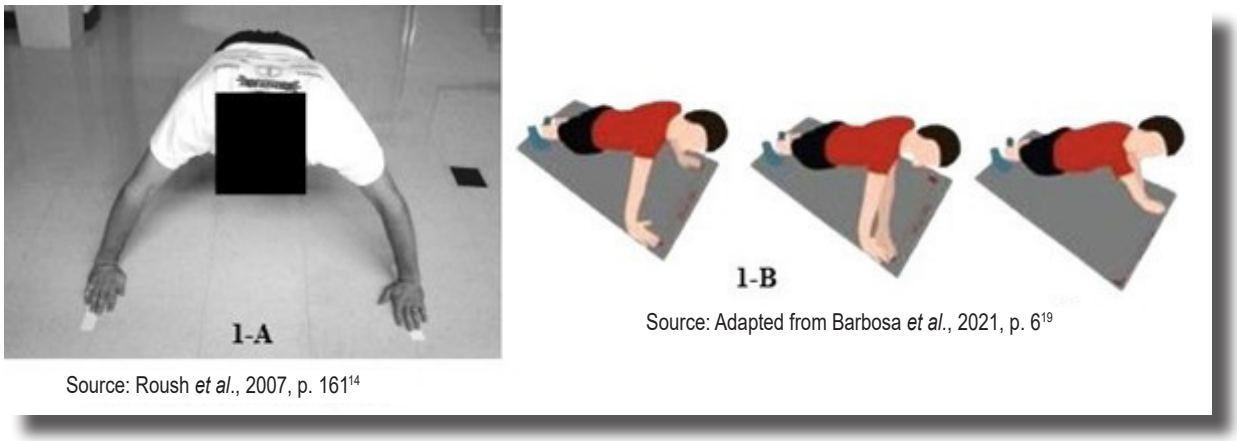
Para To perform the test, two strips of adhesive tape were placed parallel on the ground, 90 centimeters apart. The test began with the athletes assuming a push-up position, with elbows fully extended and hands positioned on each of the strips, using the third finger as a reference point (Figure 1-A)[14]. The athletes were instructed to touch the opposite hand and return to the initial support position with both hands (Figure 1-B)[19].

The athletes performed the same movement with the other hand, alternating as quickly as possible for a period of 15 seconds. During this period, the movements were cou-

DOI: 10.15343/0104-7809.202448e16272024I

nted and considered valid for measuring performance in the test. Each athlete completed a warm-up test followed by a valid test, with a 45-second rest period between tests.

During the test, athletes needed to keep their backs straight and aligned, with their hands and shoulders positioned perpendicularly to ensure that body weight was evenly distributed across the upper limbs. The knees could not touch the ground. If an athlete reported pain, they would be excluded from the study. Before starting the test, the athletes were allowed to familiarize themselves with the procedures, which were demonstrated by the evaluator, who also provided a clear explanation of the test method.



Source: Roush *et al*., 2007, p. 161[14]

Source: Adapted from Barbosa *et al*., 2021, p. 6[19]

Figure 1 - Athletes' position for the closed kinetic chain upper extremity stability test (CKCUES test).

Flexibility was assessed using the modified sit-and-reach test without Wells' bench20. To perform this test, a measuring tape was extended on the floor, and a 30 cm piece of adhesive tape was placed perpendicularly at the 38 cm mark of the measuring tape, securing it to the floor. The athletes were positioned barefoot, with their heels touching the adhesive tape at the 38 cm mark, and their feet 30 cm apart. With knees extended and hands overlapping one another, the athletes slowly leaned forward, extending their hands as far as possible, holding the extended position long enough for the distance reached to be recorded (Figure 2)[20]. Two consecutive attempts were made, with a 30-second rest between them and no warm-up before the test. The distance reached by the athletes was measured in centimeters, with one decimal place, and the highest value obtained in the two attempts was used for evaluation.

DOI: 10.15343/0104-7809.202448e16272024I

Figure 2 - Flexibility assessment using the modified sit-and-reach test without Wells' bench. Source: Gaya and Gaya, 2016. p. 8[20].

The data were analyzed using SPSS version 24.0 and were statistically processed to evaluate differences in stability and flexibility before and after the camp, as well as the relationship between these variables. The normality test ensured the appropriateness of the parametric tests applied.

