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## **A Study on Handgrip Strength in Pregnant and Non-pregnant Women of North India**

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### **Abstract**

**Objectives:** The objectives of the present study were to estimate the handgrip strength of 129 purposively selected pregnant and non-pregnant women (63 pregnant and 66 non-pregnant women) aged 20-35 years and to search its correlations with selected anthropometric variables studied. Adequate number of controls were also taken for comparisons.

**Methods:** To serve these purposes, thirteen anthropometric variables, viz height, weight, biceps and triceps skinfolds, percent body fat, percent lean body mass, upper arm circumference, dominant and non-dominant handgrip strength, arm muscle area, arm area, arm fat area and arm fat index were measured on all the subjects.

**Results:** Statistically significant differences ( $p < 0.011-0.001$ ) were found in dominant and non-dominant handgrip strength between pregnant and non-pregnant women. However, both in pregnant and non-pregnant women, dominant handgrip strength had no significant correlations ( $p > 0.05$ ) with any of the anthropometric variables studied.

**Conclusions:** Pregnant women had significantly lower handgrip strength as compared to non-pregnant women.

**Keywords:** Handgrip strength. Anthropometric variables, Pregnant and non pregnant women

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### **1. Introduction**

Pregnancy is a critical period during which women experience major psychological, physical, physiological, and social changes in their lives [1,2]. These significant changes may also lead to various health problems [3]. It is the process of having a developing embryo or fetus in the female body after a successful conception. The process ends with the delivery of the neonate. Total pregnancy period is divided into 3 trimesters: i.e. first trimester- 1 to 3 months of pregnancy (1 to 13 weeks), second trimester- 4 to 6 months (13 to 24 weeks) and third trimester- 7 to 9 months (25 weeks up to delivery).

Hand grip strength as a physiological variable, is influenced by a gamut of factors not limited to socio-demographic [4,5], anthropometric and morphologic [6,7], and pathophysiologic [8,9] variables. However, the determinants and predictors of the higher prediction for poor handgrip strength among females seem to have been inadequately explored. Pregnant women have been found to have lower upper extremity strength than non-pregnant women [10]. Similarly, decreases in strength have been demonstrated in women after compared to before pregnancy [11]. Whereas, some other studies showed no significant difference in handgrip strength between pregnant and non-pregnant females [12,13]. Therefore, the outcomes of the few

available studies are inconclusive. The anthropometric and morphological parameters are important indicators and determinants of physical performance tests including handgrip strength [6,7,14,15].

Handgrip strength is an indicator of physical strength [16] and a physiological variable that is affected by a number of factors including age, gender and body size. Strong correlations between grip strength and various anthropometric traits, (weight, height, hand length etc.) were reported earlier [17-24]. The information related to the estimation of handgrip strength and its correlations with anthropometric variables in pregnant and non-pregnant women is scanty, thus the present study was planned.

### **2. Material and Method**

#### **2.1 Study Participants**

The present cross-sectional study was based on 129 pregnant and non-pregnant women (63 pregnant and 66 non-pregnant women) aged 20-35 years selected purposively from various hospitals of Jammu and Kashmir, North India. Demographic information in the form of questionnaire was taken from each subject. The age of the subjects was determined from the registers of the hospitals. A written consent was obtained from the subjects. The study was approved by the institutional ethics committee.

### 2.1.1 The inclusion criteria for the subjects were as follows:

1. Multigravida or primigravida both were selected.
2. Pregnant women (1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup>) trimesters were selected.
3. Pregnant and non-pregnant women of Jammu and Kashmir were selected.

### 2.1.2 The exclusion criteria for the subjects were as follows:

1. Medically unstable subject.
2. Any history of persistent or previous pathological and traumatic history of musculoskeletal system of the body.

### 2.2 Anthropometric Measurements

Thirteen anthropometric variables, such as height, weight, biceps and triceps skinfolds, percent body fat, percent lean body mass, upper arm circumference, dominant and non-dominant handgrip strength, arm muscle area, arm area, arm fat area and arm fat index were taken on each subject. Anthropometric variables of the subjects were measured using the techniques provided by Lohmann *et al.* [25] and were measured in triplicate with the median value used as the criterion.

