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VERTICAL JUMP OF THE ELITE MALE VOLLEYBALL PLAYERS IN RELATION THE GAME POSITION: A SYSTEMATIC REVIEW

SALTO VERTICAL DOS JOGADORES DE VOLEIBOL MASCULINOS DE ELITE EM RELAÇÃO A POSIÇÃO DE JOGO: UMA REVISÃO SISTEMÁTICA

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Abstract

The objective of the systematic review was of determine the vertical jump of the elite male volleyball players in relation the game position. This study followed the systematic review methodology proposed in PRISMA statement. The studies were identified in electronic databases during January of 2015 to May of 2015. Inclusion criteria of the articles were evaluated under the following search strategies: (1) type of participants, (2) type of task and (3) type of result. The studies that were excluded are the articles that were not in accordance with the inclusion criteria. The researcher selected 8 studies that were included in this systematic review. The results of the study were the following: the best squat vertical jump (SJ) were of the outside hitters/receivers (41,88±5,57 cm) and of the liberos (40±6,54 cm), the best countermovement vertical jump (CMJ) were of the opposite hitters (57,4±9,5 cm) and of the outside hitters/receivers (57,4±9,5 cm), the best countermovement vertical jump (CMJ) with arm swing were of the opposite hitters (70,67±4,55 cm) and of the outside hitters/receivers (70,67±4,55 cm). The best spike jump was of the outside hitters/receivers (80 cm) and of the opposite hitters (79,1±9,2 cm), the best block jump was of the outside hitters/receivers (60 cm) and of the setters (58 cm). However, middle blockers had the wortst spike jump and block jump, but a greater height provided a better spike reach (368 cm) and block reach (341 cm). Therefore, vertical jump and height are importants for the high performance of the elite male volleyball player.

Keywords

Volleyball – Vertical Jump – Test – Physiology - Biomechanics

Resumo

O objetivo da revisão sistemática foi de determinar o salto vertical dos jogadores de voleibol masculinos de elite em relação a posição de jogo. A revisão sistemática utilizou a metodologia proposta pelo PRISMA. Os estudos foram identificados em base de dados eletrônicos durante janeiro a maior de 2015. O critério de inclusão dos estudos aconteceu conforme as seguintes estratégias de busca: (1) tipo de participantes, (2) tipo de tarefa e (3) tipo de resultado. Os estudos que foram excluídos são os artigos que não estiveram de acordo com os critérios de inclusão. O pesquisador selecionou 8 estudos que foram incluídos nessa revisão sistemática. Os resultados do estudo foram os seguintes: o melhor SJ foram dos jogadores de ponta (41,88±5,57 cm) e dos líberos (40±6,54 cm), o melhor CMJ foram dos opostos (57,4±9,5 cm) e dos jogadores de ponta (57,4±9,5 cm), o melhor CMJ com balanceio dos braços foram dos opostos (70,67±4,55 cm) e dos jogadores de ponta (70,67±4,55 cm). O melhor salto vertical da cortada foi dos jogadores de ponta (80 cm) e dos opostos (79,1±9,2 cm), o melhor salto vertical do bloqueio foi dos jogadores de ponta (60 cm) e dos levantadores (58 cm). Entretanto, o central teve o pior salto vertical da cortada e do bloqueio, mas a maior estatura proporcionou o melhor alcance da cortada (368 cm) e do bloqueio (341 cm). Portanto, salto vertical e estatura são importantes para a alta performance do jogador de voleibol masculino de elite.

Palavras-Chaves

Voleibol – Salto Vertical – Teste – Fisiologia - Biomecânica

Introduction

The vertical jump is an important action of the volleyball player because the spike, the block and the jump serve are practiced with more quality[1]. The height of the vertical jump added the height of the volleyball player is important during the block because the athlete has more easily of make a point or can hinder the opponent`s attack[2]. The good vertical jump provides a stronger attack and jump serve[3].

The studies of the volleyball informed that the vertical jump during the spike of the elite male volleyball player is of 70 centimeters (cm) to 1 meter and of the elite female volleyball player is of 50 to 90 cm[4]. However, the vertical jump during the block, during the squat jump and during the countermovement jump the results are lower[5.]

The studies of the vertical jump of the elite volleyball players are published about the effect of the training in the vertical jump[6], the biomechanics of the vertical jump during a skill[7], the biomechanics of the vertical jump during the execution of the type of jump –for example, different knee angles[8], the difference of the squat vertical jump versus the countermovement vertical jump[9], acute effect of different warm-up on vertical jump[10] and others similar studies. However, the majority of the studies about the vertical jump of the

[1] A. Fattahi; H. Sadeghi; M. Rezaei y M. Einanloo, Effects of two warm up protocol on vertical jump performance in mini-volleyball players. Adv. Res 3:3 (2015) 350-356.

[2] K. Sterkowicz-Przybycien; S. Sterkowicz y S. Zak, Sport skill level and gender with relation to age, physical development and special fitness of the participants of Olympic volleyball tournament Beijing. Coll Antropol 38:2 (2014) 511-516.

[3] M. Peeri; R. Sharif y H. Matinhomaee, Relations of some corporeal properties with performance of volleyball players who particeped. Eur J Exper Biol 3:5 (2013) 88-94.

[4] N. Marques Junior, Testes para o jogador de voleibol. Rev. Min. Educ. Fís. 13:1 (2005) 130-174; L. Rigolin da Silva; E. Franchini; M. Kis; M., Böhme; K. Matsushigue; R. Uezu y M. Massa, Evolução da altura de salto, da potência anaeróbia e da capacidade anaeróbia em jogadores de voleibol de alto nível. Rev. Bras. Ci. Esp. 26:1 (2004) 99-109 and L. Stanganelli; A. Dourado; P. Oncken; S. Mançan y S. Costa, Adaptations on jump capacity in Brazil volleyball players prior to the under-19 World championship. J. Strength Cond. Res. 22:3 (2008) 741-749.

[5] M. Arruda y J. Hespanhol, Saltos verticais. (São Paulo: Phorte, 2008) p. 15-23; R. Gheller,; J. Pupo; J. Dias; D. Detanico; J. Padulo y S. Santos, Effect of different knee starting angles on intersegmental coordination and performance in vertical jump. Hum. Mov. Sci. 42 (2015) 71-80 and Y. Pozo and E. Stiven, Análisis comparativo entre los altos reactivos y la capacidad del salto en voleibolistas universitarios. Rev. Observatorio ODEP 1:1 (2015) 93-105.