The Kolmogorov-Smirnov test was applied to confirm the normality of the data distribution. To analyze shoulder joint stability and flexibility in the pre- and post-camp periods, the t-test for dependent samples was applied. Cohen's d test was used to analyze the effect size of the differences found. The variance of the results obtained by the athletes in the pre- and post-camp tests was evaluated using Levene's test. Finally, the correlation between shoulder stability and flexibility, in the pre- and post-camp periods, was analyzed using Pearson's correlation coefficient (r). A significance level of 5% ($p \leq 0.05$) was adopted for all analyses.

The study was approved by the Research Ethics Committee of the São José do Rio Preto Medical School (FAMERP), under the Certificate of Presentation for Ethical Consideration No. 04111418.0.0000.5415. Prior to data collection, informed assent from the participants and consent from their guardians were obtained.

RESULTS

Twenty male youth athletes were evaluated, aged between 13 (85%) and 14 (15%) years, with an average height of 1.8 meters (± 0.1), an average body mass of 76.0 kg (± 13.2), and an arm span of 1.9 meters (± 0.1).

The athletes predominantly came from the Southeast (70%) and South (20%) regions of Brazil. Most athletes identified as white (75%), did not have paid employment (75%), and were supported by both parents (70%). All were students, with 80% attending the ninth grade of elementary school; 65% studied in private schools, with or without scholarships.

Regarding handball practice, 90% of the athletes trained for six to ten hours per week; 70% practiced at city clubs and/or school and were not paid; 20% trained at handball clubs and received a salary. Two athletes (10%) reported lower limb pain, with one of them using an elastic ankle brace; the others did not report any history of muscle injury

DOI: 10.15343/0104-7809.202448e16272024I

and did not undergo regular medical and/or physical therapy treatment in the three months prior to the camp.

As shown in Table 1, at the end of the Development and Technical Improvement Camp, the athletes demonstrated an increase in the average score for shoulder stability and flexibility compared to the initial evaluation.

Table 1 - Analyses of shoulder stability and flexibility during the pre- and post-evaluations of the Development and Technical Improvement Camp.

Variables	Median	Standard Deviation	CI95%	p-value*	Effect Size**
Shoulder Stability					
Pre-camp	31.8	6.2	28.9 – 34.6	0.064	0.6†
Post-camp	35.4	5.8	32.7 – 38.0		
Flexibility					
Pre-camp	35.5	12.3	29.7 – 41.2	0.272	0.4‡
Post-camp	39.6	10.9	34.5 – 44.6		

*t-test. ** Cohen d-test. † Moderate. ‡ Weak.

As shown in Figure 3, one athlete experienced a decrease in shoulder stability during the camp activities; this was the athlete who reported lower limb pain and used an elastic ankle brace. The other athletes showed an increase in shoulder stability by the end of the camp compared to the initial evaluation upon their arrival at the National Development and Technical Improvement Camp. Statistical analysis revealed a significant difference in the variance of pre- and post-camp measurements, indicating that the athletes' performance was not homogeneous (F: 0.277; p=0.602).

