

# ANALYSIS OF PHYSICAL FITNESS, ANTHROPOMETRY AND PREVALENCE OF MUSCULOSKELETAL SYMPTOMS IN THE YOUTH VOLLEYBALL CATEGORY



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## ABSTRACT

**Introduction:** The control of the occurrence of injuries throughout the training process and the monitoring of physical adaptations resulting from the exercise program present significant importance for the athlete. **Objective:** To describe the anthropometric profile and physical capacity of youth volleyball teams and determine the prevalence of musculoskeletal symptoms. **Methods:** A longitudinal study where 38 athletes participated in the Children and Youth Volleyball category monitored for four months through physical fitness and anthropometric tests and questionnaire of musculoskeletal symptoms. **Descriptive analysis and comparative means and standard deviations and t test were applied. Results:** The main statistically significant indicators observed were in the variables: height ( $p = 0.001$  for males and  $0.003$  for females) scale for males ( $p < 0.001$ ), pitch ( $p = 0.003$  for boys and  $p < 0.001$  for girls), abdominal for girls ( $p = 0.001$ ). The most prevalent symptoms were found in the back (56.5%), shoulder (52.2%), hips/thighs (52.2%) and knees (52.2%). **Conclusion:** The profile of the athletes presented as main characteristics: increase in height, scale and explosive strength of upper limbs, abdominal strength and agility. The high frequency of affirmative responses to pain complaint on the back, upper and lower parts, shoulders, hips/thighs, knees and ankle reinforces the need for long-term monitoring of young athletes response to training and promotes prevention strategies.

**Keywords:** sport, musculoskeletal pain, physical conditioning.

## INTRODUCTION

Performance in physical fitness tests is a way of assessing athletic performance and establish the profile of sports talents, as well as identifying whether the athlete is ready to compete, subsidize the training programs from short to long run, identifying the weaknesses of the athletes, among other functions<sup>1,2</sup>. The measurement of the anthropometric variables allows analyzing the aspects which refer to the biological development of the young population and may be related to the probability of sport injuries<sup>3</sup>.

Specific motor characteristics and abilities are needed according to volleyball specific elements, such as height, scale, agility and reaction velocity and performance of technical gestures and game movements<sup>2,4,6</sup>. In high performance, this sport presents significant rate of injuries<sup>7</sup>. The extenuating repetition of some functional gestures seems to be more associated with the onset of damage, being the service and the attack the main causes of shoulder injuries<sup>8</sup>. However, frequent involvement of knees and ankles is observed<sup>7,9</sup>. Overuse of the knee extensor mechanism generates dysfunction in the patellar tendon, responsible for the high rate of jumper's knee in volleyball<sup>9</sup>.

While adequate training may prevent injuries<sup>1,10</sup>, imbalance between training load and recovery may lead to overtraining<sup>11</sup>, in which performance decreases and muscular pain occurs, among other manifestations<sup>2</sup>. Thus, the control of the onset of injuries and diseases during the entire training process presents expressive importance to the athlete<sup>13</sup> as well as the monitoring of the physiological adaptations, with the goal to obtain maximum performance and avoid overtraining and injuries<sup>14</sup>. Therefore, physiotherapists working in the sport environment need to know about the physical

training principles and the risk factors which predispose to sports injuries. This study promotes better understanding about the body's reaction of young athletes to training and provides background for the development of prevention strategies for injuries in volleyball.

Therefore, the aims of this investigation were: a) to define the anthropometric profile of volleyball players of young categories; b) to compare the behavior of the physical fitness tests in two moments between sexes; and c) to determine the prevalence of osteomuscular symptoms.

## METHODOLOGY

This was an observational longitudinal study. The sample consisted of 38 volleyball athletes, where 19 were from each sex and had age range of 14-17 years, from the youth categories of two clubs from Porto Alegre - Brazil. Inclusion criteria were to have signed the Free and Clarified Consent Form, to have participated regularly in training between March and July, 2010 and to have practiced high performance volleyball for at least one year. Exclusion criterion was to have not performed any of the physical fitness tests or not have answered the questionnaire at the two moments.

