ijlpr 2022; doi 10.22376/ijpbs/lpr.2022.12.6.L132-139

International Journal of Life science and Pharma Research

ISSN 2250-0480

Research Article

Correlation Between Neck Strength and Heading Performance in Male Football Players

Benji Kakkudiyil Abraham[1], P. Sathya[2], Jibi Paul[3*] and M. Vijaya Kumar[4]

[1]*MPT Student, School of Physiotherapy, D, Y, Patil Deemed to Be University, NerulNavi Mumbai, India*

[2]*Professor, College of Physiotherapy, Dayananda Sagar University, Bangalore, Karnataka, India*

[3]*Professor and PhD Program Convener, Faculty of Physiotherapy, ACS Medical College and Hospital Campus,Dr. MGR Educational and Research Institute,Deemed to be University, Velappanchavadi, Chennai, TN, India*

[4]*Professor and Principal, College of Physiotherapy, Dayananda Sagar University, Bangalore, Karnataka, India*

Abstract: Football, also known as soccer, is the world's most popular sport, which involves multiple factors that consist of physiological, technical, tactical, mental and physical components. The technical skills involved in the game are juggling, speed dribbling, passing, shooting and heading. Repetitive impacts of the head to the ball have been shown to result in potential overload mechanism during the game. The injuries during heading are high when the head comes in contact with the elbow (41%) and head-to-head impact (32%). The need and purpose of this study is to understand the correlation between neck muscle strength and heading performance in football players. The neck strength of the flexors and the extensors was assessed by the Baseline push-pull dynamometer and to test the heading precision, The Federation Internationale de Football Association Medical Assessment and Research Centre (F-MARC) test battery which is designed by The Federation Internationale de Football Association (FIFA) was selected. A total of 63 players were assessed and the results showed that a positive relationship is seen in the mean strength difference and the forward heading, and a positive relationship is seen in the mean strength difference and the right side heading. This study concludes that the neck extensors muscle strength and the neck flexors muscle strength are important for the heading performance in football players. Also, if the neck extensors strength is more than the neck flexors muscle strength, the heading performance was better.

Keywords: Football, neck strength, Baseline push-pull dynamometer, F-MARC battery test

***Corresponding Author**

Jibi Paul , Professor and PhD Program Convener, Faculty of Physiotherapy, ACS Medical College and Hospital Campus,Dr. MGR Educational and Research Institute,Deemed to be University, Velappanchavadi, Chennai, TN, India

Received On 16 May, 2022

Revised On 12 September, 2022

Accepted On 23 September, 2022

Published On 1 November, 2022

Funding This research did not receive any specific grant from any funding agencies in the public, commercial or not for profit sectors.

Citation Benji Kakkudiyil Abraham, P. Sathya, Jibi Paul and M. Vijaya Kumar , Correlation Between Neck Strength and Heading Performance in Male Football Players.(2022).Int. J. Life Sci. Pharma Res.12(6), L132-139 http://dx.doi.org/10.22376/ijpbs/lpr.2022.12.6.L132-139