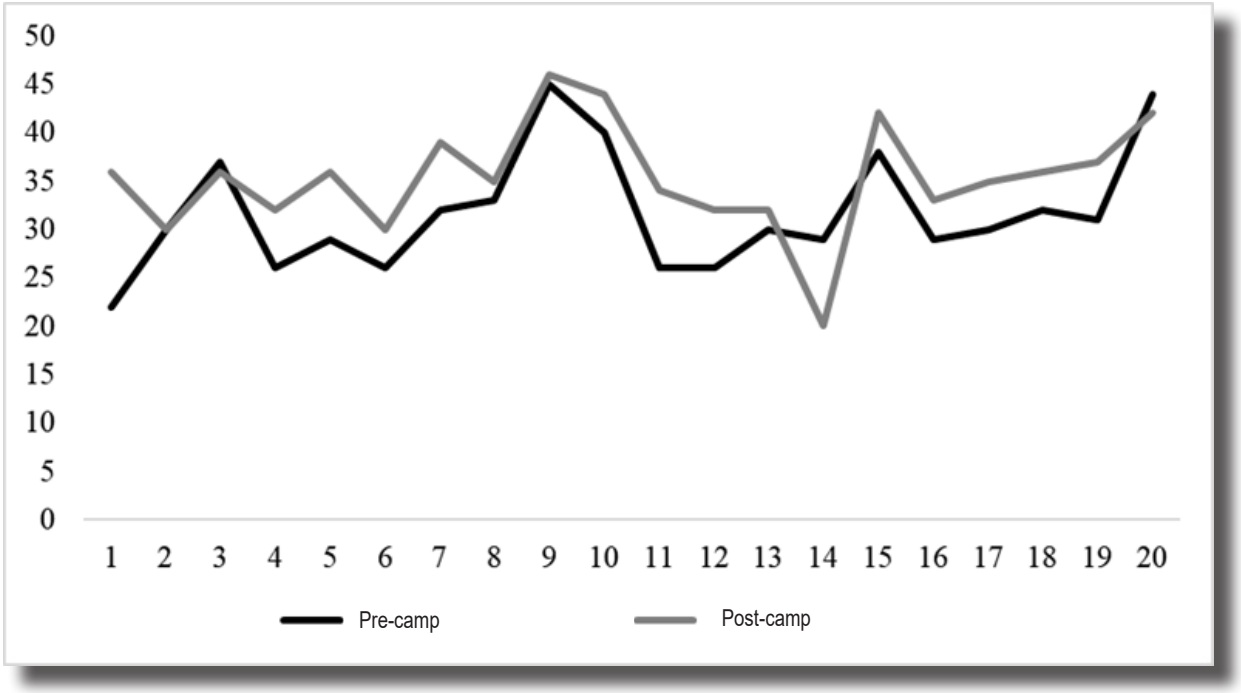


Figure 3 - Athletes' Shoulder Stability Test Results in Pre- and Post-Camp Evaluations.

DOI: 10.15343/0104-7809.202448e16272024I

As observed in Figure 4, the athletes showed an increase in flexibility at the end of the camp compared to the first evaluation, conducted at the beginning of the National Development and Technical Improvement Camp. Similar to the shoulder stability test, the variance between pre- and post-camp measurements was different, suggesting that the athletes' performance was not uniform (F: 0.410; p=0.526).

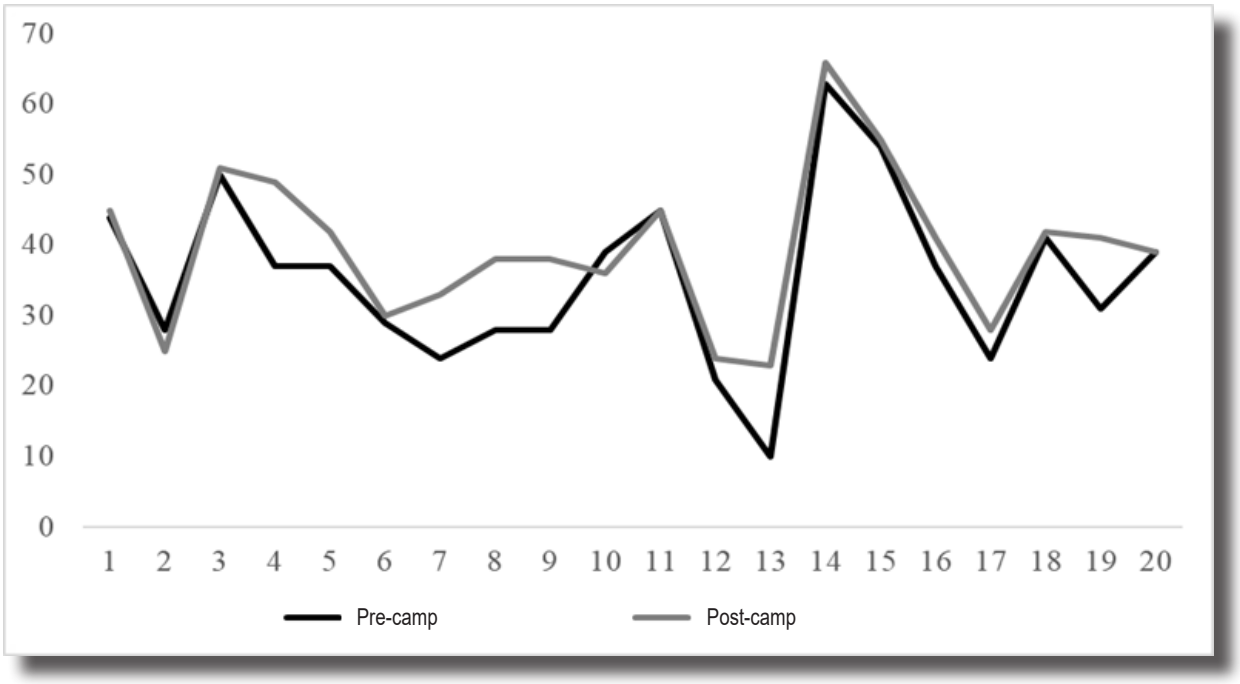


Figure 4 - Athletes' Flexibility Evaluation Using the Sit-and-Reach Test in Pre- and Post-Camp Assessments.

