QUANTITATIVE COMPARISON OF HANDGRIP STRENGTH BETWEEN CARDIAC PATIENTS AND AGE MATCHED HEALTHY CONTROLS USING A HANDHELD DYNAMOMETER

Muhammad Abubakar Siddique[1✉], Muhammad Waqar Afzal[1], Ashfaq Ahmad[1], Syed Amir Gilani[1], Muhammad Arslan Saleemi[1]

1 University Institute of Physical Therapy, Faculty of Allied Health Sciences, The University of Lahore, Pakistan

Email✉:mabs310@gmail.com

Contact #: +92-3374666209; +92-3354895871

Date Submitted: February 28, 2018

Date Revised: December 04, 2018

Date Accepted: December 05, 2018

ABSTRACT

OBJECTIVE: To determine the quantitative comparison of handgrip strength between cardiac patients and age matched healthy controls using a handheld dynamometer.

METHODS: This quantitative comparison cross-sectional study was conducted at University of Lahore Teaching Hospital, Lahore from 17th, October 2017 to 5th February 2018. Twenty cardiac and twenty age matched healthy participants were selected using consecutive (non-probability) sampling technique. After approval from ethical committee, data was collected using questionnaire. Measurements were taken of grip strength of both hands by using Jammer Dynamometer. This method was repeated three times in order to obtain mean value of both hands.

RESULTS: In this study 40 subjects were studied with mean age of the participants as 62.08±7.63years. Among them 23(57.5%) were male and 17(42.5%) were female. Mean age of males were 65±7.37years whereas mean age of females were 64.11±7.75years. Out of twenty cardiac patients, 12(60%) male and 5 (25%) female were suffering from myocardial infarction, 3(15%) female had angina. Twenty participants of age-matched healthy individual group included 11 (55%) males and 9 (45%) females. In quantitative comparison of the dominant handgrip strength of cardiac patients (54.28 ± 27.75) and age matched healthy control (74.78±30.33) there was noteworthy difference in mean values of both groups with significant p-value of 0.032 whereas in the strength of non-dominant hand grip in cardiac patients (54.11±26.46) and age matched healthy control (71.03±29.25), no significant difference was recorded.

CONCLUSION: Grip strength of dominant hand is less in cardiac patients as compared to healthy normal individual with significant relationship whereas there is no significant difference among non-dominant hand strength in both groups.

KEY WORDS: Grip strength (Non-MeSH); Dominant & Non-dominant (Non-MeSH); Cardiac patient (Non-MeSH); Myocardial Infarction (MeSH); Muscle Strength Dynamometer (MeSH); Muscle Strength (MeSH).

THIS ARTICLE MAY BE CITED AS: Siddique MA, Afzal MW, Ahmad A, Gilani SA, Saleemi MA. Quantitative comparison of handgrip strength between cardiac patients and age matched healthy controls using a handheld dynamometer. Khyber Med Univ J 2018;10(4):196-9.

INTRODUCTION

Grip strength is the capacity of a muscle to develop maximum contractile force in opposition to a resistance in an isolated contraction. Muscular endurance is the ability of a muscle group to utilize sub maximal force for expanded interval.[1] Grip strength is a quantity of the hand supremacy which is liable for hanging the weights, from sit to stand position, up from a chair, grasping to hold the glass or cup, bus and train travelling or taking a bath. The grip of hand can be determined as per hand and forearm muscles, subsequently grip strength forms a closed scheme of forces. Sufficient shoulder joint range of motion (ROM) is desired taking arm overhead to take objects down from the high cupboards or hang out laundry and also for taking hand at backside of neck helping in changing clothes and for brushing hair .The grip strength is also required for toothbrush. Reduced joint range is prominent in old age and creates troubles with the essential daily activities of life.[2] Astounding is acknowledged about strength of skeletal muscle in cardiac patients suffering from myocardial infarction and angina and found a significant reduced in grip strength in cardiac disorders patients as compared to healthy individuals.[3] However, nearby any such disease causes definite modification in muscular composition. The chief component that may contribute to muscle strength is patient's physical activity, it's eminent that increased physical activities may lead to structural changes of skeletal muscles.[4] Dynamometer is used to check out the grip strength of hand, it can document forces created by all type of muscle contractions (as concentric, eccentric, isokinetic and isometric). It gives valuable data and is extremely susceptible and reproducible. Though, it is classically restricted to research situations and large institutes.[5] It is cumbrous, laborious, lavish, and isn't portable. It can measure only some of the muscle groups. A small number of devices have ascertained to be applied in clinical practiceand are comparatively economical and easy to use.[6] It still has some disadvantages, however, chiefly lack of large sample normative isometric data with age and gender subsets and available normative data for only limited numbers of upper

