Research Article

Correlation of Flexibility and Strength in Amateur Bodybuilders

Pranav Shankar Takale[1], Dr. Mandar Malwade[2]

[1].(Internship) Krishna College of Physiotherapy, Krishna Vishwa Vidyapeeth, Karad, Maharashtra, India.
[2]. HOD Department of Pediatric Neurosciences, Faculty of physiotherapy, Krishna Vishwa Vidyapeeth, Karad, Maharashtra, India.

Abstract

Background: Regular resistance training meant to enhance muscular strength, muscular hypertrophy, physical condition, and body composition is part of amateur bodybuilding. Even though strength development is a primary focus, flexibility is also a crucial aspect of physical fitness since sufficient muscle extensibility and joint range of motion enhance movement effectiveness and exercise performance. Decreased flexibility can impact movement throughout the range and may lead to muscular or movement imbalances.

Muscular strength is the capacity of a muscle or muscle group to produce force against resistance, and it is a crucial factor in bodybuilding performance. Among amateur bodybuilders, nevertheless, the link between muscular strength and flexibility continues to be a crucial topic of study. Evaluating both criteria might enable one to spot possible discrepancies and provide helpful guidance for creating balanced training regimens.

The current study hopes to ascertain the relationship between flexibility and muscular strength in amateur bodybuilders. The Bench Press and Leg Press will be used to evaluate muscular strength; the Sit-and-Reach Test and Static Stork Test will be utilized to assess flexibility. The results could be helpful to physical therapists, trainers, and coaches as they create suitable strength and flexibility training regimens.

Methods: In Karad, a comparative study was carried out on forty amateur bodybuilders. Participants were male and female bodybuilders aged 16–30 years who had at least 1 year of bodybuilding experience and trained at least 3 times per week. Simple random sampling was used to choose the participants. Excluded were those with recent injuries within 6 months, neurological diseases, orthopedic surgery, acute pain impacting performance, or those engaged as professional bodybuilders. Once ethical clearance and written informed consent were gotten, participants were evaluated for flexibility and muscular strength. The Sit-and-Reach Test and Static Stork Test were used to evaluate flexibility; the Bench Press and Leg Press were utilized to evaluate muscular strength. Demographic and evaluation information were regularly entered.

Data Will be entered into Microsoft Excel and analysed using suitable statistical programme. To catalog participant attributes and outcome indicators, descriptive statistics were employed. With statistical significance fixed at $p < 0.05$, Pearson's or Spearman's correlation depending on data distribution was intended to be used to examine the relationship between flexibility and muscular strength.

Result- Among the 40 amateur bodybuilders evaluated, 77.5% exhibited good or normal flexibility, whereas 22.5% displayed lowered or average flexibility. 70% of participants on the muscular strength test showed good/normal strength, while 30% showed diminished/average strength. The Static Stork Test and Sit-and-Reach Test showed that the subjects generally had adequate flexibility and balance performance. Results from Bench Press and Leg Press also indicated mostly excellent muscular strength. The results showed that, in general, there was a positive link between flexibility and muscle strength. Most of the people who had good flexibility also showed good strength performance.

These results imply that keeping enough flexibility could be related to higher muscular strength in amateur bodybuilders.

Conclusion: The study found that amateur bodybuilders who had more flexibility usually showed greater levels of muscular strength. The results showed a medium positive correlation between flexibility and muscular strength, stressing the need of including both flexibility and strength exercises into bodybuilding regimens.

Keywords: Flexibility, Amateur Bodybuilders, Bench Press, Leg Press, Physiotherapy, Correlation.

Introduction

Amateur bodybuilding is a form of resistance exercise including organized exercise programs used for improvement of strength, hypertrophy, general physical fitness, and body composition. Amateur bodybuilding is generally undertaken for the purposes of recreation, health and personal physical improvement as opposed to professional bodybuilding. Resistance training results in physiological adaptations in skeletal muscles that make them able to increase their strength [1,3]. However, the influence of resistance training on flexibility and mobility still requires further research [6–8]. Knowledge of these impacts will make it possible to create training programs promoting overall physical condition.