The analysis of the correlation between shoulder stability and flexibility variables, in the pre- and post-camp periods (Table 2), indicates a strong positive correlation between pre-camp flexibility and post-camp shoulder stability ($r = 0.700$; $p = 0.001$), showing that athletes with greater flexibility before the camp tend to exhibit greater shoulder stability at the end of the camp. Additionally, the extremely strong correlation between pre- and post-camp flexibility ($r = 0.918$; $p < 0.001$) suggests that the level of flexibility athletes have before the camp is a strong predictor of the flexibility they will demonstrate at the end of the Development and Technical Improvement Camp. The correlations between shoulder stability and flexibility in the pre-camp period ($r = 0.087$; $p = 0.716$) and between shoulder stability and flexibility in the post-camp period ($r = -0.120$; $p = 0.616$) did not show a clear relationship between these variables.

DOI: 10.15343/0104-7809.202448e16272024I

Table 2 - Analysis of the correlation (r) between shoulder stability and flexibility in the pre- and post-camp periods of the Development and Technical Improvement Camp.

Variables	Post-camp Shoulder Stability	Pre-camp Flexibility	Post-camp Flexibility
Pre-camp Shoulder Stability			
r (p-value)	0.700** (0.001)	0.087 (0.716)	0.073 (0.760)
Post-camp Shoulder Stability			
r (p-value)	-	-0.120 (0.616)	-0.137 (0.565)
Pre-camp Flexibility			
r (p-value)	-	-	0.918** (<0.001)

**Correlation at the 0.01 level (two-tailed).

DISCUSSION

Flexibility is one of the factors that directly influences athletic performance across a wide variety of sports[21]. In this context, the improvement in motor performance of the handball athletes evaluated in this study represents significant gains for their level of competitiveness, as physical-motor ability is directly related to the performance potential of young athletes[22].

Adequate functional stability during limb movement requires muscle strength and endurance, which are essential to maintain joint integrity and support. Muscle strength is necessary to optimize power capacity and provide the static and dynamic stability required to withstand torques and overloads, while muscle endurance helps prevent fatigue and maintain joint control. Therefore, the interaction between muscle strength and endurance is vital for injury prevention and to ensure efficient and stable joint movement[23,24].

Moreover, the increase in flexibility and stability for athletes performing aerial movements in sports such as handball requires highly skilled mobility to execute movements at high speeds without the risk of injury. Therefore, it is necessary for athletes to develop good levels of flexibility, muscle strength, stability, coordination, synchronicity, and neuromuscular control in the shoulder complex[25].

Flexibility training is widely used across various fitness-related capacities, with the goal of increasing joint range of motion, preventing contractures, and alleviating injuries. This training can be performed actively, passively, or in a combined manner[26,27]. In active training, the athlete performs the movement alone, while in passive training, they use instruments/equipment or the assistance of a qualified professional. The type of training applied can vary depending on the sport and the characteristics of the athletes.

Stretching exercises can be used to increase range of motion and improve muscle performance in healthy individuals or those in rehabilitation. However, while static stretching training induces increases in muscle fascicle length, results vary depending on the volume and intensity of the stretching. The literature highlights the need for high volumes and intensities of stretching to provoke significant increases in fascicle length and, in some cases, muscle thickness. Thus, to achieve relevant morphological changes, such as longitudinal fascicle growth, the application of more intense and prolonged stretching protocols is necessary, which can have implications for sports practice and rehabilitation[27,28,29]. Additionally, there are differences in gains between male and female athletes, as well as greater demands on different body parts depending on the sport.

DOI: 10.15343/0104-7809.202448e16272024I

Studies point to differences between men and women in flexibility assessment. Altavilla *et al.*[30] describe that male athletes tend to have greater joint flexibility in the shoulders and trunk compared to female athletes, while females have greater flexibility in the lower limbs. However, these advantages do not necessarily benefit both sexes equally in sports practice.

In some sports, flexibility is one of the main criteria for athletes to reach a high level in learning advanced techniques[31]. In handball, flexibility is a key factor for good performance on the court, as this ability enhances sports movements, making kicks more powerful.