The height was recorded during inspiration using a stadiometer (Holtain Ltd., Crymych, Dyfed, UK) to the nearest 0.1 cm, and weight was measured by digital standing scales (Model DS-410, Seiko, Tokyo, Japan) to the nearest 0.1 kg. Biceps and triceps skinfolds were measured by Harpenden skinfold caliper (Holtain Ltd, Crosswell, Crymych, UK) to nearest 0.2 mm. Upper arm circumference was measured by steel tape in cm. Muscle girth, arm muscle area, arm fat area and arm fat index were calculated using standard methodologies [26] as: arm muscle girth (cm) = G arm - ( $\pi$  Skinfold triceps); arm muscle area (cm<sup>2</sup>) = [G arm - ( $\pi$  Sf tri)] / 4(4 $\pi$ ); arm area = (cm<sup>2</sup>) = (G arm)<sup>2</sup> / 4  $\pi$ ; arm fat area (cm<sup>2</sup>) = arm area - arm muscle area; arm fat index = arm fat area / arm area.

### 2.3 Handgrip Strength Measurement

The grip strength of both dominant and non-dominant hands was measured using a standard adjustable digital handgrip dynamometer (Takei Scientific Instruments Co., LTD, Japan) at standing position with shoulder adducted

and neutrally rotated and elbow in full extension. The dynamometer was held freely without support, not touching the subject's trunk. The position of the hand remained constant without the downward direction. The subjects were asked to put maximum force on the dynamometer thrice from both sides of the hands. The maximum value was recorded in kilograms. Anthropometric equipment and handgrip dynamometer were calibrated before each assessment. All subjects were tested after 3 minutes of independent warm-up.

### 2.4 Statistical Analysis

Standard descriptive statistics (mean  $\pm$  standard deviation) were determined for directly measured variable. Pearson's correlation coefficients were applied to establish the relationship among the variables measured. Data were analyses using SPSS (Statistical Package for Social Science) version 20.0. A 5% level of probability was used to indicate statistical significance.

## 3. Results

Table 1 showed the descriptive statistics of various demographic and anthropometric variables in Indian pregnant and non-pregnant women. The pregnant women had lesser mean values in dominant and non-dominant handgrip strength (15.59kg and 14.02kg respectively) than their non-pregnant counterparts (20.83kg and 17.64 kg respectively). However, statistically significant differences ( $p < 0.011-0.001$ ) were found both in dominant and non-dominant handgrip strength ( $t = 2.578$  and  $4.701$  respectively) between these two sets of population. When comparisons were made for anthropometric variables, statistically significant differences ( $p < 0.034-0.028$ ) were found only in weight and arm area between the pregnant and non-pregnant women.

Pearson's correlation coefficients of dominant handgrip strength with selected anthropometric variables in pregnant and non-pregnant women were given in table 2. Both in pregnant and non-pregnant women, dominant handgrip strength had no significant correlations ( $p > 0.05$ ) with any of the anthropometric variables studied.

**Table 1: Descriptive statistics of various demographic and anthropometric variables in Indian pregnant and non-pregnant women**

Variables	Pregnant women (n=63)		Non-pregnant women (n=66)		t-value	p-value
	Mean	SD	Mean	SD		
Height (cm)	153.48	10.13	175.18	13.22	1.277	0.204
Weight (kg)	58.95	10.44	63.02	10.33	2.145	<b>&lt;0.034</b>
Biceps skinfold (mm)	28.60	6.71	31.65	14.54	1.458	0.147
Triceps skinfold (mm)	28.22	8.23	29.58	8.40	0.901	0.369
%Body fat	30.61	6.14	30.67	6.33	0.048	0.962
%Lean body mass	69.46	6.11	69.35	6.33	0.097	0.923
Arm circumference (cm)	10.71	1.21	14.59	19.01	1.788	0.076
Dominant hand grip strength (kg)	15.59	5.06	20.83	18.05	2.578	<b>&lt;0.011</b>
Non-dominant handgrip strength (kg)	14.02	4.44	17.64	3.96	4.701	<b>&lt;0.001</b>
Arm muscle area (cm <sup>2</sup> )	551.41	32.39	571.25	33.32	0.327	0.744
Arm area (cm <sup>2</sup> )	8.23	2.22	14.04	20.21	2.218	<b>&lt;0.028</b>
Arm fat area (cm <sup>2</sup> )	543.01	32.57	534.85	37.24	0.127	0.899
Arm fat index	0.64	0.37	1.03	0.37	0.822	0.413

**Table 2: Pearson's correlation coefficients (r) of dominant handgrip strength with selected anthropometric variables in pregnant and non-pregnant women**