Flexibility is another significant aspect of the fitness of an athlete. Flexibility is defined as the ability of a joint or

group of joints to perform movements within its available range of motion. Appropriate flexibility increases efficiency of movement and enables functional mobility of an athlete [6–8]. In the case of resistance-trained individuals, the flexibility is conditioned by such factors as training volume, the choice of exercises, muscular hypertrophy, the applied methods of stretching and extensibility of muscles and surrounding tissues [2,4,5]. Various approaches to assessing flexibility include different methods such as flexibility assessment in order to evaluate flexibility level in athletes or the use of the Sit-and-Reach Test which is popular for assessing hamstrings and lower-back flexibility [13–19]. Since the goal of people engaged in strength training is primarily the hypertrophy of muscles, they may ignore the training of flexibility resulting in some differences in their flexibility level [1,3,5].

Muscular strength is described as a capability of a certain muscle group or muscle to develop force against external resistance. Progressive resistance training is essential for bodybuilders as it contributes to the improvement of muscular strength and muscle size. In addition, strength adaptations may depend on the training intensity, frequency, volume, exercises selection, and individual characteristics [30–39]. For the purpose of evaluating the pressing strength of the upper and lower body, researchers usually use The Bench Press and The Leg Press tests correspondingly. One-repetition maximum (1RM) tests is considered the commonly used tool for evaluating the muscular strength since there are many studies assessing the reliability and accuracy of the test for various groups of people [40–44].

Flexibility is a complex trait that is not directly related to muscular strength. Thus, the relationship between strength and flexibility is complicated, and depends on several factors, such as muscle group, training level, and the used protocol of training [2, 3]. Previous studies explored the relationship between flexibility of hamstrings, muscle optimal length, and strength, as well as the combined effects of training of both parameters [1–5]. It has been also suggested that resistance training can increase range of motion of a joint, contradicting the assumption that it reduces flexibility [6–8]. Therefore, studying of both parameters of fitness is of high importance to get the complete picture of the fitness of resistance-trained athletes.

Together, flexibility and muscular strength assessment would help us know the physical condition of amateurs in bodybuilding. We used the Sit-and-Reach Test to assess flexibility, and Static Stork Test to check single-leg stance performance. Both tests are already investigated in the previous studies [13–19,23–25]. To assess muscular strength, we used the Bench Press and Leg Press tests, using 1RM as practical measures [40–44].

Even though there are such fitness parameters as flexibility and muscular strength and they both play a role in bodybuilders' fitness level, the connection between them among amateur bodybuilders still needs to be analyzed thoroughly. It could help physiotherapists, coaches, and instructors to prepare the exercises program and plan training sessions. So, this study attempts to study the relation between flexibility and muscular strength among amateur bodybuilders.

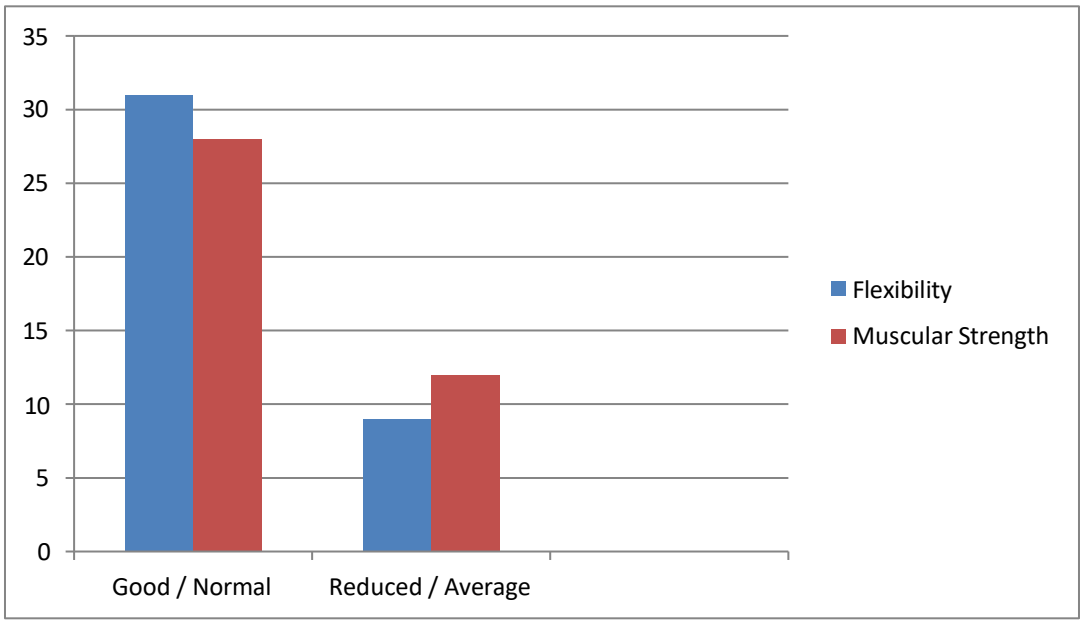
Methods: Forty amateur bodybuilders in Karad underwent a comparison investigation. Participants included men and women 16 to 30 years old. Participants who qualified had at least one year of bodybuilding expertise and worked out at least three times every week. Simple random sampling was used to choose the participants. Excluded were those who had recently injured themselves within six months, had neurological problems, had undergone prior orthopedic surgery, had acute pain impacting performance, or were involved as professional bodybuilders. Ethical permission was sought, and before evaluation written informed consent was collected from all participants.

