DOI: https://doi.org/10.53350/pjmhs2023173220

ORIGINAL ARTICLE

Comparative Study of Static and Dynamic Hand Grip Endurance with Correlation of Deep Breathing among Pregnant Women; A Cross-sectional Study

SAMAN BABAR[1], MUHAMMAD HARIS[2], MIRZA ZEESHAN SIKANDAR[3], UMAIR ABU BAKAR SIDDIQ[4], SAQIB JAVAID AHMAD[5], FARAH SHAHEEN[6]

[1]Shalamar Medical and Dental College, Lahore
[2]King Edward Medical University, Lahore
[3,4]Department of Orthopedics, Central Park Medical College, Lahore, Pakistan.
[5]Department of Radiology, Central Park Medical College, Lahore, Pakistan.
[6]Chief Physiotherapist, Shalamar Teaching Hospital Lahore.
Correspondence to: Dr. Mirza Zeeshan Sikandar, ORCID: 0000-0002-5499-7884, Email: m.zee.shan@hotmail.com, Cell: +92-336-8656736

ABSTRACT

Background: Physiology of the mother, changes constantly during pregnancy including reduced HGS that is require for carrying the child after delivery. Activities of daily living require manual gripping tasks that require dynamic and static contractions. Predictor of upper extremity function is Hand Grip Strength and handgrip endurance. Screening of hand grip strength during antenatal care is still uncommon.

Objectives: To compare static and dynamic hand grip endurance in pregnant females and to find its correlation with deep breathing.

Material and Methods: The study recruited 40 participants of primi-gravida of 1st and 2nd trimester, between ages 20 and 35 years from SHALAMAR GYNAE OPD. The participants assigned to the groups (Group 1: with DB, Group 2: without DB) based on their trimester and gravidity. Static and dynamic endurance assessed using hand held dynamometer.

Results: Mean Age ± Standard deviation for deep and non-deep breathing groups was 22.85 ± 2.30 and 24.05 ± 0.514. Age had negative little or low correlation with all variables of deep and non-deep breathing groups. Peak hand grip strength was moderately correlated with hand grip endurance with deep and non-deep breathing group (r = -0.628, r = -0.566 respectively). Static hand grip endurance was weakly correlated with peak hand grip strength in deep breathing group (r = -0.239) whereas static hand grip endurance had little, if any correlation with peak hand grip strength in deep breathing group (r = -0.165).

Clinical implication: Management of hand grip strength and endurance improves general well being of pregnancy. By employing deep breathing exercises hand grip strength can be improved.

Conclusion: Peak hand grip strength and endurance improved markedly in 2nd trimester with deep breathing. Deep breathing can improve peak hand grip endurance and peak hand grip strength in pregnancy with increasing trimester. Whereas static and dynamic hand grip endurance has insignificant effect in different trimester.

Keywords: Pregnancy, deep breathing, trimester, endurance, peak grip endurance

INTRODUCTION

Mothers' physiology, constantly changes during pregnancy. All changes, that are interlinked, affect all systems of mothers' body and are affected by hormonal influences [1] during pregnancy a mother's body goes through many changes that also impact their musculoskeletal system. All these changes may result in strains of muscles and ligaments that will increases the risk of injury. The impact of musculoskeletal issues on the mother and fetus must be considered while treating them in pregnancy.[2] The bodies of first-time mothers are altered in a variety of ways, and the women may be unsure of what to anticipate [3].A good hand grip strength is necessary for carrying and breastfeeding the baby after birth. Cardiovascular events and changes (such as change in systolic blood pressure) may be related to hand grip strength in pregnant females [4]. A sensitive marker for distinguishing between variation in physical condition of healthy women in an affluent society and outcome of pregnancy (sex and birth weight) is hand grip strength [5].