Variable	Pregnant women (n = 63)		Non- pregnant women(n =66)	
	r	p	r	p
Height (cm)	0.036	0.786	0.05	0.971
Weight (kg)	0.169	0.197	0.135	0.303
Biceps skinfold (mm)	0.041	0.759	0.065	0.622
Triceps skinfold (mm)	-0.06	0.649	0.076	0.563
%Body Fat	0.147	0.264	0.212	0.104
%Lean body mass	-0.129	0.328	-0.213	0.102
Upper arm circumference (cm)	0.214	0.1	0.006	0.964
Arm muscle area (cm <sup>2</sup> )	-0.089	0.499	0.026	0.846
Arm area (cm <sup>2</sup> )	-0.089	0.498	-0.025	0.851
Arm fat Area (cm <sup>2</sup> )	0.09	0.492	-0.022	0.87
Arm fat index (cm <sup>2</sup> )	0.156	0.233	0.022	0.869

#### 4. Discussion

In pregnancy, alterations of physiological, psychological, physical and musculoskeletal status are obvious, but the magnitude of these changes is scarcely quantified [27]. Anthropometric and morphological parameters are important indicators and determinants of physical status including handgrip strength performance. In the present study, the pregnant women had lesser mean values both in dominant and non-dominant handgrip strength than their non-pregnant counterparts. The present findings followed the report of Mbada *et al.* [28], Dumas *et al.* [13] and Truth *et al.* [11]. The average age of the pregnant women was significantly higher ( $p < 0.01$ ) than the non-pregnant women in this study. In contrary, Morrissey [12] found no significant difference in dominant and non-dominant handgrip strength between pregnant and non-pregnant women. It was reported too that pregnant women had been found to have lower upper extremity strength than non-pregnant women [10]. In fact, Pregnancy related changes in musculoskeletal system might account for the significantly lower handgrip strength in pregnant women in the present study. Pregnancy leads to change in collagen metabolism and increased connective tissue pliability and extensibility. These changes are the result from altered levels of relaxin, estrogen, and progesterone. Their ligamentous tissues are predisposed to laxity with resultant reduced joint stability. To allow the birth of the baby the symphysis pubis, sacroiliac joints, and the tensile strengths of muscles are particularly affected and this ligamentous laxity may continue for six months postpartum [29]. Nevertheless, no significant correlations were found either in pregnant or non-pregnant women between dominant handgrip strength and selected anthropometric variables which followed the findings of Mbada *et al.* [28]. Small sample size was one of the limitations of the present study. Nutritional and socio-economic status of the subjects would be taken care in our future studies. As India has a much diversified populations, it would be very difficult to draw a generalized statement without considering all major populations of India. Thus future studies considering the data from every region (i.e.

south, east, west, north-east and central) are required to validate the data.

#### 5. Conclusion

In the present study, the pregnant women had significantly lower handgrip strength as compared to their non-pregnant counterparts. Alterations of physiological, psychological, physical and musculoskeletal status of pregnant women might be the reasons for the differences in handgrip strength.

#### Reference

- [1] Dilbaz S, Caliskan E, Dilbaz B. Predictors of methotrexate treatment failure in ectopic pregnancy. *J Report Med* 2006; 51: 87-93.
- [2] Bili GV, Barri J Fessler B. *Oxford Text Book of Vasculitis*. Oxford University Press 2002.
- [3] Taskin O, Onoglu A, Inal M, Sadik S, Varder E. Long-term histopathologic and morphologic changes after thermal endometrial ablation. *J Am Assoc Gynecol Laparose* 2002; 9: 186-190.
- [4] Moy F, Chang E, Kee K. Predictors of Handgrip Strength among the Free Living Elderly In Rural Pahang, Malaysia. *Iran J Public Health* 2011; 40(4):44–53.
- [5] Wagner PR, Ascenço S, Wibelinger LM. Hand grip strength in the elderly with upper limbs pain. *Rev Dor São Paulo* 2014; 15(3):182–185.
- [6] Adedoyin RA, Ogundapo FA, Mbada C, Adekanla BA, Johnson OE, Onigbinde TA. Reference Values for Handgrip Strength among Healthy Adults in Nigeria. *Hong Kong Physiotherapy Journal* 2009; 27(1):21–29.
- [7] Aghazadeh F, Lee K, Waikar A. Impact of anthropometric and personal variables on grip strength. *J Hum Ergol (Tokyo)* 1993; 22(2):75–81.
- [8] Kallman DA, Plato CC, Tobin JD. The role of muscle loss in the age-related decline of grip strength: cross-sectional and longitudinal perspectives. *J Gerontol* 1990; 45(3):M82–8.