1. INTRODUCTION

Football, also known as soccer, is the world's most popular sport, and participation varies from a recreational activity to elite, professional play throughout the entire spectrum of the human life span[1]. This sport involves multiple factors, which consist of physiological, technical, tactical, mental, and physical components. The game consists of a 90-minute duration wherein the player performs dynamic movements to change the course of the ball influenced by teammates and opponents. The technical skills involved in the game are juggling, speed dribbling, passing, shooting and heading[2]. One of the game's key components is heading the ball, which has come under close observation in recent years[1]. The precision of timing is very important for successful heading. Here the head is used intentionally to contact and guide the ball to either press into offense or use as a defensive game play[3]. The skill in heading is approached in two ways, standing and jumping. When the players anticipate heading the ball, there is a stiffening effect identified by the neck muscles[1]. The stiffening is seen to be achieved by the eccentric contraction in the anterior cervical region by the sternocleidomastoid muscles as the ball makes contact with the head, which causes the head to move backward[1]. The other muscles which help in heading technique in the upper back are the levator scapulae, rhomboid major and minor, splenius capitis and splenius cervicus.The upper trapezius muscle also plays a role in the heading technique. Once the ball is bounced off the head, concentric sternocleidomastoid activity follows while the head moves forward[1]. The head and trunk are brought towards the ball by the flexion at the hip, while the arms are pulled back[3]. While jumping, the trunk must be flexed in order to transfer the force onto the ball[3]. When the players anticipate heading the ball, there is a stiffening effect identified by the neck muscles[1]. The stiffening is seen to be achieved by the eccentric contraction in the anterior cervical region by the sternocleidomastoid muscles as the ball makes contact with the head, which causes the head to move backward[1]. The other muscles which help in heading technique in the upper back are the levator scapulae, rhomboid major and minor, splenius capitis and splenius cervicus. The upper trapezius muscle also plays a role in the heading technique. Once the ball is bounced off the head, concentric sternocleidomastoid activity follows while the head moves forward[1]. The head and trunk are brought towards the ball by the flexion at the hip, while the arms are pulled back[3]. While jumping, the trunk must be flexed to transfer the force onto the ball[3]. The technique of heading has been increased and has been in notice of media and science[4]. Greater neck strength is related with lower heading accelerations in players [11]. The game of soccer is unique among other sports because of the purposeful and creative use of the unprotected head to control and lead the ball[3]. However, this skill places the head in a vulnerable position for injury[5]. This study aims to understand the correlation between the neck muscle strength and the heading performance in the male football players. To not have any difference in the mean neck strength and heading performance between sexes, female footballers were not included in this study. The need of the study is to identify the muscle group involved in accurate heading and training them to improve performance.

1.1 Research Design

A cross-sectional approach was used to find the correlation between neck strength and heading performance.

2. MATERIALS AND METHODS

2.1 Participants

The participants were included in this study based on the following criteria.

2.2 Inclusion criteria

- 18-25 years of age
- Male football players
- Train at least thrice a week
- 2 years of minimum play.

2.3 Exclusion criteria

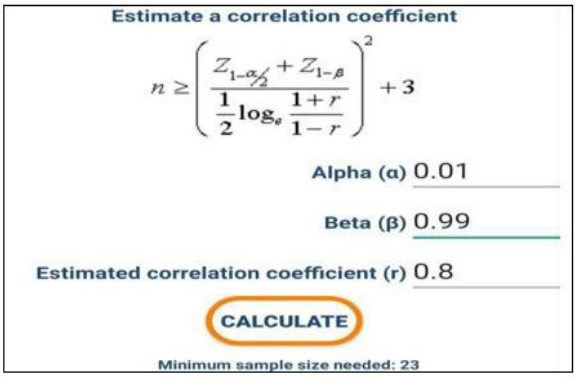
- Neck pain or cervical injuries
- Any Musculoskeletal conditions
- Any cardiovascular conditions
- Any neurological condition
- Players playing any other sport other than football were excluded from the study.

2.4 Ethical Clearance

The study was reviewed and approved by the Institutional Ethics and Research committee of D.Y. Patil University School of physiotherapy, Navi Mumbai, Maharashtra, India in the year 2019 with the ethical committee approval reference number DYPUSOP/317(a)/2019.

2.5 Sample size calculation

Study was conducted on 10 subjects. The sample size was statistically calculated using the formula below.



Since the heading component was parametric, the neck flexion and extension component was taken for analyzing the sample size. The above values for flexion and extension was used for correlation using the Pearson test on the SPSS software.

Descriptive Statistics			
	Mean	**Std. Deviation**	**N**
flexion	8.8100	2.58347	10
extension	16.2000	2.89866	10

Correlations			
		flexion	**extension**
flexion	Pearson Correlation	1	.852**
	Sig. (2-tailed)		.002
	N	10	10
extension	Pearson Correlation	.852**	1
	Sig. (2-tailed)	.002	
	N	10	10

***** correlation is significant at the 0.01 level (2-tailed).***

The sample size was calculated with a 99% confidence interval and 90% power. The value for α was 2.58, and the value for β was 1.28. Post calculation, the sample size resulted in 52.56. A 20% increase in the sample size was added, which resulted in 63.The r value was found to be 0.852, which was then substituted in the formula below.

