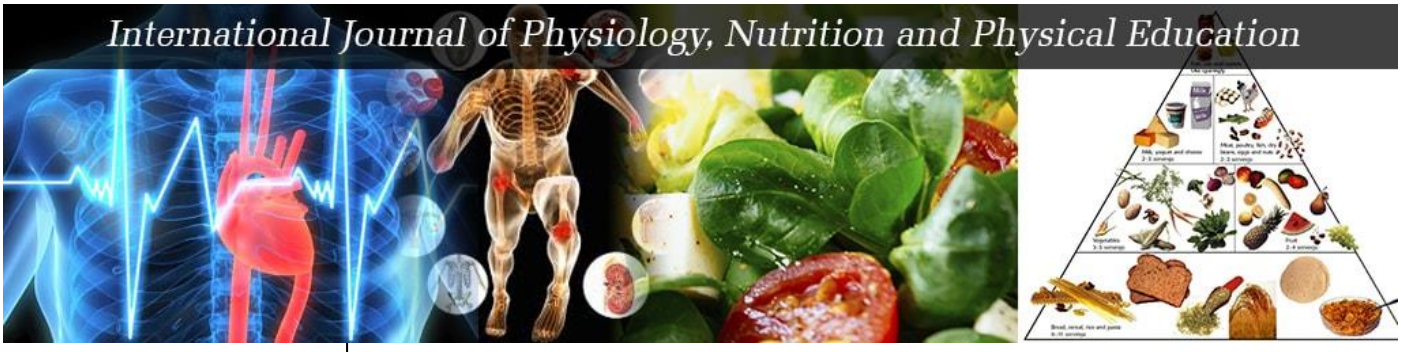

ISSN: 2456-0057
IJPNPE 2022; 7(2): 293-297
© 2022 IJPNPE
www.journalofsports.com
Received: 22-07-2022
Accepted: 23-08-2022

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Comparison of grip strength between calisthenic athletes, power lifters, bodybuilders and boxers: A cross-sectional study

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Abstract
Introduction: The focus on grip strength across different sports is essential for the optimal performance of athletes. This study was conducted to analyze the grip strength across four groups of athletes i.e calisthenic athletes, power lifters, bodybuilders and boxers.
Methodology: Forty-eight participants were recruited using convenience sampling and grip strength and anthropometric measurements were taken of those who met the inclusion criteria of an athlete being an active one and belonging to the age group of 17-45 years and the exclusion criteria being an athlete who is not amongst the categories, not training for >1 month or has a history of injury in < 4 months. The correlation and significance between grip strength and other parameters were established using descriptive and inferential statistical methods.
Results: There was a significant difference between the mean grip strengths of the skill-based regimen and free weights regimen (*t-value*=2.05), and it was found that the free-weights-based training regimen was superior to the skill-based bodyweight training in improving grip strength. There was a statistically weak positive correlation between grip strength and body composition (p<0.39), a very weak correlation with age (p=0.06) and training experience (p=0.12).
Conclusion: Athletes focusing on skill-based training should incorporate free-weight training in their regimen for improved performance. The body composition of an athlete has a direct effect on grip strength. Free-weight training may also be employed clinically for rehabilitation.

Keywords: Athletic science, grip strength, hand-grip dynamometer, rehabilitation, sports medicine, sports physiotherapy

Introduction
Grip strength is a measure of muscular strength or the maximum force/tension generated by forearm muscles. It is described as the force applied by the hand to hold on, pull on, or suspend objects in hand [1, 2]. Bodybuilding, powerlifting, boxing and calisthenics are popular strength sports, they are similar in their training means: they all use resistance exercises. The determination of grip strength is considered to be very important while assessing performance in sports [3]. Bodybuilding, powerlifting, boxing and calisthenics are sports demanding high amounts of grip strength. Grip strength, a measure of body function, has been suggested as a biomarker of ageing. The practicality of hand-grip dynamometry, the measurement of grip strength, has been widely adopted as a singular indicator of overall strength and fitness [5]. Grip strength testing is a significant measure to determine the strength of the grip obtained via different forms of resistance training [9]. In bodybuilding, there is the employment of low resistance high repetition exercises, while the type of grip used matters, the grip strength also plays a significant role in the performance of the athlete [14]. Power lifters also train with high resistance but for low repetitions and with explosive movements, here the choice of grip and the grip strength has a direct effect on the velocity with which the movement is performed and the amount of weight the athlete can lift [15]. In boxing, grip strength is positively correlated with the athletes' performance and winning rate [16]. In calisthenics training, the athletes need a strong grip strength to lift the body weight against gravity [17]. Calisthenics and Boxing have been found to be the game of skill while Bodybuilding and Powerlifting have been found to be based on free-weight training [19, 20, 21].

