A Study on Handgrip Strength and some Anthropometric Variables in Younger and Older Female Laborers of Jalandhar, Punjab, India

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Abstract

Handgrip strength is of great use as a functional index of nutritional status. Few studies confirmed that those in lower BMI category had lower mean handgrip strength too. In the present study, a total of 100 female labourers and 100 sedentary women were participated and the samples were collected purposively. The subjects were further divided into younger (18-25 years) and older (26-40 years) age groups. Age range of the subject was between 18 to 40 years. Selected anthropometric measurements were taken and nutritional indices were calculated using standard equations. Handgrip strength was measured using a digital handgrip dynamometer.When intra-group comparisons were made in younger and older female laborers, no significant differences ($p \geq 0.05$) were found for handgrip strength and the determinants of nutritional status, but in controls, intra-group comparisons showed significant differences ($p \leq 0.05$) in eight sets out of twelve (except right and left hand grip strength and arm fat index). When comparisons were made between younger and older female laborers and controls, statistically significant differences ($p \leq 0.05$) in all the parameters, especially the determinants of nutritional status were found. So it may be concluded that the nutritional status determined the handgrip strength of the female laborers.

INTRODUCTION

Handgrip strength is a measure of strength of several muscles in the hand and the forearm [1] . It is measured in either kilograms or Newtons by squeezing a handgrip strength dynamometer with one's maximum strength [2] . The power of grip is the result of forceful flexion of all finger joints with a maximal voluntary force that the subject is able to exert under normal biokinetic conditions [3,4] . The estimation of hand grip strength is of immense importance in determining the efficacy of different treatment strategies of hand and also in hand rehabilitation. The hand muscles play a vital role in the performance of day to day activities of normal life such as using tools or transferring from one position to another, such as rising from a chair [5] . The relationship between handgrip strength and a number of variables included morbidity [6] , mortality [7] , the risk of falling [8] , a range of functional ability variables [9,10] and nutritional status [11] have been reported. It is of great use as a functional index of nutritional status [12,13,14] . The hand grip strength is positively associated with nutritional status, even after controlling for potential confounders including health status and socioeconomic conditions [15,16] which confirmed that those in lower BMI category had lower mean handgrip strength. Poor nutritional status, defined by low BMI and low arm muscle area, emerged as a significant determinant of impaired handgrip strength [17] . This study therefore was initiated to test the hypothesis that poor nutritional status is associated with poor functional ability (as measured by handgrip strength) as a first step towards understanding the role of nutrition in the livelihoods of female laborers irrespective to their age group differences.

MATERIALS AND METHODS

The present study is based on purposely selected 100 women (mean age 28.57 ± 7.67) those who are working as labourers in different constructional sites in and around of Jalandhar city, Punjab, India. Also 100 sedentary women (mean age 29.85 ± 8.56) of same place were considered as controls. The subjects were further divided into younger (18-25 years) and older (26-40 years) adults. Age range was between 18 to 40 years. The data collection was undertaken under natural environmental conditions, in residential areas and construction sites situated in and around Jalandhar city, Punjab, India. The study was approved by the local ethics committee.

ANTHROPOMETRY

All anthropometric measurements, viz. height, weight, BMI, triceps skinfold, arm muscle circumference, arm muscle girth, arm muscle area, arm area, arm fat area and arm fat index were measured on each subjects by NK using standard methodologies [1518] . All variables except height and weight were measured on the right side of the body 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. Triceps and subscapular skinfolds (to the nearest of o.1 mm) were measured by Harpenden skinfold calipers (British indicators Ltd., West Sussex, UK). BMI was then calculated using the formula weight (kg)/height ^{2} (m) ^{2} . Arm muscle girth, Arm-muscle area, arm area, arm fat area and arm fat index were calculated using standard methodologies [19] as: arm muscle girth (cm) = G arm – (Skin fold triceps), arm muscle area, cm ^{2} = [G arm - (Sf tri)] / 4 , arm area (A), cm ^{2} = (G arm) ^{2} / 4 , arm fat area, cm ^{2} = arm area – arm muscle area, arm fat index, % fat area = (arm fat area / arm area).