2.6 Anthropometric assessment

A total of 63 football players participated in the study having a convenient sampling method. Proforma for assessment was filled by interviewing the players for information about their age, gender, height, weight and BMI. The BMI was calculated by dividing the weight (kg) of the football players by the square of their height (m). The BMI-matching individuals were included in this study. A baseline dynamometer was used based on the procedure according to the article by Dezman [1] Neck Strength assessment: The strength of the neck flexors and the neck extensors in football players was assessed using the Baseline pull-push Dynamometer. For the neck flexion assessment, the player was on the ground in supine position. The baseline pull push dynamometer was placed horizontal and ahead of the forehead of the player. The player was then asked to put pressure on the sensor, and the reading was noted. A total of 5 tries was given to each player of which the highest reading was recorded. The strength was measured in kilograms (kg). The player was on the ground in a prone position for the neck extension assessment. The baseline pull push dynamometer was placed on the base of the skull (occiput) of the player. The player was then asked to put pressure on the sensor, and the reading was noted. A total of 5 tries was given to each player, of which the highest reading was recorded. The strength was measured in kilograms (kg).

Fig 1: Recording neck flexion strength

Fig 2: Recording neck Extension Strength

Heading performance assessment: The heading performance was assessed using the heading component of the F- Marc test, which included the forward heading and the right side heading. In the first part of the test, the researcher stood in front of the middle of the football goal and passed the ball to the player's head. From the penalty spot, the player had to run three meters before heading the ball into the goal divided into six equal segments. Each player had three attempts following an initial trial attempt. Six points were assigned if the ball went into the top right or top left segment, one point if the ball hit the crossbar or goalpost of this segment, and three points if the ball went in the lower left or right segments. No point was assigned if the ball went in the lower middle segment.[2]

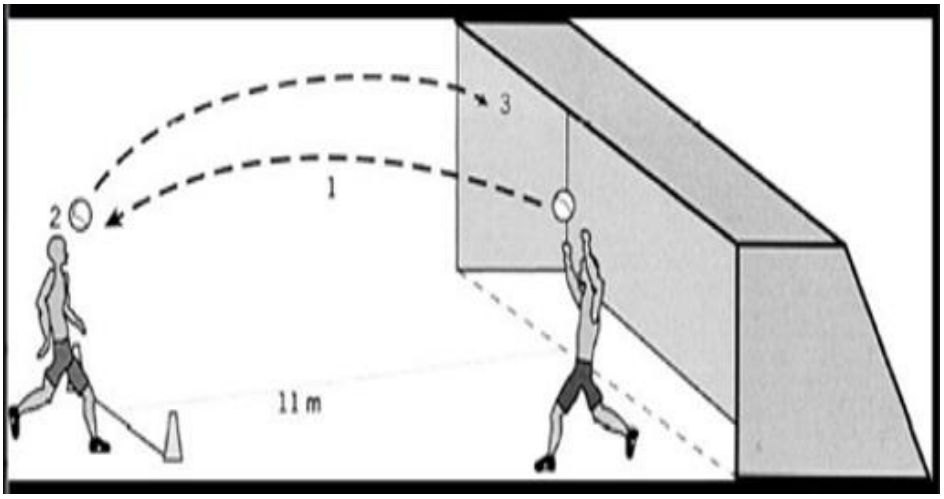


Fig 3: Front-sided heading

For the second part of the heading test, the researcher was located three meters from the goalpost (right) and threw the ball to the player's head. The player would stand three meters behind the penalty spot, where they head the ball into the goal. The researcher gave a total of three attempts and, on each shot, assigned six points if the ball went into the top left segment, one point if the ball hit the crossbar or goalpost of this segment, three points if the ball went in the lower segment, two points if the ball went in the top middle segment, and one point if the ball went in the lower middle segment. No point was assigned if the ball went in the right segment.[2]