The Sit-and-Reach Test and Static Stork Test were used to evaluate flexibility; the Bench Press and Leg Press were used to evaluate muscular strength. For study, demographic and evaluation data were methodically collected and imported into Microsoft Excel. To sum up the data, descriptive statistics were applied, including the mean, standard deviation, frequency, and percentage. The Shapiro–Wilk test was used to gauge normality. For normally distributed data, Pearson's correlation was utilized; for non-parametric data, Spearman's correlation was used to investigate the link between flexibility and muscular strength. With a 95% confidence interval, statistical significance was evaluated at $p < 0.05$.

Result:

Table : 1 . Flexibility assessment among amateur bodybuilders

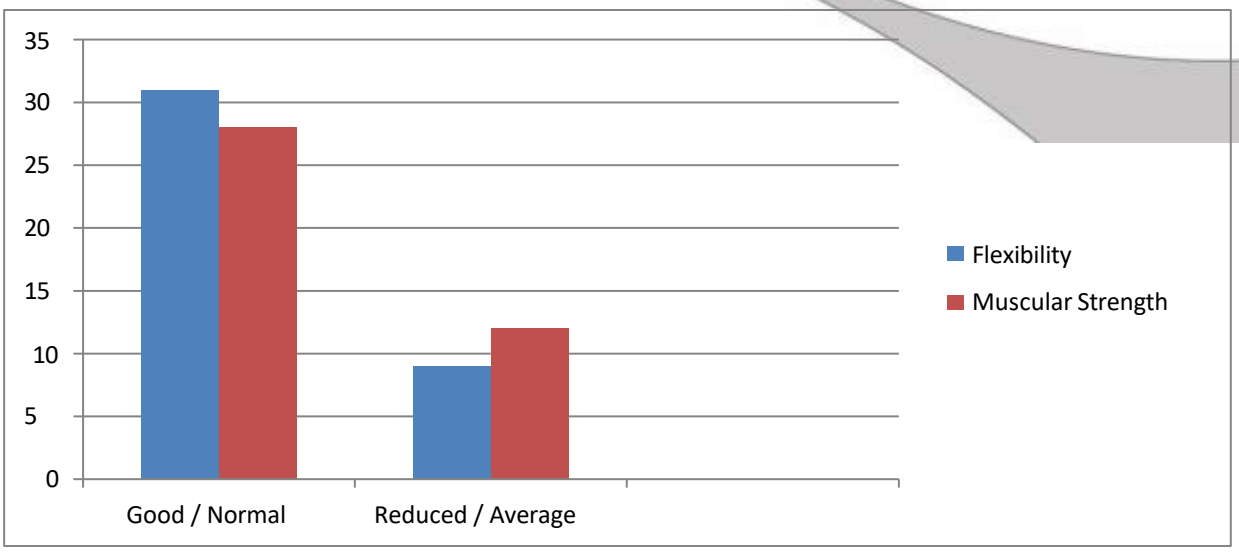
Flexibility	Good/Normal n (%)	Average/Reduced n (%)	Total
Sit-and-Reach Test	34 (85%)	6 (15%)	40 (100%)
Static Stork Test (Right)	28 (70%)	12 (30%)	40 (100%)
Static Stork Test (Left)	28 (70%)	12 (30%)	40 (100%)



Interpretation- Most of the respondents (85%) showed good/normal results on the Sit-and-Reach Test, while 15% exhibited reduced/average performance.On the right and left sides, 70% of Static Stork Test participants showed satisfactory/normal performance.The other 30% exhibited mediocre or poor performance on both sides.The results imply that most participants possessed decent static balance and flexibility performance.But a lesser percentage showed poorer performance, therefore suggesting room for development by means of suitable flexibility and balance training.