The hand grip measures have been correlated with many other body composition or fitness tests like waist-hip ratio, BMI and the biomarker for ageing [8]. While there are some positive correlations for this, research studies indicate a strong need for further research to establish a significant positive correlation with other body measures [7, 8, 10, 11, 12, 13]. The effects of a variety of exercise protocols and principles employed by the athletes may also affect grip strength and those principles may be employed for therapeutic purposes [18].

The purpose of this study was to compare the grip strengths of calisthenic athletes, power lifters, bodybuilders and boxers to assess the differences in grip strength across different sporting fields along with its correlation with body composition and frequency and duration of the training regimen of the athletes. This study is significant as the basic exercise principles of all the sporting fields are different; thus, assessing the effects of different training principles and protocols on grip strength is essential.

Methodology

Forty-eight participants were recruited for this study using convenience sampling. The participants included in the study were in the age group of 17-45 years and those who were active athletes from the following categories: (i) Calisthenic athletes (ii) Power lifters (iii) Bodybuilders (iv) Boxers. The criteria for exclusion of a participant was if a participant was not an active athlete amongst the listed categories or had not trained for >1 month, or had any history of injury, fall or musculoskeletal condition or surgery for the last 4 months. The athletes from local gyms and training houses were approached according to convenience and those who matched the inclusion and exclusion criteria were tested for their hand grip strength, followed by their waist-hip ratio and frequency (days) of training per week, daily hours of training and since when they are training professionally.

Hand-Grip dynamometry: The Hand-Grip dynamometer which was used had a 130 kg limit. The measurements were taken with the participant in a high sitting position on a chair or stool with the elbow 90° flexed and the forearm in mid-prone and supported on a table. The participants were instructed to forcefully compress the dynamometer with maximum effort. The readings were taken 3 times and an average of the 3 readings was taken as the grip strength.

Waist-Hip Ratio (WHR): The waist circumference was taken at the visually slimmest part just below the 12th Rib and the hip circumference was taken at the visually widest part of the hip just below the iliac crest. The division of both measurements was taken to find the waist-hip ratio.

We used the following statistical methods to analyze the data:

1. The mean (average) and standard deviation (SD) of the variables taken.
2. Pearson's Correlation to check the correlation between the variables
3. Student's t-test to check the significance of the grip strength across the groups and to check the significance of the null hypothesis.

Null Hypothesis: There is no significant difference between the mean score of grip strengths among skill-based training regimens and free-weight training regimens.

Results

Of the forty-eight participants analyzed, three were females. Out of all the participants screened 16 were bodybuilders, 10 were male boxers and 3 were female boxers, 8 were power lifters and 11 were calisthenics. The mean age group was 26.3±6.99 years with the minimum age of the population being 17 years and the maximum age 45 years. The mean grip strength across the athlete groups was 58.3±13.8kg.

Table 1: The mean age, grip strength and mean WHR of individual groups

Athlete Type	Number of Participants	Mean Age (Years)	Mean WHR	Mean Grip Strength (Kg)
Calisthenics	11	19 ± 2.5	0.8	59.6 ± 14.4
Boxer	13	26.3 ± 6.9	0.8	58 ± 15.7
Bodybuilder	16	30 ± 6.5	0.9	63.6 ± 8.9
Power lifter	8	26.4 ± 4.7	0.8	63 ± 14.6
Total number	48			

The correlation was calculated using Pearson's correlation method for

(i) Grip strength & WHR
(ii) Grip strength & age
(iii) Grip strength & frequency of training (per week)
(iv) Grip strength & daily hours of training
(v) Grip strength & training experience (years)
(vi) Grip strength & waist circumference
(vii) Grip strength & hip circumference for individual athlete groups. The *p*-values of the variables listed are denoted in Table 2-6.

Table 2: Calisthenic Athletes

Sr. No.	Correlation between variables	*p*-value
(i)	GRIP & WHR	-0.01
(ii)	GRIP & AGE	0.26
(iii)	GRIP & Frequency	-0.13
(iv)	GRIP & Daily Hours	0.02
(v)	GRIP & training years	-0.08
(vi)	GRIP & Waist Circumference	0.54
(vii)	GRIP & Hip Circumference	0.5

Table 3: Boxers

Sr. No.	Correlation between variables	*p*-value
(i)	GRIP & WHR	0.4
(ii)	GRIP & AGE	-0.3
(iii)	GRIP & Frequency	-0.3
(iv)	GRIP & Daily Hours	-0.56
(v)	GRIP & Training Years	-0.1
(vi)	GRIP & Waist Circumference	0.60
(vii)	GRIP & Hip Circumference	0.39