TABLE I: QUANTITATIVE COMPARISON IN BETWEEN CARDIAC PATIENTS AND AGE MATCHED HEALTHY CONTROL

Grip strength status	Group	Mean	Standard Error	p-value
Dominant Grip strength (lbs)	Cardiac patients	54.28	6.21	0.032*
	Normal	74.78	6.78	
Non dominant Grip strength (lbs)	Cardiac Patients	54.11	5.92	0.063
	Normal	71.03	6.54	

extremity muscle groups. This study was intended to provide a preliminary data base of dominant and non-dominant grip strength in cardiac patients and age matched healthy controls between age of 50-75 years.[7] Cachexia is a tissue wasting syndrome which is related to the chronic disorder of heart or chronic heart failure convoyed with significant disorder and demise rate. But there is not any broadly acknowledged definition of cardiac cachexia. Previously maximum clinicians used low body weight to describe cachexia, but naturally less body weight should not spontaneously be appropriate for a patient to be called as cachectic.[8] Physical and biological changes in the structure and function of muscle action occurs as a result of aging. Physically the mass of the muscle decreases with increasing age. Sarcopenia is the steady loss of skeletal muscle mass, strength of the muscle and quality of the muscle that take place with age.[9] Several disparate mechanisms have been anticipated for pathogenesis of skeletal muscle deteriorating among cardiac disorder patients. It has been proposed that undernourishment, poor absorption, improper metabolism, inequity of catabolic and anabolic process and deprivation of nutrients plays important role in muscle wasting.[10] It is evident that reduction of strength of hand grip in old age people is related with opposing effects comprising ill health with increased degree of fracture and disability, long term stay in the hospital and mortality.[11-13] Ageing is related by an accrual of medicine prescription and mostly chronic heart disorder patients take more than four or five medicine on daily basis which is related to polypharmacy. New choice of drugs, medications, subordinate access for treatment and unsuitable prescriptions also contribute to decrease grip strength of hand.[14] Circuit weight training is commonly used by healthy individuals for improving grip strength and muscular endurance.[15] Myocardial infarction and angina concomitant with coronary artery disease and cardiac disorder can lead to exertional dyspnea and hyperventilation which may boundary exercise capability.[16,17] Patients with myocardial infarction, angina and chronic coronary artery disease without any musculoskeletal disorder either exhibit same grip strength as healthy individual of the same age group or there is some difference. Sufficient literature is not available to provide evidence through a valid device like Hand Grip Strength Dynamometer; this study may be a valuable addition in the current literature.

METHODS

This quantitative comparison cross-sectional study was conducted at University of Lahore Teaching Hospital, Lahore from 17th, October 2017 to 5th February 2018. Sample size was 40 and sampling technique was consecutive (non-probability) sampling. Approval was obtained from hospital ethical committee. T-test were directed from the specified groups to get results. Forty individuals with myocardial infarction and angina pectoris patients were included with matched age of healthy control. Exclusion criteria was set as fracture, tumor, rheumatoid arthritis and post op patients . Jammer handheld dynamometer was used to measure the grip strength. We took measurements in the lbs (unit of strength) and took 3 readings of both dominant and non-dominant. According to proposal by American Society of Hand Therapists a standard position of arm for testing hand grip strength was adopted. They suggested that the patient should be seated with shoulder adducted and neutrally rotated, elbow 90" flexed, forearm and wrist in neutral position.[18] All assessments received ethical approval with informed consent taken from all participants. Data was analyzed by SPSS version 21.0.