The athletes were submitted to the physical fitness tests and anthropometric measurements according to the Sport Brazil Project<sup>15</sup>. To perform the recording on the prevalence of symptoms, the Nordic Musculoskeletal Questionnaire (NMQ) was applied<sup>16</sup>. Additionally, the athletes answered a questionnaire designed by the authors to collect information about the time of high performance training, weekly frequency, age, among other data. Data collection occurred in two periods: March–time of return to training with ball and

physical preparation and June/July – competition season.

Descriptive and comparative analyses through means and standard deviation and Student's t test were respectively used for the statistical procedures. Data processing used the computer program *Statistical Package for the Social Science* (SPSS version 13.0). Significance level adopted was  $p < 0.05$ . The research was approved by the Ethics Committee of the Methodist University Center of IPA under legal opinion number 458/2009. The directors of the clubs authorized the research by signing the Institutional Authorization Form.

## RESULTS

A total of 38 athletes from two volleyball clubs from Porto Alegre participated in our study, ranging the frequency of athletes in the tests. Mean weekly training time was 10.78 hours ( $\pm 1.76$ ) for boys and 14.11 ( $\pm 2.08$ ) for girls. Tables 1 and 2 described anthropometry and physical fitness between sexes in the two collections. Height presented significant increase for both (male  $p = 0.001$  and female  $p = 0.003$ ). Scale presented statistically significant increase in boys ( $p < 0.001$ ). Improvement in evaluation of abdominal strength was found in the female sex ( $p = 0.001$ ). Flexibility improved in the male sex ( $p = 0.047$ ); however, the female results were higher than the boys'.

Concerning physical fitness profile related to motor performance, the horizontal jump values did not present differences. The pitch test presented significant increase for both (female  $p < 0.001$  and male  $p = 0.003$ ). In the velocity test, boys and girls presented decrease in performance ( $p = 0.004$  and  $p = 0.15$ , respectively).

Table 3 presents the NMQ results. Lower back had higher prevalence in the category of problems in the last 12 months and in the problems in the last seven days, consisting in 55.6 and 44.4% in the first collection and 56.5 and 43.5% in the second collection, respectively. For the same category, complaints about shoulders reached 52.2%. Symptoms on the knees were prevalent in the problems in the last 12 months with 52.2% and made 21.7% of the sample in the second collection visit a professional from the health field. Hip and thighs in the first collection corresponded to 52.2% of the problems in the last 12 months and 39.1% in the category in the last seven days. Ankle and foot represented 39.1% of statements in the category complaints in the last 12 months and, with the knees, were the ones which led the athletes to visit a doctor.

## DISCUSSION

In the perspective of children and young athletes who search for excellence, it is necessary to consider the specific characteristics of this population, respect the long-term training process and avoid overestimation of early results. Cafruni<sup>17</sup> and R e *et al.*<sup>18</sup> speculated the hypothesis that early high results in sports children and young athletes can later play negative influence in their career as high performance athletes. This hypothesis involves both a mistaken process of training organization and excessive overload as well as harmful psychological loads. The training structure of a child comprehends first global motor development. The evolution of this phase to specific training of the sports modality should occur according to physical adaptations and maturational ages of the athletes<sup>13</sup>.

Height presented significant increase for both sexes (male  $p = 0.001$  and female  $p = 0.003$ ). Height is an extremely important variable for volleyball, making it easier for the athletes to surpass the net adult height of 2.43 m for male and 2.24 m for female<sup>1,5</sup>.