Table 4: Bodybuilders

Sr. No.	Correlation between variables	*p*-value
(i)	GRIP & WHR	0.39
(ii)	GRIP & AGE	0.22
(iii)	GRIP & Frequency	-0.17
(iv)	GRIP & Daily Hours	-0.07
(v)	GRIP & Training Years	0.4
(vi)	GRIP & Waist Circumference	0.49
(vii)	GRIP & Hip Circumference	0.31

Table 5: Power lifters

Sr. No.	Correlation between variables	*p*-value
(i)	GRIP & WHR	0.13
(ii)	GRIP & AGE	0.23
(iii)	GRIP & Frequency	-0.63
(iv)	GRIP & Daily Hours	-0.4
(v)	GRIP & Training Years	-0.17
(vi)	GRIP & Waist Circumference	0.34
(vii)	GRIP & Hip Circumference	0.34

Table 6: Across all athlete groups

Sr. No.	Correlation between variables	*p*-value
(i)	GRIP & WHR	0.34
(ii)	GRIP & AGE	0.06
(iii)	GRIP & Frequency	-0.23
(iv)	GRIP & Daily Hours	0.08
(v)	GRIP & Training Years	0.12
(vi)	GRIP & Waist Circumference	0.4
(vii)	GRIP & Hip Circumference	0.31

There is a low correlation between the grip strength and the waist-hip ratio across all the athlete groups (p=0.34). There is a moderately positive correlation between grip and waist circumference (p=0.4). There is a highly negative correlation between grip and frequency of training per week (p=0.63) and a moderate negative correlation between grip and daily hours of training (p= -0.4) of powerlifting athletes. There is a moderate correlation between the grip and training experience (p=0.4) and grip and waist circumference (p=0.49) in bodybuilders. In boxers, there was a high correlation between grip and waist circumference (p=0.6) and a moderate correlation between grip and waist-hip ratio (p=0.4) and grip and daily hours of training (p=0.56). There is a moderate correlation between grip and waist circumference (p=0.54) amongst calisthenic athletes.

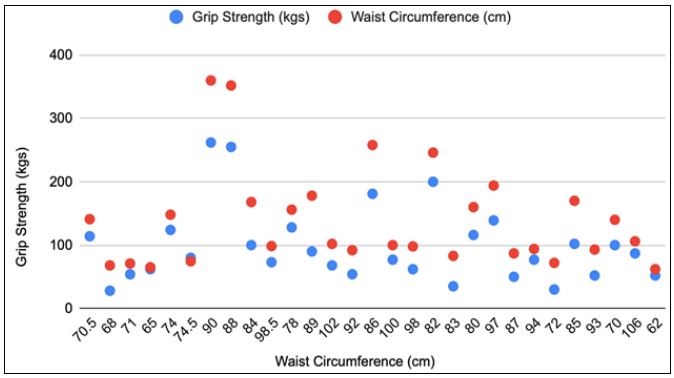

Fig 1: Correlation of grip strength(kg) and waist circumference(cm)

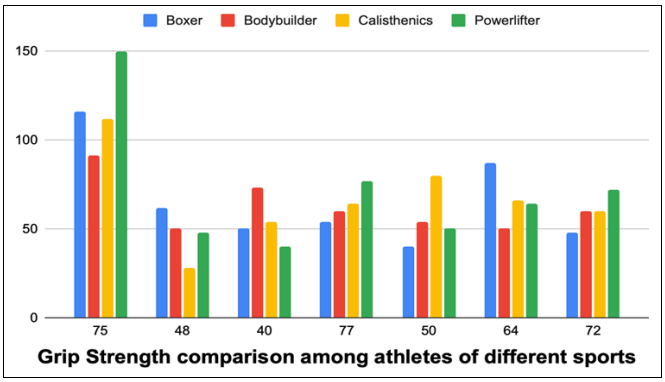

Fig 2: Comparison of grip strength (kg) among the sportspersons

Student's t-test was performed by combining all the skill-based exercise regimens i.e. Calisthenics (C) and boxing (BOX) and free-weight-based exercise regimens i.e. Bodybuilding (B) and powerlifting (P). The t-test was performed for two groups each n=24, where $df=[n_1+n_2-2]$, *here* df = 46.