[6] Z. Jastrzebski; K. Wnorowski; R. Mikolajewski; E. Jaskulska y L. Radziminski, The effect of a 6-week plyometric training on explosive power in volleyball players. Baltic J Health Phys. Activ. 6:2 (2014) 79-89 and J. Sheppard y N. Newton, Long-term training adaptations in elite male volleyball players. J. Strength Cond. Res. 26:8 (2012) 2180-2184.

[7] H. Wagner; M. Tilp; S. von Duvillard y E. Mueller, Kinematic analysis of volleyball spike jumps. Int. J. Sports Med. 30:10 (2009) 760-765 and S. Yadav y S. Mukherjee, Electromyographical relationship of jump serve performance among the volleyball players. Int. Educ. E-J 4:2 (2015) 52-57.

[8] R. Gheller; J. Pupo; L. Lima; B. Moura y S. Santos. Effect of squat depth on performance and biomechanical parameters of countermovement vertical jump. Rev. Bras. Cineantropom Desempenho Hum. 16:6 (2014) 658-668.

[9] M. Bobbert; K. Gerritsen; M. Litjens y A. Van Soest, Why is countermovement jump height greater than squat jump height? Med. Sci. Sports Exerc. 28:11 (1986) 1402-1412.

[10] R. Haghshenas; I. Taleb-Beydokhti y S. Avandi, Acute effect of diferente warm-up stretch protocols on vertical jump performance in volleyball players. Int. J. Sport Studies 4:8 (2014) 907-913.

elite male volleyball player do not inform the vertical jump of the spike, of the block and of the countermovement jump and others in relation the game position[11].

What are the results of the vertical jump of the elite male volleyball players in relation the game position?

The literature about this theme is small[12], then, the objective of the systematic review was of determine the vertical jump of the elite male volleyball players in relation the game position.

Materials and methods

This study followed the systematic review methodology proposed in Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement[13].

The studies were identified in electronic databases during January of 2015 to May of 2015. Literature searches were conducted in Google Scholar, Research Gate and PubMed. In electronic databases were consulted using the following keywords: vertical jump and volleyball, vertical jump of the male volleyball and vertical jump of the volleyball player.

Relevant articles were obtained in full, and assessed against the inclusion and exclusion criteria described below. Inclusion criteria of the articles were evaluated under the following search strategies: (1) type of participants (elite male volleyball player), (2) type of task (vertical jump test) and (3) type of result (determined the vertical jump of the elite male volleyball player during a test). The studies that were excluded are the articles that were not in accordance with the inclusion criteria of the systematic review.

In the first phase of analysis, 814 studies were found using the keywords listed in the previous section. After the reading the title and the abstract of each study (3 moths), the second phase of analysis the total was reduced to 21 studies about vertical jump of the elite volleyball player. The researchers were able to read the 21 studies in a period of 30 days and the total was reduced to 11 studies with chances of inclusion. Of these studies, 8 articles were included in this systematic review. The details for the full strategy were listed in a PRISMA flow diagram, as shown in figure 1.

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[11] B. Cabral; S. Cabra; H. Miranda; P. Dantas y V. Reis, Efeito discriminante da morfologia e alcance de ataque no nível de desempenho em voleibolistas. Rev. Bras. Cineantropom Desempenho Hum. 13:3 (2011) 223-229; A. Theodorou; G. Paradisis; V. Akopoulos; E. Smpokos; E. Skordilis y C. Cooke, Performance indices selection for assessing anaerobic power during a 30 second vertical jump test. J. Sports Med. Phys. Fit. 53:6 (2013) 596-603 and J. Zanolo; F. Ravagnani; A. Reis Filho; R. Simão y J. Ferreirinha y Efeito do treinamento de flexibilidade articular do quadril sobre o salto vertical em jovens atletas de voleibol feminino. Bras. Prescr. Fisio. Exerc. 8:50 (2014) 846-854.

[12] J. Ayuso; J. González; V. Suárez y M. Zourdos, Influence of anthropometric profile on physical performance in elite female volleyballers in relation to playing position. Nutr. Hosp. 31:2 (2015) 849-857 and J. Palao; P. Manzanares y D. Valadés, Anthropometric physical, and age differences by the player position and the performance level in volleyball. J. Hum Kinet. 44 (2014) 223-236.

[13] D. Moher; A. Liberati; J. Tetzlaff y D. Altman, Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLOS Med. 6:7(2009):1-6.