Most interactive part of the upper extremity is hand. The various functions of hand, like closing, opening and opposing thumb are unique and creative capabilities, mainly contributing to the dominance of human species [6]. Measuring hand function is one of the most fundamental for any assessment. It provides an objective index of the functional capability of the upper extremity. Loss of handgrip strength make daily activities like dressing, washing, toileting, and eating difficult and can lead to a loss of independence. Therefore, an assessment of handgrip strength can be used for monitoring, prevention and rehabilitation of hand injuries, and for prediction of disability, mortality, and morbid [7].

Hand grip strength is also an indicator of nutritional status and bone mineral content.

An ability of body to perform contraction repeatedly over a period of time is endurance or to maintain voluntary contraction maximally for a prolonged period.[6]. Daily living requires repetitive griping function of hand while hand grip strength is measured isometrically. Daily activities that involves repetitive gripping force of hand for sustained period, require dynamic handgrip strength endurance [7].Grip strength is used for predicting Frame strength of body [8].Endurance is the ability to perform prolonged muscular work at predetermined intensity without signs of fatigue. This suggests that endurance can be evaluated by time [9].Multiple fitness tests are commonly performed to determine either strength or endurance. There are many tests to measure upper body muscular endurance and lower body maximum muscular strength, but if a single test that evaluates both may be beneficial[10]. Progressive muscle relaxation and deep breathing are the relaxation activities that can be used to help pregnant women to sleep better. A combination of deep breathing and muscular relaxation can improve quality of sleep in third-trimester.[11] Whole-body endurance usually refers to cardiopulmonary endurance. This reflects the heart's ability to continuously supply oxygen to the moving muscles. Muscle endurance reflects the ability to maintain repeated contractions and it is associated with muscular strength. Activities that improve muscle endurance can also improve cardiovascular endurance.[12] This study is done to find the comparison of static and dynamic hand grip endurance with correlation of deep breathing among pregnant females as there is no previous knowledge specifically in primigravida females in local populace.

MATERIALS & METHODS

An observational correlational study was conducted at the department of gynae and obstetric at Shalamar hospital in collaboration with Central Park Teaching Hospital from February 2022 to June 2022.

Population: Non-Random convenient sampling method was employed and 40 volunteers; primi-gravida were recruited in this study after obtaining written informed consent.

Registration and Ethical Letter: This human based survey was also registered on clinical trial registry with the registration number of NCT05679791. Moreover, this work has been reported in line with the STROCSS criteria (13). Ethical letter was obtained from institutional review board of Shalamar Medical and Dental College and Teaching Hospital.

Sample Size Calculation: Sample size was calculated by using WHO, sample size calculated with the significance and power level of 95 percent and r (correlation) was anticipated 0.60 using OpenEpi, available at: https://www.openepi.com/SampleSize/SSMean.htm.

Exclusion Criterion: Primigravida with history of gestational diabetes mellitus, hypertension, pre-eclampsia, COPD, cardiovascular diseases and musculoskeletal comorbidities was excluded from the study. All the participants were subjected to the detailed obstetrical scan first at first trimester and secondly on third trimesters for the confirmation of their age and any patient with polyhydramnios and oligohydramnios or with cord compression were excluded from the study.

Sampling & Data Collection Procedure: One group with odd serial number enrolled to perform procedure with deep breathing. On the other hand, 2nd group with even serial number enrolled to perform the procedure without deep breathing. The subjects were made to sit comfortably with feet rest on the floor, hip and knee at 90 degrees, shoulder maintaining adduction, and elbows flexed on armrest comfortably between 90 to 120 degrees. The wrist positioned between 0 and 30 degrees of extension and slight in ulnar deviation. Subjects instructed to exhale through mouth during the grip exertion and inhale through nose during relaxation, the grip held for 3 seconds then 15 seconds, a rest of 2 minutes were given to all the participants between the grip repetitions, 3 repetitions noted and the maximum reading considered the peak grip strength. Then static and dynamic hand grip endurance was assessed in both groups; one group performed the mentioned protocol with deep breathing and other performed without deep breathing. Scores were recorded through Hand held dynamometer. The duration of static holding of dynamo meter were noted by stopwatch. Subjects were encouraged to maintain the contraction for as long as possible. The procedure was terminated when the subjects failed to maintain maximal voluntary contraction.