RESULTS

In this study 40 subjects were studied with mean age of the participants were 62.08±7.63 years. Among them 23(57.5%) were males and 17(42.5%) were females. Mean age of males was 65±7.37years whereas mean age of females was 64.11±7.75years.

Among male 12(52.2%) and among female 5 (29.4%) were suffering from myocardial infarction and 3(17.6%) had angina as shows in Figure I.

Among subjects, 20(50.0%) were with cardiac disease and others were normal. Among cardiac patients 17(85%) were with myocardial infarction and 3 were with angina. Out of cardiac patients 5 (25%) were suffering from cardiac diseases from 0-2yeras, 7(35%) were suffering from 2-4 years and 8(40%) have cardiac issues from 4-6 years.

On average dominant hand grip of cardiac patients was 54.28±27.75lbs in cardiac patients and in normal patients it was 74.78±30.33. Dominant hand grip strength of subjects with cardiac disorder was statistically significantly different from normal subjects (p-value 0.032). Average strength of non-dominant hand in cardiac patients was 54.11±26.46 whereas in normal it was 71.03±29.25 lbs. Non dominant hand grip strength of normal subjects was more than normal but the difference was not statistically significant (p-value 0.063).Quantitative comparison in between cardiac patients and age matched healthy control as shows in Table I.

The normal individuals have good hand grip strength; results showed that the muscular strength is reduced in cardiac disorders. Dominant hand grip strength in cardiac patient is less as compared to normal healthy individual and significant. Non-dominant hand grip strength is also lower as compared to normal age related persons but not significant.

DISCUSSION

This study shows significant difference in cardiac disorder and age matched healthy control group in dominant hand grip strength which was considerably less in patients with cardiac disorders when compared to healthy individual although not significant in the non-dominant hand grip strength. There is limited literature with similar comparison. The present study was performed to evaluate the grip strength of hand by using Jammer Dynamometer. This methodology is considered the most of the accurate measurements of hand grip strength in cardiac patients and healthy individuals. Gayda, et al.[19] examined the muscle strength by isometric technique between those patients who were effected from coronary artery disease and healthy individuals. They extracted approximately similar results of muscle strength. The authors determined that there is no dissimilarity in muscle strength or fatigue of cardiac patients and healthy individuals (229±21N/m vs 228±52N/m), but isometric endurance was reduced (64±17s vs 90±7s, P<.01). Invasive procedure patients were included, while as in the current study non-invasive patients were taken and results showed the hand grip strength of cardiac patient is less. Baum K, et al.[20] showed that lower limb leg muscle force was ominously less in cardiac patients as compared to fit individuals while no change could be identified in upper limb muscles. Physically inactive patients showed lowest torques (male: 148 ± 18 Nm; female: 82 ± 25 Nm) while highest values were measured in control subjects (male: 167 ± 16 Nm; female: 93 ± 17 Nm). This author states those people who have history of athlete their significant difference found in arm muscle shows less strength, but in the current study the dynamometer find the new consequences of grip strength of cardiac patients as less grip strength in dominant hand while very less difference in non-dominant hand. The reduction in strength of skeletal muscles can be with age or in line with other cross-sectional verdicts. These reductions in hand grip strength initiate mostly from two main factors which are biotic aging itself and reduced physical activities of daily life with the increasing age. Consistent provocations are necessary to maintain muscle strength with bed rest teachings[21], immobilization of the patient and being completely on the bed.[22]