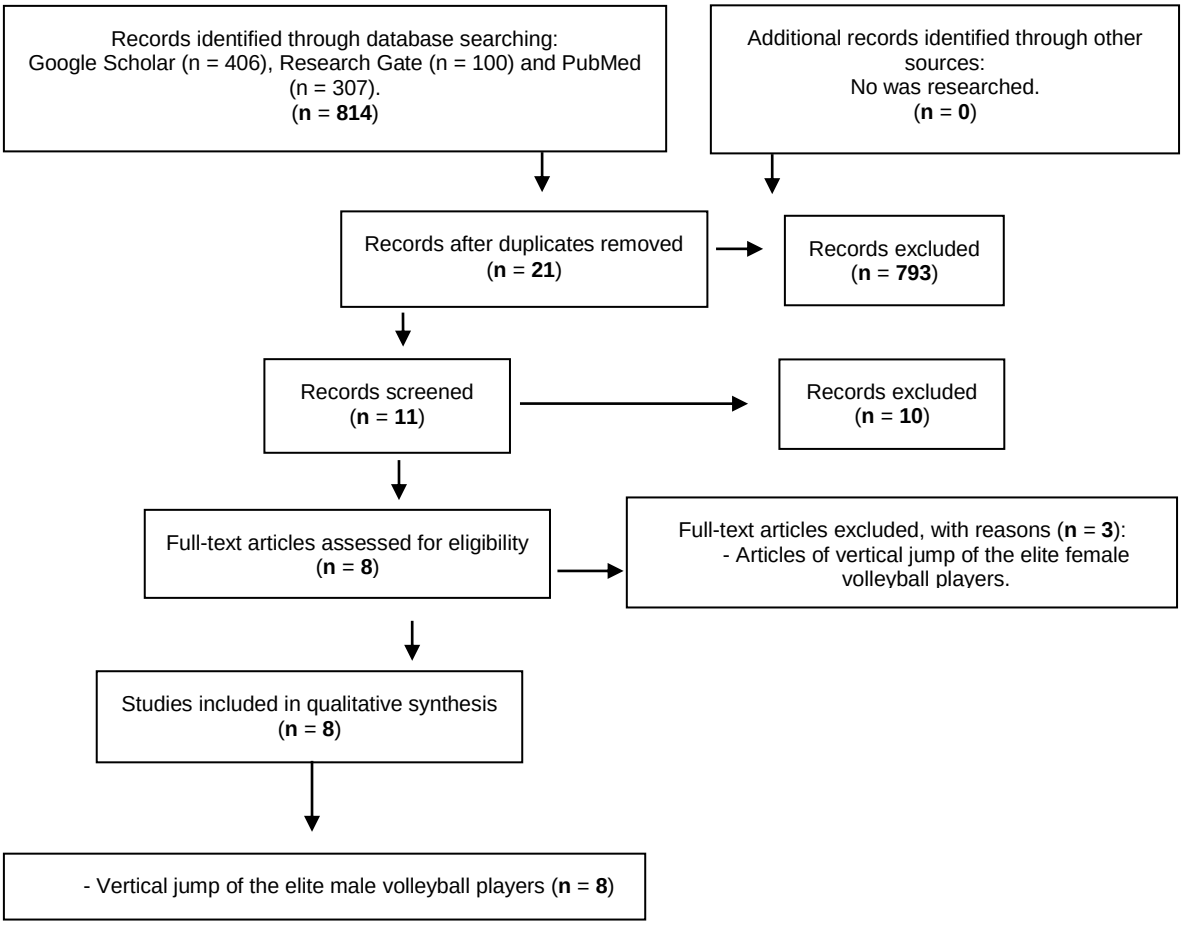


Figure 1
PRISMA flow diagram of the selection of articles

The researcher used the scale of Galna et al.[14] for the quality assessment of the studies. The scale of Galna et al.[15] use questions (internal validity, external validity and others) about the article and the researcher determined the point of 0 to 1 of each item. The studies were considered low quality with an average below of 0,6 points. The use of the scale of Galna et al.[16] occurred in two moments with the objective to check the reliability and determine the level of agreement between the two scores on this instrument. The researcher determined the quality of the studies during an assessment, after 15 days, practiced new assessment of the studies[17] of vertical jump about the elite male volleyball players.

The reliability of the quality of the studies by the scale of Galna et al.[23] was checked via intraclass correlation coeficiente ($p \leq 0,05$). Cohens`s Kappa was calculated to determine the level of agreement between the two assessments of the studies ($p \leq 0,05$).

[14] B. Galna; A. Peters; A. Murphy y M. Morris, Obstacle crossing deficits in older adults: a systematic review. Gait Posture 30:3 (2009) 270-275.
[15] B. Galna; A. Peters; A. Murphy y Morris, Obstacle crossing deficits in older…
[16] B. Galna; A. Peters; A. Murphy y Morris, Obstacle crossing deficits in older…
[17] i. Mesquita y J. Teixeira, The spike, attack zones and the opposing block in elite male beach volleyball. Int. J. Volleyball Res. 7:1 (2004) 57-62.

Bland and Altman[18] method was applied to assess the level of agreement between the first and second quality assessment of the studies by the scale of Galna et al.[19]

All these statistical treatments were performed according to the procedures of the GraphPad Prism, version 5.0.

Results and discussion

Intra-observer the level of agreement exhibited Cohen`s Kappa values of 0,60, was a good agreement that is appointed by the literature[20], but had no significant difference (p = 0,06).

The reliability of the quality of the studies by the scale of Galna et al.[21] was checked via intraclass correlation, the result was of 0,97 (p = 0,0001), this result was excellent[22].

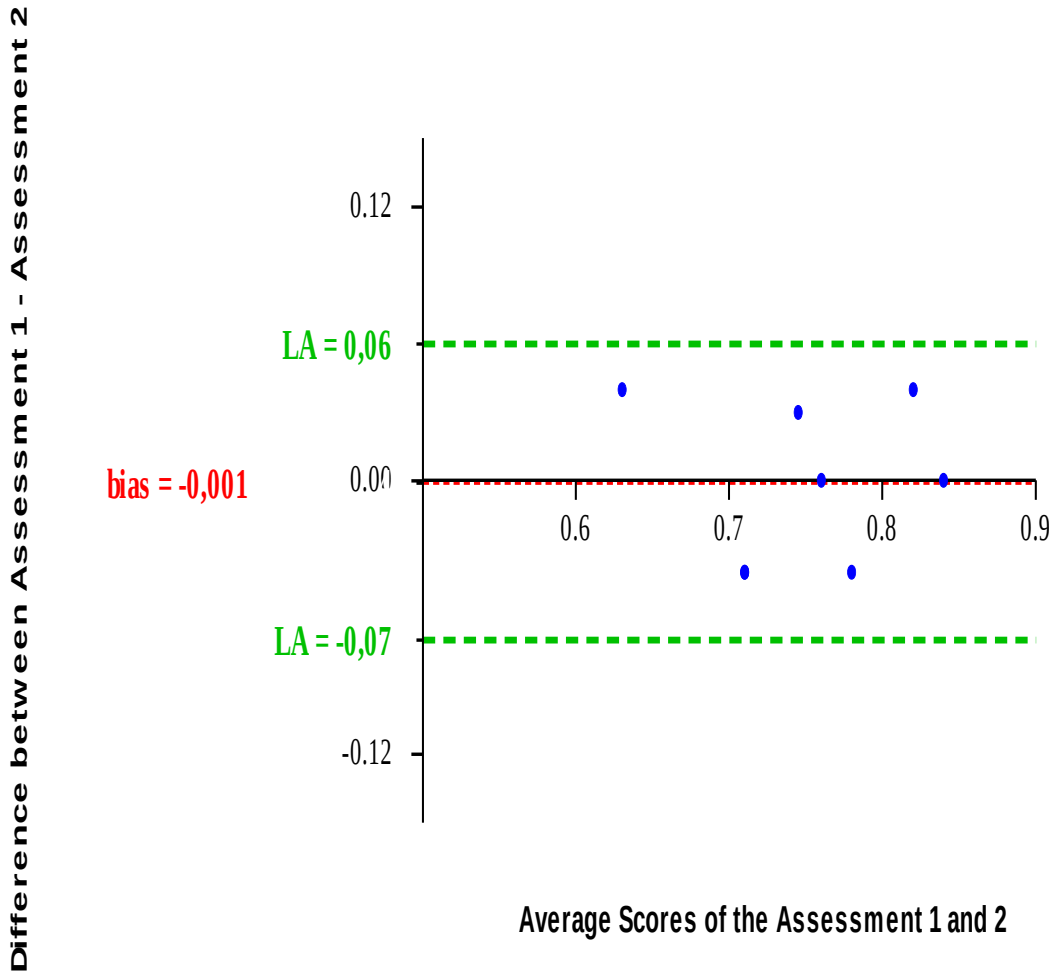
Bland and Altman[23] method was applied to assess the level of agreement between the first and second quality assessment of the studies by the scale of Galna et al.[24]