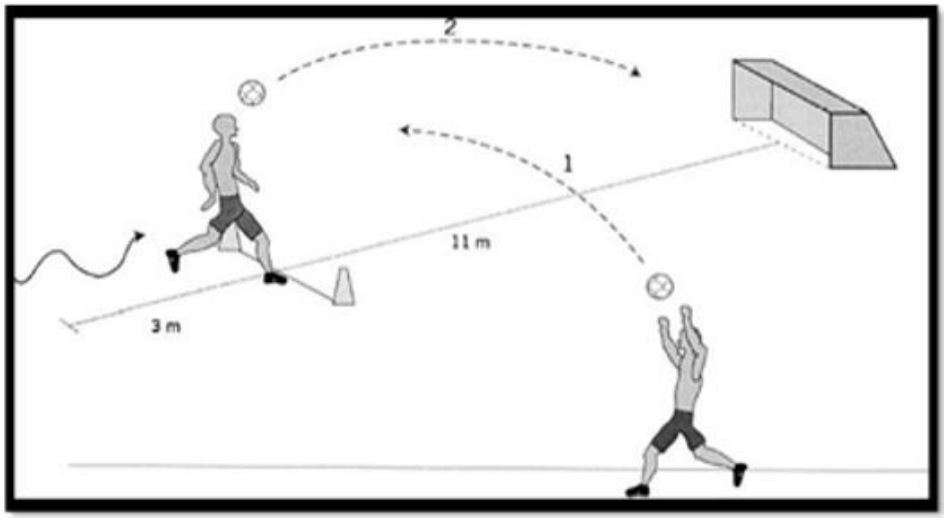


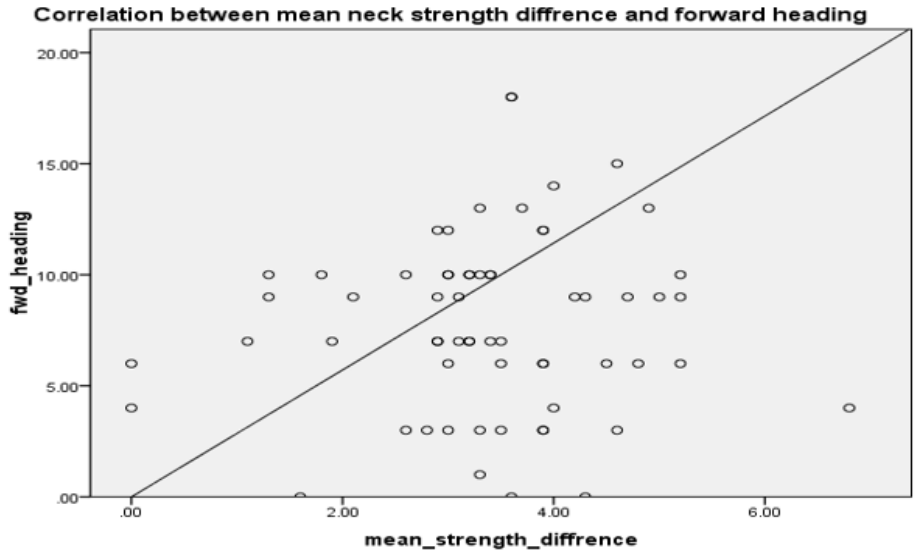
Fig 4: Right side heading

3. RESULTS

The data on the neck strength and the heading performance was collected. The collected data was analyzed using SPSS software version 16.

Table 1: Correlation between Mean of Neck Strength Difference with Forward Heading

		Difference	Fwd_heading
Difference	Pearson Correlation	1	.077
	Sig. (2-tailed)		.551
	N	63	63
Fwd_heading	Pearson Correlation	.077	1
	Sig. (2-tailed)	.551	
	N	63	63