Table : 2 Musular strength among Amateur Bodybuilders

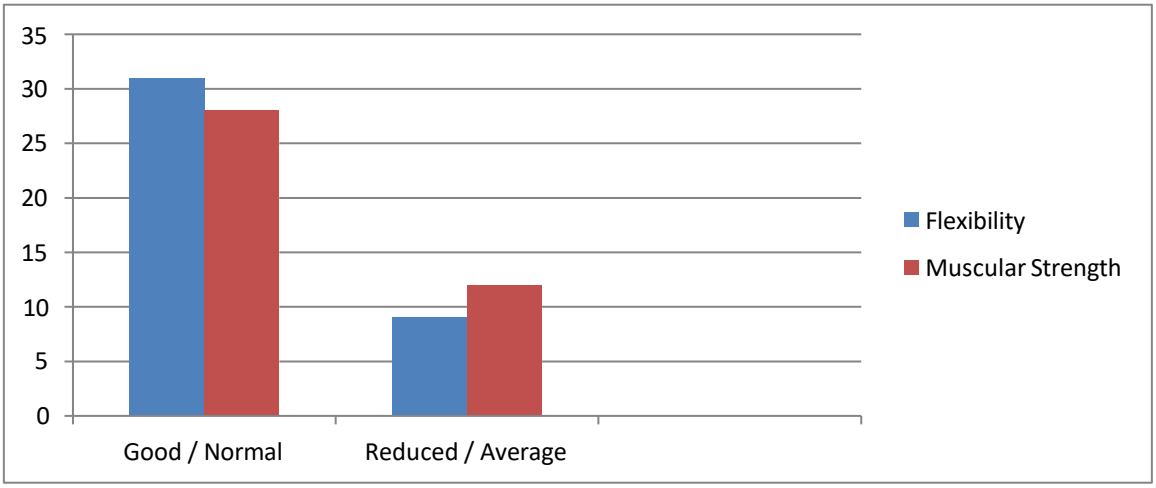
Strength Assessment	Higher Performance n (%)	Lower Performance n (%)	Total
Bench Press	23 (57.5%)	17 (42.5%)	40 (100%)
Leg Press	28 (70%)	12 (30%)	40 (100%)



Interpretation-The table shows the classification of the 40 amateur bodybuilders' muscular strength based on their 1RM performance in Bench Press and Leg Press.57.5% of Bench Press participants showed excellent/normal strength, while 42.5% showed average/reduced strength.Regarding the Leg Press, 70% of the participants exhibited excellent/normal strength, whereas 30% exhibited average/reduced capability.Thus, the Leg Press had a larger percentage of participants with good performance than the Bench Press.The results generally indicate that in this group, lower-limb strength was somewhat greater than upper-limb pressing strength.

Table : 3 Flexibility and Muscular strength findings

Performance Category	Flexibility	Muscular Strength
Good / Normal	31 (77.5%)	28 (70%)
Reduced / Average	9 (22.5%)	12 (30%)
Total	40 (100%)	40 (100%)



Interpretation- The results show a good link between flexibility and muscular strength among the amateur

bodybuilders.Most of the participants (77.5%) showed good or normal flexibility, and 70% showed good or normal muscle strength.22.5% showed average/reduced flexibility, while 30% showed reduced/average muscular strength.The large percentage of individuals doing well in both criteria implies that enhanced flexibility was often related with increased muscular strength.Those with appropriate flexibility tended to exhibit adequate strength performance.The findings point to a positive link between flexibility and muscular strength in the research sample generally.

Discussion:-

Among forty amateur bodybuilders, the current study evaluated flexibility and muscular strength and investigated the relationship between these two physical fitness parameters. The study found that 77.5 percent of participants had good/normal flexibility, while 22.5 percent showed less/average flexibility. Likewise, while 30% exhibited decreased/average muscular strength, 70% showed good/normal muscular strength. The results taken as a whole show that most amateur bodybuilders in the current study had acceptable levels of muscle strength and flexibility.