Although the difference between the assessment 1 and 2 was low (bias = - 0,001), the limits of agreement ranged from - 0,07 (lower limit of agreement) to 0,06 (upper limit of agreement), suggesting high agreement between the assessment 1 and 2 because the values stayed located near of the zero (increase the agreement) and the limits of agreement stayed located near of the zero (increase the agreement).

The author calculated the 95% confidence interval (CI) recommended by Marques Junior[25] about the Bland and Altman[26] method. The 95% CI of the bias was medium (lower CI = - 0,010 and upper CI = 0,007) and the 95% CI of the limit of agreement was near (lower CI = - 0,082 and upper CI = 0,083).

Therefore, a high agreement between the assessment 1 and 2 of the studies by scale of Galna et al.[27] was determined by Bland and Altman[28] method. The Bland and Altman[29] shows in figure 2 the agreement between assessments 1 and 2.

[18] J. Bland y D. Altman, Statistical methods for assessing agreement between two methods of clinical measurement. Lancet 8476:1 (1986) 307-310.
[19] B. Galna; A. Peters; A. Murphy y M. Morris, Obstacle crossing deficits in older…
[20] A. Gaya, Ciências do movimento humano. (Porto Alegre: Artmed, 2008) p. 286-287.
[21] B. Galna; A. Peters; A. Murphy y M. Morris, Obstacle crossing deficits in older…
[22] P. Huijbregts, Spinal motion palpation: a review of reliability studies. J. Manual Manipul Therap 10:1 (2002) 24-39.
[23] J. Bland y D. Altman, Statistical methods for assessing agreement between…
[24] B. Galna; A. Peters; A. Murphy y Morris, Obstacle crossing deficits in older…
[25] N. Marques Junior, Estatística aplicada ao esporte e a atividade física. Vol. 3. (Niterói: s.ed. 2014).
[26] J. Bland, J. y D. Altman, Statistical methods for assessing agreement between…
[27] B. Galna; A. Peters; A. Murphy y M. Morris, Obstacle crossing deficits in older…
[28] J. Bland, J. y D. Altman, Statistical methods for assessing agreement between…
[29] J. Bland, J. y D. Altman, Statistical methods for assessing agreement between…



Graph 1
Bland and Altman plot the 95% limits of agreement (LA) between the assessment 1 and 2 by the scale of Galna et al.[30]

In quality assessment of each study was found medium scientific quality (five studies, two studies of 0,69 points and three studies of 0,76 points) to high scientific quality (two studies of 0,84 points). The selected studies were of good quality because three studies of medium quality (0,76 points) have points near of the high quality studies (from 0,81 points) -the information is of the 1st assessment. The table 1 shows the methodological quality of the studies.

[30] B. Galna; A. Peters; A. Murphy y M. Morris, Obstacle crossing deficits in older…

Study	1	2	3	4	5	6	7	8	9	10	11	12	13	Average and Quality of each Study
Silva and Rivet[31]	**1** 1	**1** 1	**0,5** 1	**0,5** 0,5	**0** 0	**1** 1	**1** 1	**1** 1	**0** 0	**0** 0	**1** 1	**1** 1	**1** 1	**0,69 (medium)** 0,73 (medium)
Bellendier[32]	**1** 1	**1** 1	**1** 0,5	**0,5** 0,5	**0** 0	**1** 1	**1** 1	**1** 1	**0** 0	**0** 0	**0** 0	**1** 1	**1** 1	**0,65 (medium)** 0,61 (medium)
Sheppard et al.[33]	**1** 1	**1** 1	**0,5** 1	**0,5** 0,5	**1** 1	**1** 1	**1** 1	**1** 1	**0** 0	**0** 0	**1** 1	**1** 1	**1** 1	**0,76 (medium)** 0,80 (medium)
Marques et al.[34]	**1** 1	**1** 1	**1** 1	**1** 1	**1** 1	**1** 1	**1** 1	**1** 1	**0** 0	**0** 0	**1** 1	**1** 1	**1** 1	**0,84 (high)** 0,84 (high)
Sattler et al.[35]	**1** **1**	**1** **1**	**1** **1**	**1** **0,5**	**1** **1**	**1** **1**	**1** **1**	**1** **1**	**0** **0**	**0** **0**	**1** **1**	**1** **1**	**1** **1**	**0,84 (high)** 0,80 (medium)
Fattahi et al.[36]	**1** 1	**1** 1	**0,5** 1	**0,5** 0,5	**0** 0	**1** 1	**1** 1	**1** 1	**0** 0	**0** 0	**1** 1	**1** 1	**1** 1	**0,69 (medium)** 0,73 (medium)
Seron et al.[37]	**1** **1**	**1** **1**	**1** **1**	**1** **0,5**	**0** **0**	**1** **1**	**1** **1**	**1** **1**	**0** **0**	**0** **0**	**1** **1**	**1** **1**	**1** **1**	**0,76 (medium)** 0,73 (medium)
Palao et al.[38]	**1** 1	**1** 1	**1** 1	**1** 1	**0** 0	**1** 1	**1** 1	**1** 1	**0** 0	**0** 0	**1** 1	**1** 1	**1** 1	**0,76 (medium)** 0,76 (medium)