The grip strength of both right and left 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 subjects were asked to put maximum force on the dynamometer thrice from both sides of the hands. The maximum value was recorded in kilograms. All anthropometric equipments and hand grip dynamometer were calibrated before the assessment to check internal validity.

DATA ANALYSIS

Descriptive statistics (mean ± standard deviation) were determined for all directly measured and derived variables. Comparisons between female laborers and controls for all the measured variables were made using an independent t-test. Data were analyzed using SPSS (Statistical Package for Social Science) version 7.5. A 5% level of probability was used to indicate statistical significance.

RESULTS AND DISCUSSION

Table 1 shows the descriptive statistics of handgrip strength and some anthropometric variables in younger (18 – 25 years) and older (26 – 40 years) female laborers. The older female labourers were slightly shorter in height (0.45%), heavier in weight (4.09%), with more BMI (5.05%), arm circumference (3.97%), arm muscle girth (4.49%), arm muscle area (10.24%), arm area (8.71%), arm fat area (7.41%) and with less triceps skin fold (0.18%), arm fat index (2.64%), right and left handgrip strength (4.32% and 4.33% respectively) than the younger female labourers.

Figure 1

Table 1: Descriptive statistics of handgrip strength and some anthropometric variables in younger (18 – 25 years) and older (26 – 40 years) female laborers.

Variable	Female laborers						t value
	Younger adults (n = 47)			Older adults(n = 53)			
	Mean	SD	SE	Mean	SD	SE	
Height (cm)	149.75	5.73	0.836	149.07	5.33	0.733	0.612
Weight (kg)	42.70	5.64	0.82	44.45	7.75	1.06	1.277
BMI (kg/m^2)	19.02	2.04	0.297	19.98	3.15	0.433	1.787
Triceps skinfold (mm)	16.64	0.900	0.131	16.61	0.80	0.110	0.149
Arm muscle cir. (cm)	22.88	1.99	0.291	23.79	2.69	0.370	1.90
Arm muscle girth (cm)	18.03	1.505	0.219	18.84	1.897	0.260	2.338*
Arm muscle area (cm^2)	26.06	4.48	0.654	28.73	5.853	0.804	2.533*
Arm area (cm^2)	41.99	7.57	1.105	45.65	10.46	1.436	1.981
Arm fat area (cm^2)	15.92	3.914	0.571	17.10	6.085	0.835	1.133
Arm fat index (%)	37.69	4.503	0.656	36.72	6.86	0.943	0.829
Right hand grip strength (kg)	21.00	3.482	0.508	20.13	3.206	0.440	1.298
Left hand grip strength left (kg)	19.76	3.54	0.517	18.94	3.920	0.538	1.10

*indicates P ≤ 0.05

The descriptive statistics of handgrip strength and some anthropometric variables in younger (18 – 25 years) and older (26 – 40 years) sedentary females is shown in Table 2. The older sedentary females were shorter in height (1.58%), heavier in weight (18.66%), with more BMI (22.54%), triceps skin fold (0.82%), arm circumference (16.44%), arm muscle girth (16.84%), arm muscle area (36.00%), arm area (35.13%), arm fat area (33.90%) and less arm fat index (0.92%), right and left handgrip strength (4.87% and 3.96% respectively) then the younger sedentary females.

Figure 2

Table 2: Descriptive statistics of handgrip strength and some anthropometric variables in younger (18–25 years) and older (26–40 years) sedentary females.

Variable	Sedentary Females						t value
	Younger adults (n = 47)			Older adults(n = 53)			
	Mean	SD	SE	Mean	SD	SE	
Height (cm)	155.54	4.55	0.719	153.11	6.31	0.815	2.092*
Weight (kg)	53.05	8.17	1.29	62.95	11.04	1.43	4.850**
BMI (kg/m^2)	21.87	2.83	0.448	26.80	4.138	0.534	6.573**
Triceps skinfold (mm)	17.14	0.678	0.107	17.28	0.816	0.105	0.951
Arm muscle cir. (cm)	26.03	3.415	0.540	30.31	3.511	0.453	6.033**
Arm muscle girth (cm)	19.89	2.774	0.438	23.24	2.859	0.369	5.814**
Arm muscle area (cm^2)	32.11	9.602	1.518	43.67	10.59	1.367	5.548**
Arm area (cm^2)	54.88	14.79	2.339	74.16	16.57	2.140	5.944**
Arm fat area (cm^2)	22.77	6.152	0.972	30.49	6.95	0.897	5.696**
Arm fat index (%)	41.54	4.257	0.673	41.16	3.93	0.507	0.454
Right handgrip strength (kg)	23.45	3.69	0.584	22.36	3.84	0.496	1.411
Left hand grip strength (kg)	21.76	3.707	0.586	20.93	3.88	0.502	1.064