The relatively high percentage of subjects with excellent flexibility could be connected to regular physical activity and engagement in sports. Bodybuilding includes several repetitions of various muscle groups and joints, which could help to sustain physical fitness and functional mobility.The Sit-and-Reach Test showed that the participants had a good amount of flexibility overall. The Static Stork Test results also revealed that most participants exhibited acceptable performance on both the left and right sides. Performing resistance-training workouts with proper movement control requires enough flexibility and balance, which may be crucial.

Concerning muscular strength, the current study discovered that 70% of respondents showed appropriate or normal strength. The Leg Press revealed a higher percentage of good/normal performance than the Bench Press. This is perhaps not surprising given that the lower limbs contain significant muscle groups that are routinely developed during bodybuilding routines. Regular resistance exercise helps to enhance muscle strength and functional performance. Still, the fact that 30% of the participants had reduced or average strength shows that strength development could vary depending on their prior training experience, selected exercises, training frequency, and consistency.

The positive association between flexibility and muscular strength was a significant discovery of this investigation. Most participants displayed acceptable/normal performance across both elements. This indicates that participants who maintained adequate flexibility typically also showed adequate muscular strength. While enough muscle strength helps to enable regulated and effective movement, flexibility might enhance the capacity to achieve an acceptable range of motion during resistance-training activities. Therefore, maintaining flexibility as well as strength may be advantageous for novice bodybuilders.

But one ought to approach the results with caution. Rather than a formal statistical correlation coefficient, the relationship shown in this study is based on the descriptive categorization of subjects. The findings point to a general positive link but fail to show that greater flexibility directly leads to higher muscular strength. Other elements that could impact performance are age, training experience, body composition, exercise technique, training intensity, recovery, and individual physical characteristics.

All in all, the current study finds that the majority of amateur bodybuilders possessed adequate flexibility and muscular strength, with 77.5% exhibiting normal/good flexibility and 70% exhibiting normal/good strength. The noted positive relationship emphasizes the need to include both flexibility and strengthening exercises in bodybuilding programs to enhance general physical performance and functional fitness.

Conclusion:-

The present study found that most amateur bodybuilders showed adequate levels of muscular strength and flexibility. Of the 40 people who took part, 77.5% had good or normal flexibility, while 22.5% had less or average flexibility. Comparably, 70% exhibited good/normal muscular strength, whereas 30% exhibited decreased/average strength. The results show a positive correlation between flexibility and muscular strength, with a sizable number of participants showing proficiency in both areas. Maintaining enough flexibility together with regular strength training should improve amateur bodybuilders' physical performance and functional fitness generally. But the observed link is descriptive and does not prove a statistically verified causal link

between flexibility and muscle strength.
Conflict of interest: Nil

Ethical clearance: Ethical clearance by institutional ethical committee of Krishna vishwa vidyapeeth, karad.