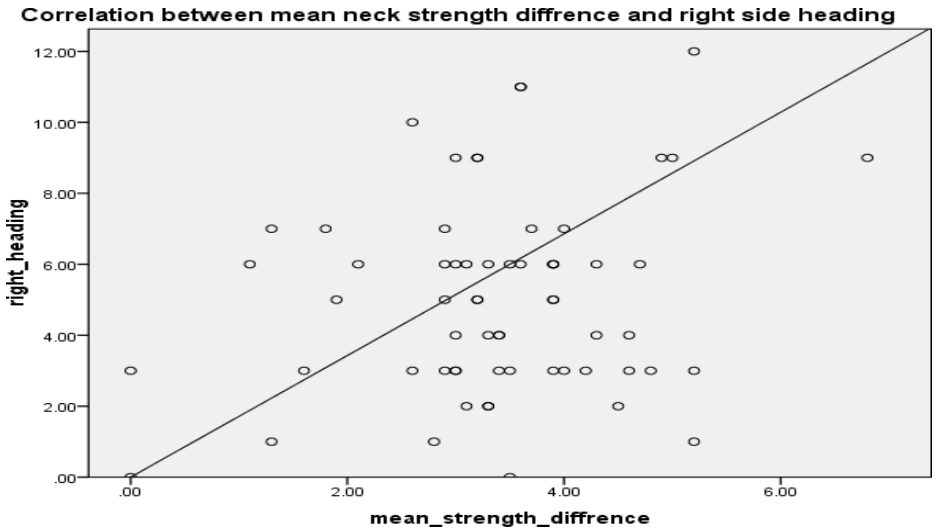


Graph 1: Correlation between Mean of Neck Strength Difference with Forward Heading

3.1 Graph 1 Inference

Table 1 and graph 1: The mean difference in the neck extension and flexion strength was correlated with the forward heading using the Pearson correlation test. The P value was found to be not significant, with the value resulting at 0.551 ($p<0.05$). A positive relationship is seen in the mean strength difference and the forward heading. The positive correlation value was seen to be at 0.077. This shows that the difference in the strengths of neck flexion and extension would lead to better forward heading performance in football players.

Table 2: Correlation between Mean Strength Differences with Right Side Heading			
		Difference	Right_heading
Difference	Pearson Correlation Sig. (2-tailed)	1	.219
	N		.085
		63	63
Right_heading	Pearson Correlation Sig. (2-tailed)	.219	1
	N	.085	
		63	63



Graph 2: Correlation Between Mean Strength Difference and Right Side Heading

3.2 Graph 2 Inference

The mean difference in the neck extension and flexion strength was correlated with the forward heading using the Pearson correlation test. The P value was found to be not significant, with the value resulting at 0.085 ($p<0.05$). A positive relationship is seen in the mean strength difference and the forward heading. The positive correlation value was seen to be at 0.219. This shows that the difference in neck flexion and extension strength would lead to better forward-heading performance in football players.

4. DISCUSSION

In this study, the mean strength difference between the neck extensors strength and the neck flexors strength was taken. This mean difference was then correlated with the right side heading score of the football players. As seen in Table – 2 and Graph – 2, the correlation test between the mean difference strength and right side heading showed a positive relationship with a correlation value at 0.219. Still, the P value was insignificant, with the P value being more than 0.05. This finding shows that there is asymmetry in the neck extension strength and the neck flexion strength. The increase in the neck extensors muscle strength than the neck flexors muscle strength results in better right side heading performance in the football players. Research by Abigail and Bretzin had shown that injury prediction was seen in linear (forward) and angular (right side) velocity during heading [13]. According to a study by Gregory. M, their hypothesis that neck strength would be related to header impact had been confirmed[10]. The findings observed in this study were similar to the study conducted by Zachary et al (2013) where the mean strength difference was in positive correlation with the angular acceleration[1]. The data above were supported according to N Shewchenko et al (2005), who conducted their study to find the head responses in the development of the biomechanical methods for heading in football. They found that the alignment of the torso was one reason to have reduction in heading response as it provides a stiff supporting structure for the head and the increased effect mass[5].Also keeping in mind the follow-through after the activation of the muscle there was found to be a reduction in angular acceleration (-13%)[5]. There were benefits with regard to the muscle pre-tensing and head-torso alignment. Head linear acceleration response was seen to be reduced, but this was not consistent with the angular acceleration or the response for the head impact power[3]. This could state that the right side heading was low due to the reduced muscular coupling and also for the low muscle pre-tensing prior to the heading. In the study by Caccese in 2017, the sternocleidomastoid and the upper trapezius muscle activity does not lead to head acceleration. This confirms that proper technique for heading will reduce and prevent acute head and neck injuries during heading and also improve the heading performance[11]. A systematic review by Peek in the year 2019 has stated that higher neck flexion strength was associated with lower heading acceleration[12]. This study shows that the asymmetry in the neck strength, with the neck extensors strength being more than the neck flexors strength, leads to better-controlled heading performance in the football players. Also the F-Marc test can be used to evaluate the intensity of the exercises to see the impact on the skill performance in football as seen by Draganidis et al in the year 2013 [2,15]. A review also states that the high neck strength may lower the head acceleration during calculated heading in Football[12]. As mentioned by Denzman [1], the differences in neck strength resulted in better head accelerations, a resistance training protocol was used to strengthen the neck muscles. But there was no effect in the kinematics of the head impact after the training program [17,18]. Strength and endurance of the neck