**Table 1.** Anthropometry and physical fitness – Male sex.

Variables	Collection	n	Mean	± SD	P value
Weight (kg)	1	18	74.56	9.83	0.004*
	2	19	76.77	9.94	
Height (cm)	1	18	185.61	6.72	0.001*
	2	19	187.05	6.62	
Scale (cm)	1	18	189.17	7.59	0.000*
	2	19	191.89	7.31	
Agility (s)	1	8	5.45	0.12	0.028*
	2	7	5.20	0.19	
Velocity (s)	1	18	3.11	0.24	0.004*
	2	14	3.66	0.37	
Horizontal jump (cm)	1	18	222.83	20.24	0.897
	2	18	220.67	26.98	
Pitch (cm)	1	18	555.00	73.66	0.003*
	2	19	609.47	75.75	
Abdominal	1	18	52.39	9.19	0.242
	2	19	54.74	8.50	
Flexibility (cm)	1	16	39.68	8.39	0.047*
	2	19	42.91	9.72	

\* $p < 0.05$ .

**Table 2.** Anthropometry and physical fitness – Female sex.

Variables	Collection	N	Mean	± SD.	P value
Weight (kg)	1	19	69.15	9.14	0.48
	2	17	70.20	8.74	
Height (cm)	1	19	171.78	9.28	0.003*
	2	17	174.11	8.53	
Scale (cm)	1	19	174.89	11.44	0.914
	2	17	176.12	10.75	
Agility (s)	1	19	5.55	0.32	0.082
	2	15	5.48	0.25	
Velocity (s)	1	19	3.40	0.20	0.15
	2	14	3.54	0.26	
Horizontal jump (cm)	1	19	180.68	18.64	0.45
	2	15	182.87	25.67	
Pitch (cm)	1	19	364.21	35.72	0.000*
	2	16	433.50	32.30	
Abdominal	1	19	45.26	8.84	0.001*
	2	16	54.81	10.36	
Flexibility (cm)	1	19	50.86	8.61	0.575
	2	16	52.50	8.09	

\* $p < 0.05$ .

When the studies by Anfilo and Shigunov are compared<sup>19</sup>, boys' height is below the Brazilian junior team, in which ranged from 190.00 to 203.00 cm. Considering the shorter height of the boys studied compared to the research mentioned above, we can suggest the need for higher jumps from our group, which may be associated with higher overload in the knees, a joint responsible for problems in the last 12 months in 52.2% of the athletes who, with the ankle, was the one which made the youngsters visit professionals of the health field the most.

Added to height, scale is a crucial characteristic for allowing greater reach in attack and block<sup>4</sup>. In our study, scale presented significant increase in boys ( $p < 0.001$ ). 176.12cm was observed in the second female collection, similarly to the height verified in female players from the same category in the study by Bojikian and B ohme<sup>4</sup>, which had mean of 175.20cm.

Flexibility ranged from 39.68 to 42.91cm in male sex and statistically significant increase ( $p = 0.047$ ) was observed while the female results did not obtain significant difference; however, they were higher than the boys' (50.86- 52.50cm). Concerning the results by Duncan *et al.*<sup>2</sup>, in which flexibility mean ranged from 19.30 to 37.00cm, the

**Table 3.** NMQ analysis.

		In the last 12 months, you presented problems in: %	In the last 12 months, you were impaired to perform usual activities due to this problem in: %	In the last 12 months you saw any professional of the health field due to this condition in: %	In the last seven days you presented problems in: %
	Collections	%	%	%	%
Neck	1	25.9	3.7	3.7	18.5
	2	29.6	7.4	-	11.1
Shoulders	1	52.2	4.3	8.7	8.7
	2	43.5	4.3	4.3	8.7
Upper back	1	34.8	-	4.3	8.7
	2	39.1	-	4.3	13
Elbows	1	8.3	-	-	-
	2	13	-	-	4.3
Wrists/hands	1	34.8	4.3	13	8.7
	2	26.1	17.4	17.4	13
Lower back	1	55.6	11.1	11.1	44.4
	2	56.5	17	13	43.5
Hip/thighs	1	52.2	8.7	13	39.1
	2	26.1	4.3	-	-
Knees	1	26.1	4.3	13	17.4
	2	52.2	13	21.7	21.7
Ankles/feet	1	39.1	4.3	21.7	8.7
	2	34.8	8.7	17.4	17.4

athletes from our study present better flexibility. Flexibility increase of the musculotendinous joint interferes in decrease of injuries of lower extremities, especially in the biarticular muscles such as the hamstrings<sup>20</sup>. Ferreira and Paula<sup>21</sup> highlight that the flexibility work influences on the athletes' performance during the game.