REFERENCES

1. Li S, Wang L, Xiong J, Xiao D. Gender-specific effects of 8-week multi-modal strength and flexibility training on hamstring flexibility and strength. Int J Environ Res Public Health. 2022;19(22):15256. doi:10.3390/ijerph192215256.
2. Wan X, Qu F, Garrett WE, Liu H, Yu B. Relationships among hamstring muscle optimal length and hamstring flexibility and strength. J Sport Health Sci. 2017;6(3):275-282. doi:10.1016/j.jshs.2016.04.009.
3. Shariat A, Lam ETC, Shaw BS, Shaw I, Kargarfard M, Tamrin SBM. Impact of back squat training intensity on strength and flexibility of hamstring muscle group. Biomed Mater Eng. 2017;28(6):643-652. doi:10.3233/BME-171651.
4. Li S, Garrett WE, Best TM, Li H, Wan X, Liu H, et al. Effects of flexibility and strength interventions on optimal lengths of hamstring muscle-tendon units. J Sci Med Sport. 2020;23(2):200-205. doi:10.1016/j.jsams.2019.09.017.
5. Widodo AF, Tien CW, Chen CW, Lai SC. Isotonic and isometric exercise interventions improve the hamstring muscles' strength and flexibility: a narrative review. Healthcare (Basel). 2022;10(5):811. doi:10.3390/healthcare10050811.
6. Alizadeh S, Daneshjoo A, Zahiri A, Hadjizadeh Anvar S, Goudini R, Hicks JP, et al. Resistance training induces improvements in range of motion: a systematic review and meta-analysis. Sports Med. 2023;53:707-722. doi:10.1007/s40279-022-01804-x.
7. Favro F, Roma E, Gobbo S, Bullo V, Di Blasio A, Cugusi L, et al. The influence of resistance training on joint flexibility in healthy adults: a systematic review, meta-analysis, and meta-regression. J Strength Cond Res. 2025;39(3):386-397. doi:10.1519/JSC.0000000000005000.
8. Afonso J, Ramirez-Campillo R, Moscão J, Rocha T, Zacca R, Martins A, et al. Strength training versus stretching for improving range of motion: a systematic review and meta-analysis. Healthcare (Basel). 2021;9(4):427. doi:10.3390/healthcare9040427.
9. Vetter S, Schleichardt A, Köhler HP, Witt M. The effects of eccentric strength training on flexibility and strength in healthy samples and laboratory settings: a systematic review. Front Physiol. 2022;13:873370. doi:10.3389/fphys.2022.873370.
10. Wan X, Qu F, Garrett WE, Liu H, Yu B. The effect of hamstring flexibility on peak hamstring muscle strain in sprinting. J Sport Health Sci. 2017;6(3):283-289. doi:10.1016/j.jshs.2017.03.012.
11. Liu H, Wan X, Garrett WE, Yu B. The relationship between hamstring flexibility and maximal strains of hamstring muscle-tendon units in sprinting: indication to hamstring strain injury. ISBS Proc Arch. 2017;35(1):101.
12. Ayala F, Sainz de Baranda P, De Ste Croix M, Santonja F. Reproducibility and criterion-related validity of the sit and reach test and toe touch test for estimating hamstring flexibility in recreationally active young adults. Phys Ther Sport. 2012;13(4):219-226. doi:10.1016/j.ptsp.2011.11.001.
13. Ayala F, Sainz de Baranda P, De Ste Croix M, Santonja F. Absolute reliability of five clinical tests for assessing hamstring flexibility in professional futsal players. J Sci Med Sport. 2012;15(2):142-147. doi:10.1016/j.jsams.2011.10.002.
14. Ayala F, Sainz de Baranda P, De Ste Croix M, Santonja F. Criterion-related validity of four clinical tests used to measure hamstring flexibility in professional futsal players. Phys Ther Sport. 2012;13(2):91-97. doi:10.1016/j.ptsp.2011.02.005.
15. López-Miñarro PA, Rodríguez-García PL. Hamstring muscle extensibility influences the criterion-related validity of sit-and-reach and toe-touch tests. J Strength Cond Res. 2010;24(4):1013-1018. doi:10.1519/JSC.0b013e3181c7c60d.
16. Mayorga-Vega D, Merino-Marban R, Viciana J. Criterion-related validity of sit-and-reach tests for estimating hamstring and lumbar extensibility: a meta-analysis. J Sports Sci Med. 2014;13(1):1-14.
17. Wells KF, Dillon EK. The sit and reach—a test of back and leg flexibility. Res Q. 1952;23(1):115-118.
18. Jackson AS, Baker AA. The relationship of the sit and reach test to criteria measures of hamstring and back