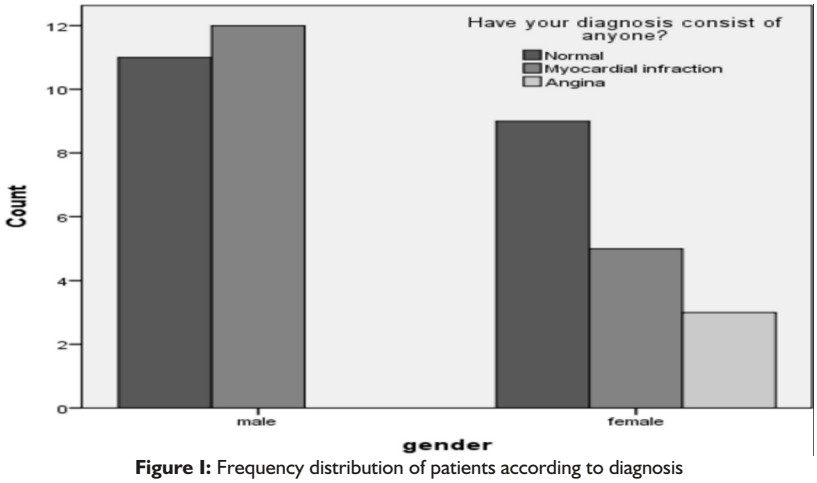

Figure 1: Frequency distribution of patients according to diagnosis

LIMITATIONS & RECOMMENDATIONS

Sample size was small and study was conducted in a single hospital setting, so findings cannot be generalized, less literature is available as less work has been done on Hand Grip strength in cardiac patients through Dynamometer. As significant difference is shown in dominant hand grip strength between healthy and cardiac patients of same age therefore there is immense need to do further work and find out more reasons with mechanism behind it is essential.

CONCLUSION

The tenacity of the study was to determine the grip strength of hand in cardiac patients and age matched healthy controls, the results showed that the grip strength was less in cardiac patients as compared to healthy individual in dominant hand which is significant, despite the fact as non-dominant hand grip strength is not significant.

REFERENCES

1. Hogrel J. Grip strength measured by high precision dynamometry in healthy subjects from 5 to 80 years. BMC Musculoskelet Disord 2015;16:139. DOI: 10.1186/s12891-015-0612-4.
2. Bocalini DS, Dos-Santos L, Serra AJ. Physical exercise improves the functional capacity and quality of life in patients with heart failure. Clinics (Sao Paulo) 2008;63(4):437-42. DOI: 10.1590/S1807-59322008000400005.
3. Izawa KP, Watanabe S, Osada N, Kasahara Y, Yokoyama H, Hiraki K, et al. Handgrip strength as a predictor of prognosis in Japanese patients with congestive heart failure. European Eur J Cardiovasc Prev Rehabil 2009;16(1):21-7. DOI: 10.1097/HJR.0b013e32831269a3.
4. Folland JP, Williams AG. The adaptations to strength training: morphological and neurological contributions to increased strength. Sports Med 2007;37(2):145-68. DOI: 10.2165/00007256-200737020-00004.
5. Cadogan A, Laslett M, Hing W, McNair P, Williams M. Reliability of a new hand-held dynamometer in measuring shoulder range of motion and strength. Man Ther 2011;16(1):97-101. DOI: 10.1016/j.math.2010.05.005.
6. Roberts HC, Denison HJ, Martin HJ, Patel HP, Syddall H, Cooper C, et al. A review of the measurement of grip strength in clinical and epidemiological studies: towards a standardised approach. Age Ageing 2011;40(4):423-9. DOI: 10.1093/ageing/afr051.
7. Van-Harlinger W, Blalock L, Merritt JL. Upper limb strength: study providing normative data for a clinical handheld dynamometer. PM R 2015;7(2):135-40. DOI: 10.1016/j.pmrj.2014.09.007.
8. Rozentryt P, Von-Haehling S, Lainscak M, Nowak JU, Kalantar-Zadeh K,

Polonski L, et al. The effects of a high-caloric protein-rich oral nutritional supplement in patients with chronic heart failure and cachexia on quality of life, body composition, and inflammation markers: a randomized, double-blind pilot study. J Cachexia Sarcopenia Muscle 2010;1(1):35-42. DOI: 10.1007/s13539-010-0008-0.