In a comparative study of agility and flexibility between male handball and volleyball players, using the sit-and-reach test, handball athletes showed significant differences compared to volleyball athletes[32]. These results confirm that the above-average performance achieved by the studied athletes enables them to attain good performance on the court, whether in training or competitions.

The development of specific skills is important for injury prevention in high-performance athletes across different sports. To this end, preventive programs can be tailored to various aspects, such as improving flexibility, mobility, muscle strengthening, and proprioception, taking into account the characteristics of the sport and the risks of potential injuries[33].

In this regard, the correlations between shoulder stability and flexibility observed in this study emphasize the importance of coaches prioritizing the incorporation of flexibility exercises into training routines, as flexibility can positively impact athletes' performance in competitions. The implementation of practices that improve stability, the adoption of emotional control techniques, and the inclusion of strengthening exercises can lead to more effective development and better competition results. Additionally, regular evaluations and progress monitoring are essential to identify areas that need attention and to adapt training programs to the individual needs of athletes[34,35].

Thus, coaches play a crucial role in the development process of athletes, providing support over long periods, particularly for youth athletes (children, cadets, and juniors)[36]. These professionals are essential for transmitting technical and tactical knowledge, guiding the application of these skills, and encouraging improvement and refinement, so that young athletes can become exceptional professionals.

The small number of participants in this study and the inclusion of only one sport, in the male category, limit the ability to perform comparative analyses. Likewise, the sample, consisting of athletes selected through regional trials, does not allow for the generalization of results, as it represents a select group of high-performance youth athletes. On the other hand, the study provides relevant insights into the preparation and selection of athletes for Brazil's youth male handball team, fostering discussions on the impact of the National Development and Technical Improvement Camp activities on the health of these adolescents.

The results provide data that allow consideration of the possible negative effects experienced by athletes during the Regional Camps that precede the National phase, with the aim of creating and implementing actions to reduce these negative impacts and maximize the development of future elite handball athletes. Additionally, the study supports the development of services that offer technical training support and physical health care for these young athletes throughout their careers, with the goal of promoting healthy sports involvement, high performance, personal and professional growth, mental health, and overall well-being.

DOI: 10.15343/0104-7809.202448e16272024I

CONCLUSION

The athletes selected for the Brazilian youth handball team demonstrated performance progression by the end of the activities conducted at the National Development and Technical Improvement Camp, as evidenced by the increase in shoulder stability and flexibility.

To achieve this progression, it is essential to incorporate a variety of specific exercises that promote these abilities, such as rotator cuff strengthening exercises, dynamic and static stretches, and activities that simulate game movements. To improve flexibility, it is advisable to include static stretches and mobility protocols that target both the specific shoulder muscles and adjacent muscle groups.

Moreover, the involvement of health professionals, such as physiotherapists, psychologists, nurses, nutritionists, doctors, and physical educators, is crucial in the planning and execution of these exercises, especially in youth categories (children, cadets, and juniors). The presence of these specialists ensures that training programs are well-structured and tailored to the athletes' needs, promoting their development and performance in a safe and effective manner.

CRediT author statement

Project Administration: Santos-Afonso M, Lourenção LG; Formal Analysis: Santos-Afonso M, Lourenção LG; Conceptualization: Santos-Afonso M, Lourenção LG; Data Curation: Santos-Afonso M; Writing-original draft preparation: Santos-Afonso M, Lourenção LG; Writing-review and editing: Saes MO, Ratto RS, Afonso MS, Moraes V; Investigation: Santos-Afonso M; Methodology: Santos-Afonso M, Lourenção LG; Resources: Santos-Afonso M, Lourenção LG; Software: Lourenção LG; Supervision: Lourenção LG; Validation: Santos-Afonso M, Lourenção LG, Saes MO, Ratto RS, Afonso MS, Moraes V; Visualization: Santos-Afonso M, Lourenção LG, Saes MO, Ratto RS, Afonso MS, Moraes V.

All authors read and agreed to the published version of the manuscript.