flexibility in young females. Res Q Exerc Sport. 1986;57(3):183-186.
19. Jones CJ, Rikli RE, Max J, Noffal G. The reliability and validity of a chair sit-and-reach test as a measure of hamstring flexibility in older adults. Res Q Exerc Sport. 1998;69(4):338-343.
20. Martin HJ, Syddall HE, Dennison EM, Cooper C, Sayer AA. Estimating muscle size and strength from simple anthropometric and functional measures in older people. BMC Geriatr. 2006;6:2. doi:10.1186/1471-2318-6-2.
21. Bohannon RW. Reference values for the timed up and go test: a descriptive meta-analysis. J Geriatr Phys Ther. 2006;29(2):64-68.
22. Springer BA, Marin R, Cyhan T, Roberts H, Gill NW. Normative values for the unipedal stance test with eyes open and closed. J Geriatr Phys Ther. 2007;30(1):8-15.
23. Martin C, Olivier B, Snyders C. Intra-rater and inter-rater reliability of six musculoskeletal preparticipatory screening tests. S Afr J Physiother. 2019;75(1):590. doi:10.4102/sajp.v75i1.590.
24. Muehlbauer T, Gollhofer A, Granacher U. Associations between measures of balance and lower-extremity muscle strength/power in healthy individuals across the lifespan. Sports Med. 2015;45(2):167-180.
25. Winter DA, Prince F, Frank JS, Powell C, Zabjek KF. Unified theory regarding A/P and M/L balance in quiet stance. J Neurophysiol. 1996;75(6):2334-2343. doi:10.1152/jn.1996.75.6.2334.
26. Gribble PA, Hertel J. Effect of lower-extremity muscle fatigue on postural control. Arch Phys Med Rehabil. 2004;85(4):589-592.
27. Granacher U, Gollhofer A. Is there an association between variables of postural control and strength in the lower extremity of adolescents? J Strength Cond Res. 2007;21(3):726-733.
28. Suchomel TJ, Nimphius S, Stone MH. The importance of muscular strength in athletic performance. Sports Med. 2016;46(10):1419-1449.
29. Suchomel TJ, Nimphius S, Bellon CR, Stone MH. The importance of muscular strength: training considerations. Sports Med. 2018;48(4):765-785.
30. Schoenfeld BJ, Grgic J, Ogborn D, Krieger JW. Strength and hypertrophy adaptations between low- vs. high-load resistance training: a systematic review and meta-analysis. J Strength Cond Res. 2017;31(12):3508-3523.
31. Schoenfeld BJ, Ogborn D, Krieger JW. Dose-response relationship between weekly resistance training volume and increases in muscle mass: a systematic review and meta-analysis. J Sports Sci. 2017;35(11):1073-1082.
32. Grgic J, Schoenfeld BJ, Davies TB, Lazinica B, Krieger JW, Pedisic Z. Effect of resistance training frequency on gains in muscular strength: a systematic review and meta-analysis. Sports Med. 2018;48(5):1207-1220.
33. Ralston GW, Kilgore L, Wyatt FB, Baker JS. The effect of weekly set volume on strength gain: a meta-analysis. Sports Med. 2017;47(12):2585-2601.
34. Morton RW, Oikawa SY, Wavell CG, Mazara N, McGlory C, Quadrilatero J, et al. Neither load nor systemic hormones determine resistance training-mediated hypertrophy or strength gains in resistance-trained young men. J Appl Physiol. 2016;121(1):129-138.
35. Schoenfeld BJ, Grgic J, Krieger J. How many times per week should a muscle be trained to maximize muscle hypertrophy? A systematic review and meta-analysis of studies examining the effects of resistance training frequency. J Sports Sci. 2019;37(11):1286-1295.
36. Grgic J, Schoenfeld BJ, Orazem J, Sabol F. Effects of resistance training performed to repetition failure or non-failure on muscular strength and hypertrophy: a systematic review and meta-analysis. J Sport Health Sci. 2022;11(2):202-211.
37. Cormie P, McGuigan MR, Newton RU. Developing maximal neuromuscular power: Part 1—biological basis of maximal power production. Sports Med. 2011;41(1):17-38.
38. Cormie P, McGuigan MR, Newton RU. Developing maximal neuromuscular power: Part 2—training considerations for improving maximal power production. Sports Med. 2011;41(2):125-146.
39. LeSuer DA, McCormick JH, Mayhew JL, Wasserstein RL, Arnold MD. The accuracy of prediction equations for estimating 1-RM performance in the bench press, squat, and deadlift. J Strength Cond Res. 1997;11(4):211-213.
40. Grgic J, Lazinica B, Schoenfeld BJ, Pedisic Z. Test-retest reliability of the one-repetition maximum strength assessment: a systematic review. Sports Med Open. 2020;6:31. doi:10.1186/s40798-020-00260-z.
41. Levinger I, Goodman C, Hare DL, Jerums G, Selig S. The reliability of the 1RM strength test for untrained middle-aged individuals. J Sci Med Sport. 2009;12(2):310-316.

42. Grgic J, Lazinica B, Schoenfeld BJ, Pedisic Z. Test-retest reliability of the one-repetition maximum strength assessment: a systematic review. Sports Med Open. 2020;6:31. doi:10.1186/s40798-020-00260-z.
43. Mitter B, Csapo R, Bauer P, Tschan H. Reproducibility of strength performance and strength-endurance profiles: a test-retest study. Sports. 2022;10(5):75. doi:10.3390/sports10050075.