Table 1
Summary of the quality assessment of the studies selected

Obs.: The numbers in bold are the results of the 1st assessment and without this effect are of the 2nd assessment.
The numbers from 1 to 13 are the questions of the scale of Galna et al.[39] : 1. Research aims or questions stated clearly (Scoring Criteria: 1 – yes; 0,5 – yes, lacking detail or clarity; 0 – no); **2.** Participant detailed (number, age, sex, height, weight) (Scoring Criteria: 0 to 1); **3.** Recruitment and sampling methods described (1 – yes; 0,5 – yes, lacking detail or clarity; 0 – no); **4.** Inclusion and exclusion criteria detailed (1 – yes; 0,5 – yes, lacking detail or clarity; 0 – no); **5.** Controlled co-variates (walking speed, age, gender) (0 to 1); **6.** Key outcome variables clearly described (1 – yes; 0,5 – yes, lacking detail or clarity; 0 – no); **7.** Adequate methodology able to repeat study (participant sampling, equipment, procedure, data processing, statistical) (0 to 1); **8.** Methodology able to answer research question (participant sampling, equipment, procedure, data processing, statistical) (1 – yes; 0 - no). **9.** Reliability of the methodology stated (1 – yes; 0 - no); **10.** Interval validity of the methodology stated (1 – yes; 0 - no); **11.** Research questions answered adequately in the discussion (1 – yes; 0 - no); **12.** Key findings supported by the results (1 – yes; 0 - no); **13.** Key findings interpreted in a logical manner which is supported by references (1 – yes; 0 - no). **Quality of the Studies:** 0 to 0,59 is low, 0,60 to 0,80 is medium and 0,81 to 1 is high.

[31] R. Silva; R. y Rivet, Comparação dos valores de aptidão física da seleção brasileira de voleibol masculina adulta do ano de 1986, por posição de jogo através da estratégia Z CELAFISCS. Rev. Bras. Ci. Mov. 2:3 (1988) 28-32.
[32] J. Bellendier, Una visión analítico-descriptiva del Mundial de Voleibol "Argentina 2002". Rev. Educ. Fís. Dep. 9:60 (2003) 1-13.
[33] J. Sheppard; T. Gabbet y L. Stanganelli, An analysis of playing position in elite men`s volleyball: considerations for competition demands and physiologic characteristics. J. Strength Cond. Res. 23:6 (2009) 1858-1866.
[34] M. Marques; R. Tillaar; T. Gabbett; V. Reis y J. Badillo, Physical fitness qualities of professional volleyball players: determination of positional difference. J. Streghth Cond. Res. 23:4 (2009) 1106-1111.
[35] T. Sattler; D. Sekulic; V. Hadzic; O. Uljevic y E. Dervisevic, Vertical jumping tests in volleyball: reliability, validity, and playing-position specifics. J. Strength Cond. Res. 26:6 (2012) 1532-1538.
[36] A. Fattahi; M. Ameli y H. Sadeghi, Relationship between anthropometric parameters with vertical jump in male elite volleyball players due to game`s postion. Middle-East J. Sci. Res. 13:8 (2013) 1016-1023.
[37] B. Seron; J. Durigan; L. Almeida; A. Dourado y L. Stanganelli, Análise e comparação dos saltos na placa e saltos de ataque e bloqueio em uma equipe de voleibol masculina participante da superliga 2010/2011. Rev. Min. Educ. Fís. Especial: 9 (2013) 793-798.
[38] J. Palao; P. Manzanares y D. Valadés, Anthropometric physical, and age differences…
[39] B. Galna; A. Peters; A. Murphy y M. Morris, Obstacle crossing deficits in older…

In table 2 was presented a summary of each study selected for the systematic review.

Study	Elite Male Volleyball Players	Vertical Jump Test	Results in Centimeters
Silva and Rivet[40]	Brazilian team 4th place in the World Championship of 1986 (n = 12, 2 setters, 4 middle blockers and 6 opposite hitters and/or outside hitters/receivers). The elite volleyball players had the following height: 185,7±0,07 cm of the setters, 196,5±2,40 cm middle blockers and 190,6±3,90 cm of the opposite hitters and/or of the outside hitters/receivers.	The tests were the countermovement vertical jump without arms (CMJ) and the CMJ with arm swing, the norms of the tests was of the CELAFISCS.	Setters (CMJ = 55±1,41, CMJ with arm swing = 66,50±4,95), Middles (CMJ = 50,25±6,70, CMJ with arm swing = 62,75±4,92) and Opposites and/or Outsides (CMJ = 57,17±5,31, CMJ with arm swing = 70,67±4,55).
Bellendier[41]	Volleyball players of the World Championship of 2002. The elite volleyball players had the following height: 188,2 cm of the setters, 202 cm middle blockers, 201 cm of the opposite hitters and 194,9 cm of the outside hitters/receivers.	The study not informed.	Setters (Spike Reach = 321 to 346, Block Reach = 300 to 330), Middles (Spike Reach = 347 to 368, Block Reach = 323 to 341), Opposites (Spike Reach = 345 to 355, Block Reach = 320 to 340) and Outsides (Spike Reach = 340 to 364, Block Reach = 320 to 338).
Sheppard et al.[42]	All the participants were members of national teams of the Argentina, Australia, Canada and Brazil (n = 42, 20,92±2,9 years old, 198,9±5,6 cm and 91,9±9,3 kg). The elite volleyball players had the following height: 192,90±4,20 cm of the setters, 203,1±3,9 cm of the middle blockers and 197,8±4,6 cm of the opposite hitters and/or of the outside hitters/receivers. The standing reach height was the following: 254,2±9,6 cm of the setters, 268,1±6,6 cm of the middle blockers and 262,3±8,4 cm of the opposite hitters and/or of the outside hitters/receivers.	The tests were the CMJ and the spike jump. The jump height was calculated with the following subtraction: jump reach height – standing reach height = ? cm.	Setters (CMJ = 54,4±9,4, Spike Jump = 73,9±7,8, Spike Reach = 328,1±10,4), Middles (CMJ = 55,9±8,7, Spike Jump = 75,1±7,8, Spike Reach = 343,2±8,7) and Opposites and/or Outsides (CMJ = 57,4±9,5, Spike Jump = 79,1±9,2, Spike Reach = 341,3±9,1).
Marques et al.[43]	All the participants were of several countries and were members of European team (n = 36, 6 setters, 9 middle blockers, 4 opposite hitters, 10 outside hitters/receivers and 4 liberos, 26,6±3,1 years old). The elite volleyball players had the following height: 190±0,05 cm of the setters, 203±0,04 cm of the middle blockers and 200±0,04 cm of the opposite hitters, 191±0,02 of the outside hitters/receivers and 182±0,04 of the liberos.	The CMJ measured using a trigonometric carpet (Ergo jump Digitime 1000, Digitest, Finland). Each athlete completed 3 attempts with 2 minutes (min) of rest allowed between trials. The average of the 2 best trials was used for analysis.	Setters (CMJ = 47,01±3,39), Middles (CMJ = 42,90±5,37), Opposites (CMJ = 41,91±2,57), Outsides (CMJ = 46.67±4.34) and Liberos (CMJ = 44,44±0,99) .