- [9] Pizzato TM, Baptista CR, Souza MA, Benedicto MM, Martinez EZ, Mattiello-Sverzut AC. Longitudinal assessment of grip strength using bulb dynamometer in Duchenne Muscular Dystrophy. *Braz J Phys Ther* 2014; 18(3):245–251.
- [10] Masten WY, Smith JL. Reaction time and strength in pregnant and non pregnant employed women. *J Occup Med* 1988; 30(5):451–456.
- [11] Treuth MS, Butte NF, Puyau M. Pregnancy-related changes in physical activity, fitness, and strength. *Med Sci Sports Exerc* 2005; 37(5):832–847.
- [12] Morrissey SJ. Work place design recommendations for the pregnant worker. *International Journal of Industrial Ergonomics* 1998; 21(5):383–395.
- [13] Dumas G, Charpentier K, Wang M, Leger A. Comparison of strength between pregnant and non-pregnant women (Abstract). *American Society of Biomechanics Annual Conferences* 2008; 31(8):375–411.
- [14] Jeune B, Skyttke A, Courtnil A, Greco V, Gampe J, Berardelli M. Pregnancy and lower limb varicose veins: Prevalence and risk factors. *Vasc Bras* 2010; 9(2): 29–35.
- [15] Amri S. Anthropometric Correlates of Motor Performance. *Movement, Health and Exercise* 2012; 1(1):75–92.
- [16] Foo LH. Influence of body composition, muscle strength, diet and physical activity on total body and forearm bone mass in Chinese adolescent girls. *Br J Nutr* 2007; 98: 1281–1287.
- [17] Malina RM, Zavaleta AN, Little BB. Body size, fatness, and leanness of Mexican American children in Brownsville, Texas: changes between 1972 and 1983. *Am J Pub Health* 1987; 77: 573–577.
- [18] Ross CH, Rösblad B. Norms for grip strength in children aged 4–16 years. *Acta Paediatrica* 2002; 91: 617–625.
- [19] Singh AP, Koley S, Sandhu JS. Association of hand grip strength with some anthropometric traits in collegiate population of Amritsar. *The Oriental Anthropologist* 2009; 9(1): 99–110.
- [20] Koley S, Yadav MK. An Association of Handgrip Strength with Some Anthropometric Variables in Indian Cricket Players. *FACTA UNIVERSITATIS, Series: Physical Education & Sports* 2009; 7 (2): 113–123.
- [21] Koley S. Singh AP. An association of dominant hand grip strength with some anthropometric variables in Indian collegiate population. *Anthropol Anz* 2009; 67: 21–28.
- [22] Koley S, Kaur N, Sandhu JS. Association of Hand Grip Strength and Some Anthropometric Traits in Female Laborers of Jalandhar, Punjab, India. *Journal of Life Sciences* 2009; 1(1): 57–62.
- [23] Jurimae T, Hurbo J, Jurimae J. Relationship of Handgrip Strength with Anthropometric and Body Composition Variables in Pre-pubertal Children. *Journal of Comparative Human Biology* 2009; 6(3): 225–238.
- [24] Kaur N and Koley S. An Association of Nutritional Status and Hand Grip Strength in Female Labourers of North India. *Anthropologist* 2010; 12(4):237–243.
- [25] Lohmann TG, Roche AF, Martorell R. *Anthropometric Standardization Reference Manual*. Champaign, IL: Human Kinetics Books, 1988.
- [26] McArdle WD, Katch FI, Katch VL. *Exercise Physiology: Energy, Nutrition and Human Performance*. Lippincott Williams and Wilkins, 2001.
- [27] Mbada CE, Ojedoyin OO, Ayanniyi O, Adeyemi AB, Olagbegi OM, Adekanla BA. Comparative assessment of back extensor muscles' endurance between Nulliparous and Parous women. *Journal of Back and Musculoskeletal Rehabilitation* 2007; 20(4):143–149.
- [28] Mbada CE, Adeyemi AB, Omosebi O, Olowokere AE, Faremi FA. Hand grip strength in pregnant and non-pregnant females. *Middle East Rehabil Health* 2015; 2(2): e27641.
- [29] Brook G, Brayshaw E, Cordon Y, Davis G, Evans G, Hawkers R. *Physiotherapy in Women's Health*. 3<sup>rd</sup> edn. London: Elsevier, 2003.