REFERENCES

1. Afonso M dos S, Sousa WW da S, Afonso M dos S, Junior A de OS, Neves FB, Lourenção LG. Analysis of Injuries in Athletes Practitioners Amateur Race Street. Res., Soc. Dev. [Internet]. 2020 [Acessado em 02 de maio de 2024];9(3):e101932614. Disponível em: https://doi.org/10.33448/rsd-v9i3.2614
2. da Silva AMB, Enumo SRF, Afonso R de M. Estresse em atletas adolescentes: Uma revisão sistemática. Rev. Psicol. IMED. [Internet]. 2016 [Acessado em 20 de junho de 2019];8(1):59-75. Disponível em: https://seer.atitus.edu.br/index.php/revistapsico/article/view/1124/885
3. Colagrai AC, Barreira J, Nascimento FT, Fernandes PT. Saúde e transtorno mental no atleta de alto rendimento: mapeamento dos artigos científicos internacionais. Movimento [Internet]. 2022 [Acessado em 02 de maio de 2024];28:e28008. Disponível em: https://seer.ufrgs.br/index.php/Movimento/article/view/118845
4. Santos-Afonso M, Lourenção LG, Afonso MS, Saes MO, Santos FB, Penha JGM, et al. Burnout Syndrome in Selectable Athletes for the Brazilian Handball Team-Children Category. Int. J. Environ. Res. Public Health [Internet]. 2023 [Acessado em 02 de maio de 2024];20(4):3692. Disponível em: https://doi.org/10.3390/ijerph20043692
5. Palmer D, Cooper DJ, Emery C, Batt ME, Engebretsen L, Scammell BE, et al. Self-reported sports injuries and later-life health status in 3357 retired Olympians from 131 countries: a cross-sectional survey among those competing in the games between London 1948 and PyeongChang 2018. Br. J. Sports Med. [Internet]. 2021 [Acessado em 02 de maio de 2024];55(1):46-53. Disponível em: https://doi.org/10.1136/bjsports-2019-101772
6. McCall A, Nedelec M, Carling C, Le Gall F, Berthoin S, Dupont G. Reliability and sensitivity of a simple isometric posterior lower limb muscle test in professional football players. J Sports Sci [Internet]. 2015 [Acessado em 20 de junho de 2019];33(12):1298-1304. Disponível em: https://doi.org/10.1080/02640414.2015.1022579
7. Isoard-Gautheur S, Guillet-Descas E, Gustafsson H. Athlete burnout and the risk of dropout among young elite handball players. Sport Psychol [Internet]. 2016 [access on 2019 Jun 20];30(2):123-130. Disponível em: https://doi.org/10.1123/tsp.2014-0140
8. Ashworth B, Hogben P, Singh N, Tulloch L, Cohen DD. The Athletic Shoulder (ASH) test: reliability of a novel upper body isometric strength test in elite rugby players. BMJ Open Sport Exerc. Med. [Internet]. 2018 [Acessado em 20 de junho de 2019];4(1):e000365. Disponível em: https://doi.org/10.1136/bmjsem-2018-000365
9. Smucny M, Kolmodin J, Saluan P. Shoulder and Elbow Injuries in the Adolescent Athlete. Sports Med Arthrosc Rev. [Internet]. 2016 [Acessado em 20 de junho de 2019];24(4):188-194. Disponível em: https://doi.org/10.1097/JSA.0000000000000131
10. Vila H, Barreiro A, Ayán C, Antúnez A, Ferragut C. The Most Common Handball Injuries: A Systematic Review. Int. J. Environ.