9. Hairi NN, Cumming RG, Naganathan V, Handelsman DJ, Le Couteur DG, Creasey H, et al. Loss of muscle strength, mass (sarcopenia), and quality (specific force) and its relationship with functional limitation and physical disability: the Concord Health and Ageing in Men Project. J Am Geriatr Soc 2010;58(11):2055-62. DOI: 10.1111/j.1532-5415.2010.03145.x.
10. Harris WS, Mozaffarian D, Rimm E, Kris-Etherton P, Rudel LL, Appel LJ, et al. Omega-6 fatty acids and risk for cardiovascular disease: a science advisory from the American Heart Association Nutrition Subcommittee of the Council on Nutrition, Physical Activity, and Metabolism; Council on Cardiovascular Nursing; and Council on Epidemiology and Prevention. Circulation 2009;119(6):902-7. DOI: 10.1161/CIRCULATIONAHA.108.191627.
11. Chodzko-Zajko WJ, Proctor DN, Singh MAF, Minson CT, Nigg CR, Salem GJ, et al. Exercise and physical activity for older adults. Med Sci Sports Exerc 2009;41(7):1510-30. DOI: 10.1249/MSS.0b013e3181a0c95c.
12. Bohannon RW. Hand-grip dynamometry predicts future outcomes in aging adults. J Geriatr Phys Ther 2008;31(1):3-10.
13. Forman DE, Clare R, Kitzman DW, Ellis SJ, Fleg JL, Chiara T, et al. Relationship of age and exercise performance in patients with heart failure: the HF-ACTION study. Am Heart J 2009;158(4 Suppl):S6-S15. DOI: 10.1016/j.ahj.2009.07.018.
14. Ashfield TA, Syddall HE, Martin HJ, Dennison EM, Cooper C, Sayer AA. Grip strength and cardiovascular drug use in older people: findings from the Hertfordshire Cohort Study. Age Ageing 2009;39(2):185-91. DOI: 10.1093/ageing/afp203.
15. Orr R, Raymond J, Singh MF. Efficacy of progressive resistance training on balance performance in older adults. Sports Med 2008;38(4):317-43. DOI: 10.2165/00007256-200838040-00004.
16. Conraads VM, Deaton C, Piotrowicz E, Santaularia N, Tierney S, Piepoli MF, et al. Adherence of heart failure patients to exercise: barriers and possible solutions. Eur J Heart Fail 2012;14(5):451-8. DOI: 10.1093/eurjhf/hfs048.
17. Piepoli MF, Conraads V, Corra U, Dickstein K, Francis DP, Jaarsma T, et al. Exercise training in heart failure: from theory to practice: A consensus document of the Heart Failure Association and the European Association for Cardiovascular Prevention and Rehabilitation. Eur J Heart Fail 2011;13(4):347-57. DOI: 10.1093/eurjhf/hfr017.
18. Schlüssel MM, Dos-Anjos LA, De-Vasconcellos MT, Kac G. Reference values of handgrip dynamometry of healthy adults: a population-based study. Clin Nutr 2008;27(4):601-7. DOI: 10.1016/j.clnu.2008.04.004.
19. Gayda M, Merzouk A, Choquet D, Ahmaidi S. Assessment of skeletal muscle fatigue in men with coronary artery disease using surface electromyography during isometric contraction of quadriceps muscles. Arch Phys Med Rehabil 2005;86(2):210-5. DOI: 10.1016/j.apmr.2004.07.351.
20. Baum K, Hildebrandt U, Edel K, Bertram R, Hahmann H, Bremer FJ, et al. Comparison of skeletal muscle strength between cardiac patients and age-matched healthy controls. Int J Med Sci 2009;6(4):184-91. DOI: 10.7150/ijms.6.184.
21. Berg HE, Eiken O, Miklavcic L, Mekjavic IB. Hip, thigh and calf muscle atrophy and bone loss after 5-week bedrest inactivity. Eur J Appl Physiol 2007;99(3):283-9. DOI: 10.1007/s00421-006-0346-y.
22. Tesch PA, Von-Walden F, Gustafsson T, Linnehan RM, Trappe TA. Skeletal muscle proteolysis in response to short-term unloading in humans. J Appl Physiol 2008;105(3):902-6. DOI: 10.1152/japplphysiol.90558.2008.

AUTHORS' CONTRIBUTIONS

Following authors have made substantial contributions to the manuscript as under:

MAS: Acquisition, analysis & interpretation of data, final approval of the version to be published.

MWA: Concept & study design, acquisition of data, drafting the manuscript, final approval of the version to be published.

AA & SAG: Drafting the manuscript, critical review, final approval of the version to be published.

MAS: Analysis & interpretation of data, final approval of the version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICT OF INTEREST

Authors declared no conflict of interest

GRANT SUPPORT AND FINANCIAL DISCLOSURE

NIL