Data Analysis Plan: The data was entered and analyzed using SPSS 25. Numerical data like age, height, weight will be presented in the form of mean S.D whereas quantitative data like gravida and parity status and endurance etc. will be presented in the form of frequency (percentage)or endurance time in minutes and seconds and HGS in kg. after fulfilling parametric assumptions. Hand grip strength stratified according to group will be assessed using independent sample t test. p value of 0.05 or less considered as significant.

RESULTS

A total of 40 participants were segregated into two groups of 20 participants with the mean ages of 22.85 ± 2.30 and 24.05 ± 0.514 years. Descriptive statistics were applied for peak hand grip strength, static hand grip strength and dynamic hand grip strength. Independent t-test was used to compare the two groups as explained in Table 4.1. Mean age, mean static hand grip endurance and mean dynamic hand grip endurance was higher in non-deep breathing group whereas peak hand grip strength was higher in deep breathing groups.

On appliance of Independent Sample t test, Table 2 shows that in deep breathing group, mean peak hand grip strength was higher in 1st trimester whereas static grip strength and dynamic grip endurance was higher during 2nd trimester. In non-deep breathing group, we see that the results are contrariwise to deep breathing group i.e., mean peak hand grip strength was higher in 2nd trimester whereas static grip strength and dynamic grip endurance was higher during 1st trimester. Table 2 shows independent t test which was applied for peak hand grip strength, static grip endurance and dynamic grip endurance based on their trimesters.

Table 3 shows correlation between different variables. In deep breathing group, age had little or no positive correlation with peak grip strength (r = 0.220) whereas in non-deep breathing group, age had little or no negative correlation with peak grip strength (r = -0.178). Age, in deep breathing group, had moderate negative correlation with static hand grip endurance (r = -0.526). Other than that, age had negative little or low correlation with all variables of deep and non-deep breathing groups. Peak hand grip strength was moderately correlated with hand grip endurance with deep and non-deep breathing group (r = -0.628, r = -0.566 respectively). Static hand grip endurance was weakly correlated with peak hand grip strength in deep breathing group (r = -0.239) whereas static hand grip endurance had little, if any correlation with peak hand grip strength in deep breathing group (r = -0.165).

Table 1. Comparison of Descriptive Data of Study Groups

Groups	Variables	Mean	Standard Deviation	Standard Error
Deep Breathing	Age	22.85	2.300	.514
	Peak Hand Grip Strength	24.05	11.861	2.652
	Static Hand Grip Strength	15.75	7.511	1.679
	Dynamic Hand Grip Strength	43.80	18.295	4.091
Non-Deep Breathing	Age	24.05	2.819	.630
	Peak Hand Grip Strength	16.00	8.310	1.858
	Static Hand Grip Strength	17.60	10.308	2.305
	Dynamic Hand Grip Strength	44.60	22.484	5.028

Table 2: Comparison of Study Variables in 1st and 2nd Trimester based on Breathing.

Group	Variables	Mean + Standard Deviation		P Value
		1st Trimester	2nd Trimester	
Deep Breathing	Peak Grip Strength	28.30 ± 13.857	19.80 ± 8.053	.048*
	Static Grip Endurance	13.90 ± 6.822	17.60 ± 8.058	.466
	Dynamic Grip Endurance	40.50 ± 16.828	47.10 ± 19.980	.452
Non-Deep Breathing	Peak Grip Strength	25.50 ± 7.322	16.50 ± 9.571	.161
	Static Grip Endurance	19.70 ± 8.870	15.50 ± 11.655	.181
	Dynamic Grip Endurance	42.50 ± 15.939	46.70 ± 28.343	.006*