flexors and extensors can be trained and modified to address the differences in individuals as identified in the study by Barrett et al[19].A study by Michael Streifer has stated that increased neck strength and reduced imbalance may reduce the incidence of sport-related concussion[14]. Hypothetically, strength and endurance of the neck muscles can be necessary for protection against concussion[6]. Clinical Implication can be used to train and increase the accuracy and performance of heading

4.1 Limitation of the Study

1) Can be used to train and increase the accuracy and performance of heading
2) Males were only included in the study,
3) Females can be included to check the difference between sexes, head circumference and ball dimensions can be correlated, and emg can be used to check specific muscle activation.

Future recommendation: Females can be included to check the difference between sexes, head circumference and ball dimensions can be correlated, and emg can be used to study specific muscle activation.

5. CONCLUSION

This study concludes that the neck extensors muscle strength and the neck flexors muscle strength are essential for the heading performance of football players. This study also concludes that the neck extensors strength should be more than the neck flexors muscle strength to yield a better heading performance.

6. ACKNOWLEDGEMENT

Mr. Benji K Abraham was involved in the conceptualization of the study & data collection. Dr. P. Sathya contributed to the analysis and writing of the manuscript. All authors collectively discussed the methodology & results and contributed their valuable work.

7. AUTHORS CONTRIBUTION STATEMENT

Mr. Benji K. Abraham and Dr. Sathya P. conceived of the presented idea. Mr.Benji Abraham developed the theory and performed the computations and literature to back the study. Dr. Sathya P. verified the analytical methods and supervised the study. Dr. Jibi Paul and Dr. M. Vijaya Kumar contributed to the discussion part related to the results of the study. They have fine-tuned the final manuscript.

8. CONFLICT OF INTEREST

Conflict of interest declared none.