Among the components of physical fitness related to motor performance, the horizontal jump values were classified as very good both in male and female sexes<sup>15</sup>, demonstrating the relevance of this motor value in volleyball, but with no significance difference in the two collections though. The pitch test presented increase for both (female  $p < 0.001$  and male  $p = 0.003$ ). Both boys and girls presented results classified as good<sup>15</sup>, which sends us back to the great demand over the complex of the shoulder articulations in volleyball. Muscular strength is determinant for performance in volleyball<sup>22</sup>. In the velocity test, the boys and girls presented decrease in their performance ( $p = 0.004$  and  $p = 0.15$ , respectively). The used test evaluated dislocation velocity, not contemplating reaction and performance of movements velocity, both important, since the actions of the players must be fast<sup>6,22</sup>. Agility presented statistically significant improvement only in the male sex ( $p = 0.028$ ). In the second collection moment, the female results corresponded to the excellence level and the female ones, while the male ones were very good<sup>15</sup>. This motor competence is one of the most important for volleyball<sup>1,21,22</sup>.

Although the NMQ may be considered subjective concerning the severity of the complaints and does not directly associate with injuries, in this study it was selected to be used<sup>16</sup>. When the behavior of the symptoms was observed during the two collections and the NWQ categories were compared, it was confirmed that in the second collection there was increase of the complaints on the knees added to greater distance from the daily activities and higher frequency of visits to professionals of the health field. The symptoms in wrists or hands, despite having decreased their frequency in the second collection, seem to have intensified with the passage of

time, since the number of athletes not able to perform the daily activities and who visited a professional in the health field increased. Such fact let us associate the complaints with injuries consequent from the sports practice. There was higher prevalence of problems in the category of 12 preceding months. The low back presented the highest percentage of manifestations in this category and in the problems on the last seven days, consisting in 55.6 and 44.4% in the last collection and 56.5 and 43.5% in the second, respectively. Low back pain, despite being fairly present in the athletes, does not put them away from the competitions<sup>23</sup>. Overload and fatigue may be the cause of the contracture of the paravertebral musculature, the sacroiliitis and spondilolisis, triggering low back pain<sup>24</sup>. The report of problems on the shoulder in the last 12 months was 52.2% on the first collection, which reminds us of the chronic character of the shoulder injuries, despite onset in the other three categories with lower frequency. The shoulder and knee injuries occur more due to overload and fatigue<sup>24,25</sup>. According to Ejnisman *et al.*<sup>26</sup>, out of the 119 athletes from the many modalities who presented pain on the shoulder region, the volleyball athletes were the ones who presented most shoulder injuries.

According to Mendonça *et al.*<sup>27</sup>, volleyball required disproportional demand from the shoulders, in a way that the lateral rotators are more prone to fatigue, which may lead to the onset of the symptoms on the shoulder complex and decrease in performance. The study carried out by Cangussu *et al.*<sup>28</sup> did not have specific correlation between shoulder pain and motor performance of the athletes. These findings corroborate our study, which evidenced that the athletes presented very good performance in the pitch despite the complaints.

The upper part of the back presented the highest prevalence in the category of problems in the last 12 months, reaching 39.1% in the second collection. This phenomenon may be derived from muscular tension in that region and compression of the suprascapular nerve associated with shoulder dysfunction. Compression of the

suprascapular nerve is a typical situation in volleyball athletes<sup>24</sup>.