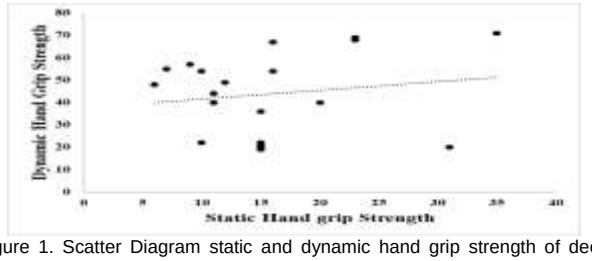

Figure 1. Scatter Diagram static and dynamic hand grip strength of deep breathing group

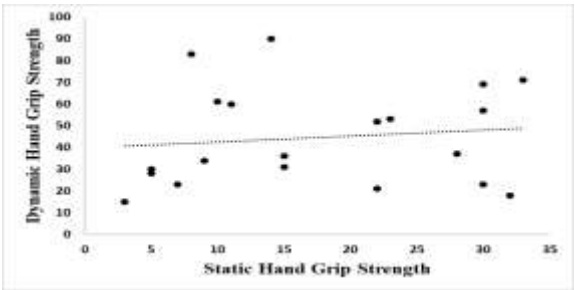

Figure 2. (Dynamic and Static hand grip scatter plot for non-deep breathing group)

Table 3. Correlation of different Study Variables within Both Groups.

Groups	Variables		Age	Dominant hand	Peak hand grip strength	Static hand grip endurance	Dynamic Hand grip endurance
Age	Pearson Correlation	1	-.078	.220	-.526	-.141	
		Sig. (2-tailed)		.744	.351	.017*	.554
		N	20	20	20	20	20
Deep Breathing	Peak hand grip strength	Pearson Correlation	.220	.041	1	-.239	-.628
		Sig. (2-tailed)	.351	.863		.310	.003*
		N	20	20	20	20	20
	Static hand grip endurance	Pearson Correlation	-.526	.051	-.239	1	.162
		Sig. (2-tailed)	.017	.830	.310		.495
		N	20	20	20	20	20
	Dynamic Hand grip endurance	Pearson Correlation	-.141	-.268	-.628	.162	1
		Sig. (2-tailed)	.554	.254	.003*	.495	
		N	20	20	20	20	20
Non-Deep Breathing	Age	Pearson Correlation	1	.[c]	-.178	-.264	-.047
		Sig. (2-tailed)		.	.454	.261	.844
		N	20	20	20	20	20
	Peak hand grip strength	Pearson Correlation	-.178	.[c]	1	-.165	-.566
		Sig. (2-tailed)	.454	.		.488	.009
		N	20	20	20	20	20
	Static hand grip endurance	Pearson Correlation	-.264	.[c]	-.165	1	.125
		Sig. (2-tailed)	.261	.	.488		.599
		N	20	20	20	20	20
	Dynamic Hand grip endurance	Pearson Correlation	-.047	.[c]	-.566	.125	1
		Sig. (2-tailed)	.844	.	.009	.599	
		N	20	20	20	20	20

DISCUSSION

Grip strength and endurance is one of the most significant fitness factors to consider when evaluating hand functions, and also an important part of hand rehabilitation. It's a true biomarker for physiological health and integrity since then, anatomical structures of the forearm and hand have been studied. In grasping tasks, the hand generates muscle force is necessary for the ongoing performance of ADLS and reduced handgrip strength identified as one of the limiting factors for carrying loads and lifting [15]. Similarly, this study measures static and dynamic hand grip endurance that are necessary in daily activities of gripping tasks and can be used as a marker for evaluating body endurance and can also an important part of hand rehabilitation during an antenatal care.