Table 7: Calculation of t-value for C&BOX and B & P

Group	Number of Participants (n)	Mean	SD^2	Mean difference	Standard Error of Difference (SED)	t-value
C & BOX	24	55.50	234.78	7.83	3.83	2.05
B & P	24	63.33	117.19			

The calculated *t*-value is 2.05 which is significant at a 0.05 level where the table value is 1.96. So, the null hypothesis is not accepted and the data is significant. Thus there is a significant difference in the mean score of C&BOX and B&P. Here, the mean comparison of B&P is greater than C&BOX so the B&P group has higher grip strength than C&BOX.

Discussion

In our study, it was found that the mean grip strength across the groups was 58.3 Kg±13.8. Lyke D *et al*. 2007 found the normative mean hand grip strength of athletes in Germany was 55.17 Kg in male athletes and 33.9 kg in female athletes when compared across different sports [6]. This shows the similarity of the mean grip strength, despite the data being from different countries. In a study conducted in Bulgaria deducing the relationship between body dimension and strength abilities, it was found that the power lifters were the strongest and the bodybuilders had absolute strength positively correlated with the body dimensions. In our study, the grip strength had a positive, statistically significant moderate correlation with the waist circumference across all the groups and sports. For bodybuilders, the training years and waist circumference had a moderate correlation with grip strength, indicating the importance of experience and a gross body composition impacting the ability to generate a one-time force with the wrist. Umesh Lad *et al*. (2013) found that hand grip strength had a statistically weak negative correlation with BMI [7]. In our study, there was a statistically low correlation between grip strength and waist-hip ratio. A statistically moderate correlation between grip and waist circumference indicates the importance of maintaining the body composition to generate an adequate amount of force to perform. Jordre, B. and Schweinle, W. (2020) conducted a study analysing the grip strengths of senior athletes (Age > 50 years) and concluded that the grip strength was 8.6-11.1 kg higher than the normal population included in their study; In our study, it was observed that there is a very weak correlation between grip strength and age, where if an athlete is active then there is a negligible effect of ageing on grip strength. Thomas *et al*. (2017) found that there is a positive correlation between calisthenic training with body composition [17] in our study, it was found that there is a moderate correlation between grip and body composition in calisthenic athletes. We also observed that there was a moderately negative correlation between grip strength and the daily hours trained by the power lifters where the more they train daily lesser their grip strength, this would indicate a lack of muscle recovery after an intensive workout and thus having a lesser force generation

during testing. There was a moderate correlation of grip with the waist-Hip ratio in boxers which would indicate the importance of maintaining their body composition for optimal performance. Geel, S.E. and Robergs, R.A., (2002) found the effects of free weight training in patients with fibromyalgia by employing the regimen clinically and found that the symptoms improved [22]. In our study, it was found that the free-weight exercise regimen may be more effective in this regard, along with its implications in the rehabilitation of the wrist and forearm, this seems to be a promising direction for further research in this area.

Limitations:
The number of participants for each sport was different and the sample size was small. The population is limited to the city of Ahmedabad and Gandh inagar.

Conclusion
- In this study, we conclude that free-weights-based resistance training improves grip strength in athletes.
- Their body composition has an effect on their gripping performance.
- Calisthenic athletes and boxers should incorporate more free-weights-based exercises in their training regimen to improve their performance.

Acknowledgements
- The Kickboxing Studio, Ahmedabad, Gujarat
- Pro Action academy, Ahmedabad, Gujarat
- Gym Nxt Generation, Ahmedabad, Gujarat
- The Fitt Wave, Ahmedabad, Gujarat
- Gift City Club, Gandhinagar, Gujarat

Conflict of Interest
There is no conflict of interest.