Concerning knee injuries, 52.2% of the athletes in the second collection presented problems in the last 12 months. In volleyball, many of the main functional gestures involve jumps, which submit the knee joint to successive overload<sup>24</sup>. In this sport, high demand of velocity and power of the knee extensor mechanism, as well as its overuse, are important factors in the onset of jumper's knee, characterized by alterations, pain and weakness of the patellar tendon<sup>9,29,30</sup>. This dysfunction is more prevalent in adult players; however, similar episodes of jumper's knee in youngsters may subsequently lead to career interruption in volleyball<sup>9</sup>. Patellofemoral pain and the jumper's knee are predominant in volleyball concerning problems to the knee joint for overload and fatigue<sup>24</sup>. In the study by Gisslèn *et al.*<sup>9</sup>, the highest pain rates in the patellar tendon were verified in athletes in specific training phase of the sport, where load increase also occurs. In our study, knee symptoms make 21.7% of the sample in the second collection visit a professional of the health field. Ankle and knee were the ones which most made the athletes visit the professional. This finding corroborates the ones by Hamill and Knutzen<sup>31</sup>, in which the ankles presented the highest incidence of disorders with acute and ligament injuries. Ankle sprains are the most frequent acute injury found in this sport<sup>32</sup>.

## LIMITATIONS

The analysis of the resistance test was not explored due to the standard deviation higher than the mean, generated by the interference of the place of the running performance, inappropriate in one of the clubs, which reflected on great discrepancy of values compared to the other club. The tests application occurred in different moments of the training session according to the athletes, materials and the space availability.

## CONCLUSION

The physical fitness and anthropometry profile of the athletes presented as main characteristics: increase in height, scale, abdominal resistance, explosive strength of upper extremities and agility. Great prevalence of pain or previous symptoms in the back, low or upper, shoulders, hip/thighs, knees and ankles reinforces the need of long-term follow-up of the reaction of youngster athletes to training, as well as enable strategies for prevention of pain and injuries.

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All authors have declared there is not any potential conflict of interests concerning this article.