[40] R. Silva y R. Rivet, Comparação dos valores de aptidão física da seleção brasileira…
[41] J. Bellendier, Una visión analítico-descriptiva del Mundial de Voleibol…
[42] J. Sheppard; T. Gabbet y L. Stanganelli, An analysis of playing position in elite men`s…
[43] M. Marques; R. Tillaar; T. Gabbett; V. Reis y J. Badillo, Physical fitness qualities…

Sattler et al.[44]	All the participants were members of national teams that competed in the Slovenian National Championship (1st and 2nd Divisions) during 2008-2009 season (n = 95, 6 setters, 26 middle blockers, 15 opposite hitters, 24 outside hitters/receivers and 11 liberos).	The squat vertical jump (SJ), the CMJ, the block jump and the spike jump were measured using the Optojump system (Microgate, Bolzano, Italy) during 3 trials with pause of 3 to 5 min.	Setters (SJ = 37,2±4,1, CMJ = 42,27±4,23, Spike Jump = 61,16±6,89, Block Jump = 46,47±5,18), Middles (SJ = 38,69±5,09, CMJ = 43,63±4,84, Spike Jump = 61,84±7,23, Block Jump = 47,42±5,66), Opposites (SJ = 39,33±4,48, CMJ = 43,21±4,91, Spike Jump = 64,25±7,3, Block Jump = 48,19±6,35), Outsides (SJ = 41,88±5,57, CMJ = 46,55±5,01, Spike Jump = 66,06±6,94, Block Jump = 49,87±5,44) and Liberos (SJ = 40,49±6,54, CMJ = 46±4,52, Spike Jump = 60,81±3,52, Spike Block = 50,9±4,61).
Fattahi et al.[45]	All the participants were members of national teams of the Iran (n = 40, 27,93±3,92 years old). The volleyball players of the study 25% were setters, 50% were spikers (middle blockers, opposite hitters and outside hitters/receivers) and 25% were liberos.	The Sargent jump test determined the height of the CMJ with arm swing. The jump height was calculated with the following subtraction: jump reach height – standing reach height = ? cm.	Setters (CMJ with arm swing = 57,2±5,52 cm), Spikers (CMJ with arm swing = 60,5±4,39 cm) and Liberos (CMJ with arm swing = 42,6±3,41 cm).
Seron et al.[46]	All the participants were members of a Londrina team that competed in the Brazilian Championship (1st Division) during 2010-2011 season (n = 13, 2 setters, 4 middle blockers, 2 opposite hitters and 5 outside hitters/receivers).	The SJ, the CMJ, the CMJ with arm swing, the block jump and the spike jump were measured using the Multisprint (Hidrofit LTDA, Belo Horizonte, Brazil).	Setters (SJ = 39,76, CMJ = 42,23, CMJ with arm swing = 52,03, Spike Jump = 78, Block Jump = 58), Middles (SJ = 35,52, CMJ = 39,55, CMJ with arm swing = 48,3, Spike Jump = 73, Block Jump = 53, Opposites (SJ = 33,95, CMJ = 38,55, CMJ with arm swing = 45,3, Spike Jump = 77, Block Jump = 57,2) and Outsides (SJ = 39,6, CMJ = 42,96, CMJ with arm swing = 54,2, Spike Jump = 80, Block Jump = 60).
Palao et al.[47]	All the participants were members of the volleyball teams that competed in the Olympic Games (2000, 2004, 2008 and 2012) and in the World Championship (2002, 2006 and 2010) (n = 120 volleyball teams). The elite volleyball players had the following height: 192±0,6 cm of the setters, 202±0,05 cm of the middle blockers, 197±0,05 cm of the opposite hitters, 197±0,05 cm of the outside hitters/receivers and 186±0,06 cm of the liberos.	The information about the volleyball players was obtained from the database of the different championship of the official FIVB website (www.fivb.org).	Setters (Spike Reach = 335±0,11, Block Reach = 318±0,11), Middles (Spike Reach = 348±0,12, Block Reach = 330±0,10), Opposites (Spike Reach = 345±0,10, Block Reach = 327±0,10), Outsides (Spike Reach = 345±0,10, Block Reach = 327±0,10) and Liberos (Spike Reach = 326±0,13, Block Reach = 310±0,10).

Table 2
Summary of the studies selected

[44] T. Sattler; D. Sekulic; V. Hadzic; O. Uljevic y E. Dervisevic, Vertical jumping tests in…
[45] A. Fattahi; M. Ameli y H. Sadeghi, Relationship between anthropometric…
[46] B. Seron; J. Durigan; L. Almeida; A. Dourado y L. Stanganelli, Análise e comparação…
[47] J. Palao; P. Manzanares y D. Valadés, Anthropometric physical, and age differences…

The squat vertical jump (SJ - the test evaluates the strength) and the countermovement vertical jump without arms (CMJ - the test evaluates indirectly the elastic component) are tests that the physical trainer uses to evaluate the physiological adaptations of the strength training[48]. The countermovement vertical jump (CMJ) with arm swing is a test that used to evaluate the strength and the coordination[49]. Then, is important the physical education teacher apply these tests to evaluate the volleyball player.

The results of the studies presented in table 2 showed that the best SJ were of the outside hitters/receivers (41,88±5,57 cm) and of the liberos (40±6,54 cm). The libero during the game does not practice jump – spike, block and jump serve, but had an excellent result. The setters (37,2±4,1 to 37,76 cm), the middle blockers (35,52 to 38,69±5,09 cm) and the opposite hitters (33,95 to 39,33±4,48 cm) had a high SJ.