During pregnancy relaxin hormone releases that increases the laxity of the ligaments and results in decreased strength and it remains up to 6 months after delivery. All changes either physiological or physical leads to decreased hand grip strength during pregnancy as compare to non-pregnant females. This current study showed that peak hand grip strength and endurance increases in 2nd trimester with deep breathing and there is moderate correlation between peak hand grip strength and deep breathing. However, there is more dynamic hand grip endurance than static hand grip endurance in 1st and 2nd trimester in females but there was insignificant correlation of static and dynamic hand grip endurance with deep breathing [16]. This present study tested the reliability of three hand grip strength trials in pregnant females to find peak hand grip strength as recommendations states that by taking the mean of three trials it will give more reliable findings instead of one. The American Society of Hand Therapist recommends that three trials can be used as a measure of hand grip strength and the current study used the mean value of three trials for dominant hand either right or left [5].

In a study, the influence of hand posture on grip endurance and strength was compared and concluded that at 30 degrees extension of wrist, maximum grip strength is reached and the best position for radio carpal joint's orthosis and arthrodesis [17] this study also performed hang grip strength and static, dynamic endurance in 30 degrees of wrist extension and slight ulnar deviation to give peak grip strength. Women suffering from worry, sadness, stress, low back pain, or sleep difficulties have been found to benefit from a prenatal yoga practice. It's been proven that doing yoga for the first time while pregnant is safe, as well as fetal tolerance.[18] This study showed that peak hand grip strength was moderately correlated with deep breathing. Peak hand grip strength was higher with deep breathing in 2nd trimester as compare to non-deep breathing.

Slow deep breathing has powerful impacts in pregnancy as a study suggested that reduction in 5.6 mmHg of systolic BP and 3.0 mmHg of diastolic BP [19] High-risk pregnancy has shown that yoga can be an effective in reducing complications related to hypertension and improving outcomes of fetus [20] similarly this study showed increased peak hand grip strength in 2nd trimester with deep breathing whereas static and dynamic hand grip endurance has insignificant correlation with deep breathing. HGS has become a marker of nutritional status [21] similarly HGS assessment in pregnancy can also be used as a biomarker and indicator and will provide useful information to plan an antenatal care. Pregnant females have decreased hand grip strength than non-pregnant females [22]. All the physiological and physical changes and physical activity that is commonly reduced in pregnancy, leads the women for having poorer hand grip strength. A major limitation of this study was uneven groups by age and BMI as it all affects HGS.

CONCLUSION

Mean static grip endurance and mean dynamic grip endurance was higher in non-deep breathing group whereas peak grip strength was higher in deep breathing group. Peak grip strength and grip endurance improved markedly during 2nd trimester with deep breathing so deep breathing can improve peak hand grip endurance and peak hand grip strength in pregnancy with increasing trimester whereas static and dynamic hand grip endurance has insignificant effect in different trimester with deep breathing and non-deep breathing.

Conflict of Interest: None
Funding: None

REFERENCES

1. Talbot L, Maclennan K. Physiology of pregnancy. Anaesthesia & Intensive Care Medicine. 2016;17(7):341-5.
2. Ireland ML, Ott SM. The effects of pregnancy on the musculoskeletal system. Clinical Orthopaedics and Related Research®. 2000;372:169-79.
3. Bergbom I, Modh C, Lundgren I, Lindwall L. First-time pregnant women's experiences of their body in early pregnancy. Scandinavian journal of caring sciences. 2017;31(3):579-86.
4. Auwal A, Amina Shuaib B, Sani Musa D, Abubakar SM, Adamu RI, Truijen S, et al. Determination of hand grip strength and its correlates during pregnancy: a cross-sectional study. BMC Pregnancy and Childbirth. 2021;21:1-13.
5. Żelaźniewicz A, Pawłowski B. Maternal hand grip strength in pregnancy, newborn sex and birth weight. Early human development. 2018;119:51-5.