Res. Public Health [Internet]. 2022 [Acessado em 02 de maio de 2024];19(17):10688. Disponível em: https://doi.org/10.3390/ijerph191710688
11. Nuño A, Chirosa IJ, van den Tillaar R, Guisado R, Martín I, Martinez I, et al. Effects of Fatigue on Throwing Performance in Experienced Team Handball Players. J Hum Kinet. [Internet]. 2016 [Acessado em 20 de junho de 2019];54:103-113. Disponível em: https://doi.org/10.1515%2Fhukin-2016-0039
12. Igorova M, Predoiua R, Predoiua A, Igorova A. Creativity, resistance to mental fatigue and coping strategies in junior women handball players. EpSBS [Internet]. 2016 [Acessado em 20 de junho de 2019];11:286-292. Disponível em: https://www.europeanproceedings.com/files/data/article/41/885/article_41_885_pdf_100.pdf
13. Confederação Brasileira de Handebol (CBHb) [página na internet]. Liga Nacional de Handebol, Dez estados realizaram os Acampamentos Regionais no mês de julho. São Bernardo do Campo, 10 ago 2018 [Acessado em 20 de junho de 2019]. Disponível em: https://cbhb.org.br/noticias/leitura/5339/dez-estados-realizaram-os-acampamentos-regionais-no-m234-s-de-julho
14. Roush JR, Kitamura J, Waits M. Reference Values for the Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST) for Collegiate Baseball Players. N. Am. J. Sports Phys. Ther. [Internet]. 2007 [Acessado em 20 de junho de 2019];2(3):159-163. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2953295/pdf/najspt-02-159.pdf
15. Tucci HT, Martins J, Sposito GC, Camarini PMF, Oliveira AS. Closed Kinetic Chain Upper Extremity Stability test (CKCUES test): a reliability study in persons with and without shoulder impingement syndrome. BMC. Musculoskelet. Disord. [Internet]. 2014 [Acessado em 20 de junho de 2019];15:1. Disponível em: https://doi.org/10.1186/1471-2474-15-1
16. Callaway A, Peck J, Ellis S, Williams J. A randomised observational study of individualised variations in the start position of the closed-kinetic chain upper extremity stability test. Phys Ther Sport [Internet]. 2020 [Acessado em 02 de maio de 2024];41:16-22. Disponível em: https://doi.org/10.1016/j.ptsp.2019.10.007
17. Degot M, Blache Y, Vigne G, Juré D, Borel F, Neyton L, et al. Intrarater reliability and agreement of a modified Closed Kinetic Chain Upper Extremity Stability Test. Phys Ther Sport [Internet]. 2019 [Acessado em 18 de janeiro de 2020];38:44-48. Disponível em: https://doi.org/10.1016/j.ptsp.2019.04.017
18. de Oliveira VM, Pitangui AC, Nascimento VY, da Silva HA, Dos Passos MH, de Araújo RC. Test-retest reliability of the closed kinetic chain upper extremity stability test (ckcuest) in adolescents: reliability of CKCUEST in adolescents. Int. J. Sports Phys. Ther. [Internet]. 2017 [Acessado em 20 de junho de 2019];12(1):125-132. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5294939/
19. Barbosa GM, Calixtre LB, Fialho HRF, Locks F, Kamonseki DH. Measurement properties of upper extremity physical performance tests in athletes: a systematic review. Braz. J. Phys. Ther. [Internet]. 2024 [Acessado em 11 de setembro de 2024];28(1):100575. Disponível em: https://doi.org/10.1016/j.bjpt.2023.100575
20. Gaya ACA, Gaya AR. Projeto esporte Brasil: manual de testes e avaliação [Internet]. Porto Alegre: UFRGS, 2016 [Acessado em 11 de setembro de 2024]. Disponível em: https://www.ufrgs.br/proesp/arquivos/manual-proesp-br-2016.pdf
21. Opplert J, Babault N. Acute Effects of Dynamic Stretching on Muscle Flexibility and Performance: An Analysis of the Current Literature. Sports Med. [Internet]. 2018 [Acessado em 20 de junho de 2019];48(2):299-325. Disponível em: https://doi.org/10.1007/s40279-017-0797-9
22. Aguiar CM, Coelho EF, Paula HE de, Ferreira RM, Lima JRP de, Werneck FZ. Determinantes do desempenho no atletismo: uma perspectiva dos treinadores. Conexões [Internet]. 2022 [Acessado em 02 de maio de 2024];20(00):e022004. Disponível em: https://doi.org/10.20396/conex.v20i00.8666327
23. Mangesh GG, Juzer KH, Lakshman YU, Balasaheb PR, Ajinkya PP, Anil KS. Comparison of core stability in different sportsmen. Saudi j. sports med. [Internet]. 2017 [Acessado em 20 de junho de 2019];17(3):168-173. Disponível em: https://doi.org/10.4103/sjsm.sjsm_11_17
24. Amirouche F, Koh J. Biomechanics of Human Joints. In: Koh J, Zaffagnini S, Kuroda R, Longo UG, Amirouche F. (eds). Orthopaedic Biomechanics in Sports Medicine. Switzerland: Springer, Cham; 2021 [Acessado em 10 de setembro de 2024]. p. 3-13. Disponível em: https://doi.org/10.1007/978-3-030-81549-3_1
25. Radwan A, Francis J, Green A, Kahl E, Maciurzynski D, Quartulli A, et al. Is there a relationship between shoulder dysfunction and central instability?. Int. J. Sports Phys. Ther. [Internet]. 2014 [Acessado em 20 de junho de 2019];9(1):8-13. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3924603/
26. Afonso M dos S, Barros S dos S, Koth AP, Rodrigues VL, Neves FB, Lourenção LG. Sports physiotherapy in program of prevention of injury in professional football. Res., Soc. Dev. [Internet]. 2020 [Acessado em 18 de janeiro de 2020];9(3):e72932434. Disponível em: https://doi.org/10.33448/rsd-v9i3.2434
27. Araújo EB, Serrão Júnior NF. There is a relationship of human genetics on stretching and muscle strength: a literature review. Res., Soc. Dev. [Internet]. 2023 [Acessado em 02 de maio de 2024];12(1):e24112139670. Disponível em: https://doi.org/10.33448/rsd-v12i1.39670
28. Valença A de A, Soares BO, Cavalcante BR, Beltrão NB, Nascimento VYS, Pitangui ACR, et al. Does the stretching intensity matter when targeting a range of motion gains? a randomized trial. Motriz: rev educ fis [Internet]. 2020 [Acessado em 02 de maio de 2024];26(2):e10208019. Disponível em: http://doi.org/10.1590/s1980-6574202000018019
29. Panidi I, Donti O, Konrad A, Dinas PC, Terzis G, Mouratidis A, et al. Muscle Architecture Adaptations to Static Stretching Training: A Systematic Review with Meta-Analysis. Sports Med. - Open [Internet]. 2023 [Acessado em 10 de setembro de 2024];9:47. Disponível em: https://doi.org/10.1186/s40798-023-00591-7
30. Altavilla G, Tore PA, Riela L, D'Isanto T. Anthropometric, physiological and performance aspects that differentiate male athletes from females and practical consequences. J. Phys. Educ. Sport [Internet]. 2017 [Acessado em 02 de maio de 2024];17(Sup.5):2183-2187. Disponível em: https://doi.org/10.7752/jpes.2017.s5226
31. Najmi N, Abdullah MR, Juahir H, Maliki ABHM, Musa RM, Mat-Rasid SM, et al. Comparison of body fat percentage and physical performance of male national senior and junior karate athletes. J. appl. fundam. sci. [Internet]. 2018 [Acessado em 20 de junho de 2019];10(1S):485-511. Disponível em: https://www.ajol.info/index.php/jfas/article/view/168318
32. Sharma N, Shafqit H. Comparative Study on the Agility and Flexibility Ability of State and National Level Male Players Between Handball and Volleyball of Poonch District (Jammu and Kashmir). Int J Integr Educ [Internet]. 2019 [Acessado em 18 de janeiro de 2020];2(5):112-116. Disponível em: https://www.neliti.com/publications/333923/comparative-study-on-the-agility-and-flexibility-