The results of the SJ this systematic review were better than the study of Maffiuletti et al.[50] (2002) – 34,2±4,1 to 37,6±6,1 cm, that studied the volleyball players (n = 10) of the Italian Championship. For Arruda and Hespanhol[7], the volleyball players usually have the SJ of 41,1±2,1 cm, better result than the setters, middle blockers and the opposite hitters of this study. In Marques Junior[51], the volleyball players have a SJ between 41 to 49 cm. However, the results of the studies of this systematic review has a limitation, these articles do not inform at what moment of the macrocycle the volleyball players were training because the SJ of the systematic review was much lower than the SJ of Marques Junior[52].

The result of the CMJ of this systematic review was with values between 38 to 57 cm. In Marques Junior[53], the CMJ of the volleyball player had better result, 45 to 61 cm. The study of Aouadi et al.[54], the results were similar of the systematic review, 47,63±3,5 to 50,7±3,9 cm. The volleyball players studied were athletes of the Tunisian Championship. The best CMJ of this systematic review were of the opposite hitters (57,4±9,5 cm) and of the outside hitters/receivers (57,4±9,5 cm). Perhaps, one of the motives for this better CMJ these spikers (opposites and outsides) were the several jumps in the attack during the match.

The studies of the volleyball literature about SJ and CMJ that were used to compare with the data of this systematic review were not by game position, requiring more research on this topic.

[48] P. Komi, Physiological and biomechanical correlates of muscle function: effects of muscle structure and stretch-shortening cycle on force and speed. Exerc. Sports. Sci. Rev. 12:1 (1984) 81-121 and N. Marques Junior, Testes para o jogador de voleibol…

[49] A. Shalmanov, Voleibol: fundamentos biomecânicos. (Guarulhos: Phorte, 1998) 85-87.

[50] N. Maffiuletti; S. Dugnani; M. Folz; E. Di Pierno y F. Mauro, Effect of combined electrostimulation and plyometric training on vertical jump height. Med. Sci. Sports Exerc. 34:10 (2002) 1638-1644.

[51] N. Marques Junior, Seleção de testes para o jogador de voleibol. Mov. Percep. 11:16(2010):168-206.

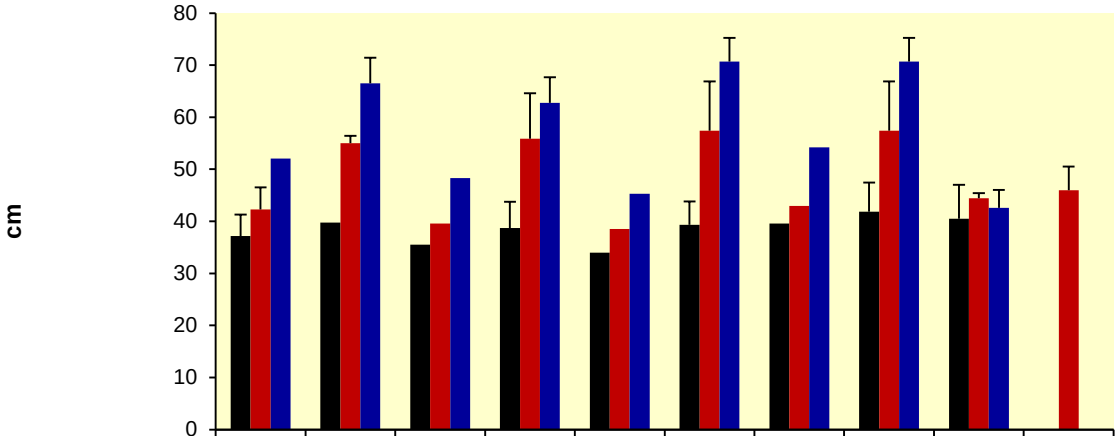
[52] N. Marques Junior, Seleção de testes para o jogador de voleibol…

[53] N. Marques Junior, Seleção de testes para o jogador de voleibol…

[54] R. Aouadi; M. Chedly; R. Khalifa; S. Hermassi; M. Chelly; R. Tillaar y T. Gabbett, Association of anthropometric qualities with vertical jump performance in elite male volleyball players. J. Sports Med Phys. Fit. 51:2 (2011) 1-7.

The best CMJ with arm swing of this systematic review were of the opposite hitters (70,67±4,55 cm) and of the outside hitters/receivers (70,67±4,55 cm). The CMJ with arm swing, the author of this systematic review found no more study on this topic in volleyball.

The graph 2 illustrates these results of the elite male volleyball players in relation the game position. The graph 2 shows the worst and the best of each type of jump.



	Setter	Setter	Middle	Middle	Opposite	Opposite	Outside	Outside	Libero	Libero
SJ	37,2	39,76	35,52	38,69	33,95	39,33	39,6	41,88	40,49	
CMJ	42,27	55	39,55	55,9	38,55	57,4	42,96	57,4	44,44	46
CMJ with arm swing	52,03	66,5	48,3	62,75	45,3	70,67	54,2	70,67	42,6	

Graph 2
Results of the vertical jump used to evaluate the physical training and the coordination

The spike jump and the block jump is an important test for the physical education teacher to understand the performance of these skills during the match[55]. However, the test of the spike jump and of the block jump need to have the results of the reach for the coach understand the performance of these skills[56]. For example, a volleyball player has a good spike jump but the spike reach of the athlete is bad. This result is important because the coach can understand the probability that this volleyball player has during the match and during the training of get bad performance of the attack.

The spike reach of the volleyball player deserves to be equal or greater than 330 cm[57], therefore the height is very important[58]. The highest volleyball players usually have greater spike reach, but a lower vertical jump does not interfere much in this advantage. The systematic review evidenced this. The middle blockers of the systematic review had a spike jump (75,1±7,8 cm) worse than the others spikers (80 cm of the outside hitters/receivers and 79,1±9,2 cm of the opposite hitters) and than the setters (78 cm).

[55] J. Sheppard; J. Cronin; T. Gabbet; M. McGuigan; N. Etxebarria y R. Newton, Relative importance of strength, power, and anthropometric measure to jump performance of elite volleyball players. J. Strength Cond. Res. 22:3(2008):758-765.
[56] L. Gladden y D. Colacino, Characteristics of volleyball players and success in a national tournament. J. Sports Med. Phys. Fit. 18 (1978) 57-64.
[57] M. Massa; M. Böhme; L. Rigolin da Silva y R. Uezu, Análise de referenciais cineantropométricos de atletas de voleibol masculino envolvidos em processo de promoção de talentos. Rev. Mackenzie Educ. Fís. 2:2 (2003) 101-113.
[58] J. Bellendier, Una visión analítico-descriptiva del Mundial de Voleibol…

However, middle blockers had the best spike reach (368 cm) than the others volleyball players (364 cm of the outside hitters/receivers, 355 cm of the opposite hitters and 346 cm of the setters).