6. Baxi G, Tigdi SR, Palekar TJ, Basu S, Sule K. Static and dynamic handgrip endurance in young adults. Indian Journal of Physiotherapy and Occupational Therapy. 2017;11(4):118.
7. Karatrantou K. Dynamic handgrip strength endurance: A reliable measurement in older women. Journal of Geriatric Physical Therapy. 2019;42(3):E51-E6.
8. White C, Dixon K, Samuel D, Stokes M. Handgrip and quadriceps muscle endurance testing in young adults. Springerplus. 2013;2(1):1-8.
9. Staszkiewicz R, Ruchlewicz T, Szopa J. Handgrip strength and selected endurance variables. Journal of Human Kinetics. 2002;7:29-42.
10. Trosclair D, Bellar D, Judge L, Smith J, Mazerat N, Brignac A. Hand-grip strength as a predictor of muscular strength and endurance. The Journal of Strength & Conditioning Research. 2011;25:S99.
11. Prastini MSA, Herawati L, Frety EE, Aditiawarman A. The Effect Of Progressive Muscle Relaxation and Slow Deep Breathing Combinations on Sleep Quality of Pregnant Women. Halaman Olahraga Nusantara (Jurnal Ilmu Keolahragaan). 2022;5(1):158-69.
12. McCormick A, Meijen C, Marcora S. Psychological determinants of whole-body endurance performance. Sports medicine. 2015;45(7):997-1015.
13. Agha R, Abdall-Razak A, Crossley E, Dowlut N, Iosifidis C and Mathew G, for the STROCSS Group. The STROCSS 2019 Guideline: Strengthening the Reporting of Cohort Studies in Surgery. International Journal of Surgery 2019;72:156-165.
14. Ma X, Yue Z-Q, Gong Z-Q, Zhang H, Duan N-Y, Shi Y-T, et al. The effect of diaphragmatic breathing on attention, negative affect and stress in healthy adults. Frontiers in psychology. 2017:874.
15. Abdullahi A, Bala AS, Danazumi SM, Abubakar SM, Adamu RI, Truijen S, Zakari MK et al. Determination of hand grip strength and its correlates during pregnancy: a cross-sectional study. BMC Pregnancy Childbirth. 2021 Aug 4;21(1):540. doi: 10.1186/s12884-021-04003-0. PMID: 34348682; PMCID: PMC8340369.
16. Abdullahi A, Bala AS, Danazumi SM, Abubakar SM, Adamu RI, Truijen S, et al. Determination of hand grip strength and its correlates during pregnancy: a cross-sectional study. BMC Pregnancy and Childbirth. 2021;21(1):1-13.
17. Mbada CE, Adeyemi AB, Omosebi O, Olowokere AE, Faremi FA. Hand grip strength in pregnant and non-pregnant females. Middle East Journal of Rehabilitation and Health. 2015;2(2).
18. Lee J-A, Sechachalam S. The effect of wrist position on grip endurance and grip strength. The Journal of hand surgery. 2016;41(10):e367-e73.
19. Babbar S, Shyken J. Yoga in pregnancy. Clinical Obstetrics and Gynecology. 2016;59(3):600-12.
20. Rashed AM, Abdel-Wahab N, Moussa EMM, Hammam N. Association of hand grip strength with disease activity, disability and quality of life in children and adolescents with Juvenile Idiopathic Arthritis. Adv Rheumatol. 2018 Jun 28;58(1):11. doi: 10.1186/s42358-018-0012-1. PMID: 30657067.21.
21. Morlino D, Marra M, Cioffi I, Sammarco R, Speranza E, Di Vincenzo O, De Caprio C, De Filippo E, Pasanisi F. A proposal for reference values of hand grip strength in women with different body mass indexes. Nutrition. 2021 Jul-Aug;87-88:111199. doi: 10.1016/j.nut.2021.111199. Epub 2021 Feb 13. PMID: 33744638.22.
22. Żelaźniewicz A, Pawłowski B. Maternal hand grip strength in pregnancy, newborn sex and birth weight. Early Hum Dev. 2018 Apr;119:51-55. doi: 10.1016/j.earlhumdev.2018.03.004. Epub 2018 Mar 17. PMID: 29558661.