References
1. Nakandala Piumi, *et al*. Descriptive study of hand grip strength and factors associated with it in a group of young undergraduate students in university of peradeniya, srilanka who are not participating in regular physical training. International Journal of Physiotherapy; c2019. p. 6. 10.15621/ijphy/2019/v6i3/183876.
2. Panayotov, Valentin. Relationships between body dimensions and strength abilities in experienced Olympic weightlifters, powerlifters and bodybuilders; c2020. Retrieved from: https://www.researchgate.net/profile/Valentin-Panayotov/publication
3. Erdağı *et al*. A study on the determination of handgrip strength of Olympic style weightlifting athletes. Physical education of students. 2020;24:141-148. 10.15561/20755279.2020.0303.
4. Jordre B, Schweinle W. Hand grip strength in senior athletes: Normative Data and community-dwelling comparisons. International journal of sports physical therapy; c2020 Aug. Retrieved October 13, 2022, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC773569/
5. Bohannon RW. Grip strength: An indispensable biomarker for older adults. Clinical interventions in aging; c2019, Oct 1. Retrieved October 13, 2022, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC677847/
6. Leyk, *et al*. Hand-grip strength of young men, women and highly trained female athletes. European journal of applied physiology. 2007;99:415-21. 10.1007/s00421-006-0351-1.
7. Lad UP, Satyanarayana P, Shisode-Lad S, Siri Ch C, Kumari NR. A Study on the Correlation Between the Body Mass Index (BMI), the Body Fat Percentage, the Handgrip Strength and the Handgrip Endurance in Underweight, Normal Weight and Overweight Adolescents. J Clin Diagn Res. 2013 Jan;7(1):51-4. DOI: 10.7860/JCDR/2012/5026.2668. Epub 2012 Oct 31. PMID: 23450189; PMCID: PMC3576749.
8. Hutasuhut, Fatmah, Ryoto, Vergie. Associations Between Muscle Grip Strength with Age, Body Mass Index, Waist-to-Hip Ratio, Level of Independent, Physical Activity Level and Macronutrient Intake in Elderly Women. Pakistan Journal of Nutrition. 2014;13:409-414. 10.3923/pjn.2014.409.414.
9. Jawan L, Adnan R, Sulaiman N, *et al*. Efficacy of handgrip strength in predicting total body strength among high performance athletes. Springer Link; c1970 Jan 1. Retrieved October 15, 2022, from https://link.springer.com/chapter/10.1007/978-981-287-107-7_4
10. Raouf Nasri, Saoussen, *et al*. Grip Strength is a Predictor of Bone Mineral Density Among Adolescent Combat Sport Athletes, Journal of Clinical Densitometry, Volume 2013;16:1.
11. Lad UP, *et al*. A Study on the Correlation Between the Body Mass Index (BMI), the Body Fat Percentage, the Handgrip Strength and the Handgrip Endurance in Underweight, Normal Weight and Overweight Adolescents. J Clin Diagn Res. 2013 Jan;7(1):51-4. DOI: 10.7860/JCDR/2012/5026.2668. Epub 2012 Oct 31. PMID: 23450189; PMCID: PMC3576749.
12. Bohannon RW. Grip Strength: An Indispensable Biomarker For Older Adults. Clin Interv Aging. 2019 Oct 1;14:1681-1691. DOI: 10.2147/CIA.S194543. PMID: 31631989; PMCID: PMC6778477.
13. Olivia T, Vladimir P, Viorel UM. Development of back muscles strength by alternating grips during the same exercise in performance bodybuilding. https://www.analefefs.ro/anale-fefs/2011/issue-2-supplement/pe-autori/25.pdf
14. Santos MDM dos, *et al*. Does the grip width affect the bench press performance of Paralympic Power lifters? Human Kinetics; c2020 Sept 11. Retrieved October 17, 2022, from https://journals.humankinetics.com/view/journals/ijspp/15/9/article-p1252.xml
15. Guidetti L, Musulin A, Baldari C. Physiological factors in middleweight boxing performance – researchgate; c2002. (n.d.). Retrieved October 17, 2022, from https://www.researchgate.net/profile/Laura-Guidetti/publication/11281922_Physiological_factors_in_middleweight_boxing_performance/links/02bfe512734afc645d000000/Physiological-factors-in-middleweight-boxing-performance.pdf
16. Tucky KL. The validity of using grip strength to represent total body strength and of using a 1Rm bench press to represent upper body strength. University of Nevada, Las Vegas; c1993.
17. Thomas, Ewan, Bianco, *et al*. The effects of a calisthenics training intervention on posture, strength and body composition. Isokinetics and Exercise Science. 2017;25:1-8. 10.3233/IES-170001.
18. Preisinger E, *et al*. The effect of calisthenic home exercises on postmenopausal fractures-a long-term

observational study. Maturitas; c2001 Oct 30. Retrieved October 17, 2022, from https://www.sciencedirect.com/science/article/abs/pii/S0378512201002298
19. Chen MA, *et al*. The Effects of Biofeedback on Performance and Technique of the Boxing Jab. Perceptual and Motor Skills. 2021;128(4):1607-1622. https://doi.org/10.1177/00315125211013251
20. LI F, GAO HP. On Main Characteristics of Competitive Calisthenics from the Perspective of Sports Training.
21. Committee on Sports Medicine; Strength Training, Weight and Power Lifting, and Body Building by Children and Adolescents. Pediatrics 1990 Nov;86(5):801-803. 10.1542/peds.86.5.801
22. Geel SE, Robergs RA. The effect of graded resistance exercise on fibromyalgia symptoms and muscle bioenergetics: a pilot study. Arthritis Care & Research: Official Journal of the American College of Rheumatology. 2002;47(1):82-86.