9. REFERENCES

1. Dezman ZD, Ledet EH, Kerr HA. Neck strength imbalance correlates with increased head acceleration in soccer heading. Sports Health. 2013 Jul;5(4):320-6. doi: 10.1177/1941738113480935, PMID 24459547.
2. Padrón-Cabo A, Rey E, Pérez-Ferreirós A, Kalén A. Test–retest reliability of skill tests in the F-MARC battery for youth soccer players. Percept Mot Skills. 2019 Oct;126(5):1006-23. doi: 10.1177/0031512519866038, PMID 31362581.
3. Erkmen N. Evaluating the heading in professional soccer players by playing positions. J Strength Cond Res. 2009 Sep 1;23(6):1723-8. doi: 10.1519/JSC.0b013e3181b42633, PMID 19675491.
4. Becker S, Berger J, Backfisch M, Ludwig O, Kelm J, Fröhlich M. Effects of a 6-week strength training of the neck flexors and extensors on the head acceleration during headers in soccer. J Sports Sci Med. 2019 Dec;18(4):729-37. PMID 31827358.
5. Shewchenko N, Withnall C, Keown M, Gittens R, Dvorak J. Heading in football. Part 1: Development of biomechanical methods to investigate head response. Br J Sports Med. 2005 Aug 1;39;Suppl 1:i10-25. doi: 10.1136/bjsm.2005.019034, PMID 16046351.
6. Geary K, Green BS, Delahunt E. Intrarater reliability of neck strength measurement of rugby union players using a handheld dynamometer. J Manipulative Physiol Ther. 2013 Sep 1;36(7):444-9. doi: 10.1016/j.jmpt.2013.05.026, PMID 23845197.Caccese JB. Kaminski TW. Minimizing head acceleration in soccer: a review of the literature. Sports Medicine. 2016 Nov;46(11):1591-604.
7. Caccese JB, Kaminski TW. Minimizing head acceleration in soccer: a review of the literature. Sports Med. 2016 Nov;46(11):1591-604. doi: 10.1007/s40279-016-0544-7, PMID 27142534.
8. Bauer JA, Thomas TS, Cauraugh JH, Kaminski TW, Hass CJ. Impact forces and neck muscle activity in heading by collegiate female soccer players. J Sports Sci. 2001 Jan 1;19(3):171-9. doi: 10.1080/026404101750095312, PMID 11256822.
9. Vannebo KT, Iversen VM, Fimland MS, Mork PJ. Test–retest reliability of a handheld dynamometer for measurement of isometric cervical muscle strength. J Back Musculoskelet Rehabil. 2018 Jan 1;31(3):557-65. doi: 10.3233/BMR-170829, PMID 29526841.
10. Gutierrez GM, Conte C, Lightbourne K. The relationship between impact force, neck strength, and neurocognitive performance in soccer heading in adolescent females. Pediatr Exerc Sci. 2014 Feb 1;26(1):33-40. doi: 10.1123/pes.2013-0102, PMID 24091298.
11. Caccese JB, Buckley TA, Tierney RT, Arbogast KB, Rose WC, Glutting JJ et al. Head and neck size and neck strength predict linear and rotational acceleration during purposeful soccer heading. Sports Biomech. 2018 Oct 2;17(4):462-76. doi: 10.1080/14763141.2017.1360385, PMID 29037111.
12. Peek K, Elliott JM, Orr R. Higher neck strength is associated with lower head acceleration during purposeful heading in soccer: a systematic review. J Sci Med Sport. 2020 May 1;23(5):453-62. doi: 10.1016/j.jsams.2019.11.004, PMID 31780360.
13. Bretzin AC, Mansell JL, Tierney RT, McDevitt JK. Sex differences in anthropometrics and heading kinematics among division I soccer athletes. Sports Health. 2017 Mar;9(2):168-73. doi: 10.1177/1941738116678615, PMID 28225689.
14. Streifer M, Brown AM, Porfido T, Anderson EZ, Buckman JF, Esopenko C. The potential role of the cervical spine in sports-related concussion: clinical

perspectives and considerations for risk reduction. J Orthop Sports Phys Ther. 2019 Mar;49(3):202-8. doi: 10.2519/jospt.2019.8582, PMID 30645949.
15. Draganidis D, Chatzinikolaou A, Jamurtas AZ, Carlos Barbero J, Tsoukas D, Theodorou AS et al. The time-frame of acute resistance exercise effects on football skill performance: the impact of exercise intensity. J Sports Sci. 2013 Apr 1;31(7):714-22. doi: 10.1080/02640414.2012.746725, PMID 23301779.
16. Mansell J, Tierney RT, Sitler MR, Swanik KA, Stearne D. Resistance training and head-neck segment dynamic stabilization in male and female collegiate soccer players. J Athl Train. 2005 Oct;40(4):310-9. PMID 16404453.
17. Lisman P, Signorile JF, Del Rossi G, Asfour S, Eltoukhy M, Stambolian D et al. Investigation of the effects of cervical strength training on neck strength, EMG, and head kinematics during a football tackle. Int J Sports Sci Eng. 2012;6(3):131-40.
18. Barrett MD, Mcloughlin TF, Gallagher KR, Gatherer D, Parratt MT, Perera JR et al. Effectiveness of a tailored neck training program on neck strength, movement, and fatigue in under-19 male rugby players: a randomized controlled pilot study. Open Access J Sports Med. 2015;6:137-47. doi: 10.2147/OAJSM.S74622, PMID 25999771.