The results of the spike reach of this systematic review (321 to 368 cm) were better than the study of Puhl et al.[59] (317,1±14,1 cm). The researchers studied the volleyball players of the United States of American team (n = 8). The systematic review had similar spike reach of the study of Smith et al.[60] (332 to 353 cm). The researchers studied volleyball players members of Canadian national team (n = 15). However, the spike reach were of studies of 1982 and 1992, respectively. During those years the volleyball players had lower height and the spike reach was lower 234,5±9,12 to 300 cm[61]. Second Arruda and Hespanhol[62], the spike reach during the Japan World Cup of 2007 was of 321 to 375 cm, better result than this systematic review – the best spike reach was of 368 cm of the middle blockers.

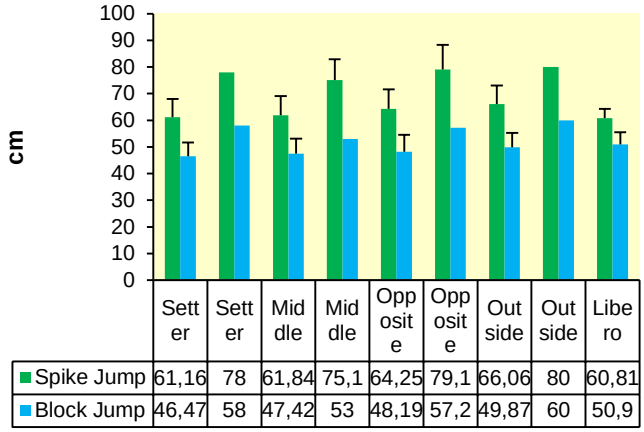
The block jump and the block reach of this systematic review had similar resuts to the found in the attack – spike jump and spike reach. The middle blockers of the systematic review had a block jump (53 cm) worse than the others volleyball players (60 cm of the outside hitters/receivers, 58 cm of the setters and 57,2 cm of the opposite hitters). However, middle blockers had the best block reach (341 cm) than the others athletes (340 cm of the opposite hitters – this athlete usuaally is the second tallest player, 338 cm of the outside hitters/receivers and 330 cm of the setters).

The result of the middle blockers (341 cm) of this systematic review was the same value of the Argentine player (It was middle blocker) with the highest block reach of the World Championship of 2002[63]. In Marques Junior[64], the block reach of the volleyball player was of 302 to 345 cm, similar value of the systematic review. The Japan World Cup of 2007 was detected that the block reach of the elite male volleyball player was of 308 to 346 cm[65], then, the result was similar of the systematic review.

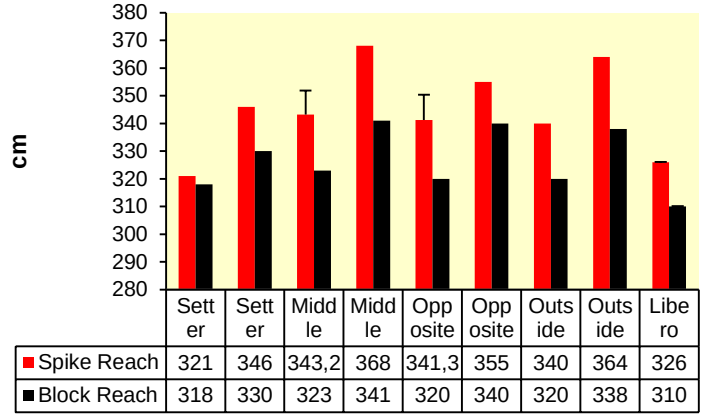
The studies of the volleyball literature about spike jump, spike reach, block jump and block reach that were used to compare with the data of this systematic review were not by game position, requiring more research on this topic.

The graph 3 illustrates these results of the elite male volleyball players in relation the game position. The graph 3 shows the worst and the best of each type of jump.

[59] J. Puhl; S. Case; S. Fleck y P. Handel, Physical and physiological characteristics of elite volleyball players. Res Q Exerc Sport 53:3 (1982) 257-262.
[60] D. Smith; D. Roberts y B. Watson, Physical, physiological and performance differences between Canadian national team and universiade volleyball players. J. Sports Sci. 10:2 (1992) 131-138.
[61] J. Quadra; C. Pinto; A. Andrade; A. Carvalho y T. Ottoni, O voleibol no Brasil. Rev. Educ. Fís-:111(1981) 43-46 and N. Marques Junior, Testes para o jogador de voleibol…
[62] M. Arruda y J. Hespanhol, Fisiologia do voleibol. (São Paulo: Phorte, 2008) 57-60.
[63] J. Bellendier, Una visión analítico-descriptiva del Mundial de Voleibol…
[64] N. Marques Junior, Seleção de testes para o jogador de voleibol…
[65] M. Arruda y J. Hespanhol, Fisiologia do voleibol…



	Setter	Setter	Middle	Middle	Opposite	Opposite	Outside	Outside	Libero
Spike Jump	61,16	78	61,84	75,1	64,25	79,1	66,06	80	60,81
Block Jump	46,47	58	47,42	53	48,19	57,2	49,87	60	50,9



	Setter	Setter	Middle	Middle	Opposite	Opposite	Outside	Outside	Libero
Spike Reach	321	346	343,2	368	341,3	355	340	364	326
Block Reach	318	330	323	341	320	340	320	338	310

Graph 3
Results used to evaluate the sport technique

The systematic review had limitations, were found few studies about the vertical jump of the elite male volleyball player in relation the game position (n = 8).

Conclusions

The systematic review presented the vertical jump in relation the game position. The volleyball players of the systematic review with the best vertical jump (SJ, CMJ, CMJ with arm swing, spike jump and block jump) were the opposite hitters and the outside hitters/receivers. However, the volleyball game requires a excellent vertical jump added a good height, the spike reach and the block reach are related with the player height – the best reach of the study was of the middle blockers. Therefore, vertical jump and height are importants for the high performance of the elite male volleyball player.

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