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## REFERÊNCIAS

1. Bangsbo J, Mohr M, Poulsen A, Gomez JP, Krstrup P. Training and testing the elite athlete. *J Exerc Sci Fit* 2006;4:1-14.
2. Duncan MJ, Woodfield L, Nakeeb YA. Anthropometric and physiological characteristics of junior elite volleyball players. *Rev Br J Sports Med* 2006;40:649-51.
3. Ferreira MA. Biomechanical, anthropometrical and physical profile of the North-West University Club netball players and the relationship to musculoskeletal injuries. North-West University Study Leader: 2007.
4. Bojikian, LP, Böhme MTS. Crescimento e composição corporal em jovens atletas de voleibol feminino. *Rev Bras Educ Fis Esp* 2008;22:91-102.
5. Flores AA, Rodríguez FR, Gómez FOB, Arce PJJ, Marincovich DIM, Gutiérrez, OB. Perfil antropométrico de jogadores profissionais de voleibol sudamericano. *Int J Morphol* 2009;27:53-7.
6. Silva CD, Tumelero S. Comparação física e de resposta ao treinamento para atletas da categoria infanto-juvenil em funções específicas no voleibol. *Dig* 2007;12(107).
7. Verhagen EALM, Beek AJV, Bouter LM, Bahr RM, Mechelen WV. A one season prospective cohort study of volleyball injuries. *Br J Sports Med* 2004;38:477-81.
8. Bonza JE, Fiels SK, Yard EE, Comstock RD. Shoulder injuries among united states high school athletes during the 2005-2006 and 2006-2007 school years. *J Athl Train* 2009;44:76-83.
9. Gisslèn K, Gyulai C, Söderman K, Alfredson H. High prevalence of jumper's knee and sonographic changes in swedish elite junior volleyball players compared to matched controls. *Br J Sports Med* 2005;39:298-301.
10. Bompa TO, Carrera M. Periodization training for sports. 2ª ed. Human Kinetics, 2005;3.
11. Cunha GS, Ribeiro JL, Oliveira AR. Sobre-treinamento: teorias, diagnóstico e marcadores. *Rev Bras Med Esporte* 2006;15:297-302.
12. Glesson M. Biochemical and immunological markers of overtraining. *J Sports Sci Med* 2002;1:31-41.
13. Bompa TO, Half GG. Theory and methodology of training. 5ª ed. Human Kinetics, 2009;3.
14. Bompa TO, Carrera MC. Periodização. 4ª São Paulo: Phortes, 2002;155.
15. PROJETO ESPORTE BRASIL. Disponível em: <<http://www.proesp.ufrgs.br>> Acesso em: 24 setembro 2009.
16. Pinheiro FA, Tróccoli BT, Carvalho CV. Validação do Questionário Nórdico de Sintomas Osteomusculares como medida de fadiga. *Rev Saúde Pública* 2002;36:307-12.
17. Cafuni CB. Análise da carreira desportiva de atletas brasileiros estudo da relação entre o processo de formação e o rendimento desportivo. Universidade do porto faculdade de ciências do desporto e de educação física. Dissertação. 2002.
18. Rê AHN, Junior DDR, Böhme MTS. Stress e nível competitivo: considerações sobre jovens praticantes de futsal. *Rev Bras Ci e Mov* 2004;12:83-7.
19. Anfilio MA, Shigunov V. Reflexões sobre o processo de seleção e preparação de equipes: o caso da seleção brasileira masculina voleibol infanto juvenil. *Rev Bras Cineantropom Desempenho Hum* 2004;6:17-25.
20. Hartig DE, Henderson M. Increasing Hamstring Flexibility Decreases Lower Extremity Overuse Injuries in Military Basic Trainees. *Am J Sports Med* 1999;27:173-6.
21. Ferreira DA, Paula AH. Identificação e comparação do perfil de aptidão física em atletas de voleibol por posição de jogo. *Rev Dig Ipatinga* 2006;1:1-15.
22. Benetti G, Schneider P, Meyer F. Os benefícios do esporte e a importância da treinabilidade da força muscular de pré-púberes atletas de voleibol. *Rev Bras Cineantropom Desempenho Hum* 2005;7:87-93.
23. Gonçalves GB, Pereira JS. Repercussões da curvatura lombar nas características da lombalgia em praticantes de voleibol. *Fisioter Mov* 2009;22:537-46.
24. Cohen M, Abdalla RJ. Lesões no esporte diagnóstico tratamento e prevenção. Ed. Revinter, 2005;419, 714.
25. Aagaard H, Jorgensen U. Injuries in elite volleyball. *Scand J Med Sci Sports* 1996;6:228-32.
26. Eijnisman B, Andreoli CV, Carrera EF, Abdalla RJ, Cohen MA. Lesões músculo-esqueléticas no ombro do atleta: mecanismo de lesão, diagnóstico e retorno à prática esportiva. *Rev Bras Ortop* 2001;36:389-93.
27. Mendonça LM, Bittencourt NFN, Anjos MTS, Silva AA, Fonseca ST. Avaliação muscular isocinética da articulação do ombro em atletas da Seleção Brasileira de Voleibol Sub-19 e Sub-21 Masculino. *Rev Bras Med Esporte* 2010;16:107-11.
28. Cangussu DFR, Rodrigues DCM, Reis D, Venturini C. Estudo da associação entre dor e desempenho funcional do membro superior de jogadores de vôlei. *Rev Bras Ci e Mov* 2007;15:15-20.
29. Lian BO, Engebretsen L, Bahr R. prevalence of jumper's knee among elite athletes from different sports: a cross-sectional study. *Am J Sports Med* 2005;33:561-7.
30. Malliaris P, Cook J, Ptasznik R, Thomas S. Prospective study of change in patellar tendon abnormality on imaging and pain over a volleyball season. *Br J Sports Med* 2006;40:272-4.
31. Hamill J, Knutzen KM. Bases biomecânicas do movimento humano. São Paulo: Ed Manole, 1999;202.
32. Briner WW, Benjamin HJ. Volleyball injuries: managing acute and overuse disorders. *Phys Sports Med* 1999;27:48-60.