DOI: 10.15343/0104-7809.202448e16272024I

DOI: 10.15343/0104-7809.202448e16272024I

ability-of-state-and-national-l
33. Norberto MS, Puggina EF. Relações entre flexibilidade de membros inferiores e índice de lesões em modalidades de resistência. Rev Bras Ciênc Esporte [Internet]. 2019 [Acessado em 18 de janeiro de 2020];41(3):290-297. Disponível em: https://doi.org/10.1016/j.rbce.2018.05.003
34. Santos RVA. A fisioterapia nas lesões de ombro: prevenção e reabilitação em atletas praticantes de voleibol e handebol. Centro Universitário UNIRB; 2022 [Acessado em 13 de setembro de 2024]. Disponível em: http://dspace.unirb.edu.br:8080/xmlui/handle/123456789/397
35. Carvalho MS, Chon CW, Jambo BR, Viegas Filho GL, Ribeiro PH. Reabilitação funcional de atletas: uma abordagem integrada de medicina do esporte e ortopedia. CPAQV [Internet]. 2024 [Acessado em 13 de setembro de 2024];16(2):1-13. Disponível em: https://doi.org/10.36692/z1ec8g08
36. Castaldelli-Maia JM, Gallinaro JGDME, Falcão RS, Gouttebarge V, Hitchcock ME, Hainline B, et al. Mental health symptoms and disorders in elite athletes: a systematic review on cultural influencers and barriers to athletes seeking treatment. Br. J. Sports Med. [Internet]. 2019 [Acessado em 18 de janeiro de 2020];53(11):707-721. Disponível em: http://dx.doi.org/10.1136/bjsports-2019-100710

Received: 21 may 2023.
Accepted: 26 september 2024.
Published: 24 october 2024.