*indicates $P \leq 0.05$; **indicates $P \leq 0.001$;

Figure 3

Table 3: Descriptive statistics of handgrip strength and some anthropometric variables in younger adults (18–25 years) of female laborers and their sedentary counterparts.

Variable	Younger adults (18 -25 yrs)						t value
	Female laborers (n = 47)			Sedentary females (n = 40)			
	Mean	SD	SE	Mean	SD	SE	
Height (cm)	149.75	5.73	0.836	155.54	4.55	0.719	5.147**
Weight (kg)	42.70	5.64	0.82	53.05	8.17	1.29	6.953**
BMI (kg/m^2)	19.02	2.04	0.297	21.87	2.83	0.448	5.444**
Triceps skinfold (mm)	16.64	0.900	0.131	17.14	0.678	0.107	2.88*
Arm muscle cir. (cm)	22.88	1.99	0.291	26.03	3.415	0.540	5.358**
Arm muscle girth (cm)	18.03	1.505	0.219	19.89	2.774	0.438	3.968**
Arm muscle area (cm^2)	26.06	4.48	0.654	32.11	9.602	1.518	3.852**
Arm area (cm^2)	41.99	7.57	1.105	54.88	14.79	2.339	5.223**
Arm fat area (cm^2)	15.92	3.914	0.571	22.77	6.152	0.972	6.280**
Arm fat index (%)	37.69	4.503	0.656	41.54	4.257	0.673	4.068**
Right handgrip strength (kg)	21.00	3.482	0.508	23.45	3.69	0.584	3.181**
Left hand grip strength (kg)	19.76	3.54	0.517	21.76	3.707	0.586	2.566*

*indicates $P \leq 0.05$; **indicates $P \leq 0.001$

Table 3 shows the descriptive statistics of handgrip strength and some anthropometric variables in younger (18 – 25 years) female laborers and sedentary females. The younger female laborers were shorter in height (3.86%), lighter in weight (24.23%), with less BMI (14.98%), triceps skin fold (3.00%), arm circumference (13.76%), arm muscle girth (10.31%), arm muscle area (23.21%), arm area (30.69%), arm fat area (43.02%), arm fat index (10.21%), right and left handgrip strength (11.66% and 10.12% respectively) than the younger sedentary females.

The descriptive statistics of handgrip strength and some anthropometric variables in older (26 - 40 years) female labourers and sedentary females is shown in Table 4. The older female labourers were shorter in height (2.71%), lighter in weight (41.62%), with less BMI (34.13%), triceps skin fold (3.97%), arm circumference (27.44%), arm muscle girth (23.40%), arm muscle area (52.00%), arm area (62.45%), arm fat area (78.30%), arm fat index (12.09%), right and left handgrip strength (11.07% and 10.56% respectively) than the older sedentary females.

Handgrip strength has long been thought of as a possible

predictor of overall body strength. But little information was available regarding this. Smith et al. [20] found a direct correlation in grip strength and overall body strength in elderly female populations. It is also reported that handgrip strength determines the muscular strength of an individual [21]. The present study indicates that both younger and older female laborers have lower mean values in all variables measured including lower mean values of grip strength of both hands as compared to sedentary females. In fact, Chilima and Ismail [16] reported that hand grip strength was positively associated with nutritional status, even after controlling for potential confounders including health status and socioeconomic conditions. Their study also confirmed that those in lower BMI category had lower mean handgrip strength. Therefore, the poor nutritional status is associated with poor functional status as assessed by handgrip strength. Pieterse et al. [17] also reported that poor nutritional status, defined by low BMI and low arm muscle area, emerged as a significant determinant of impaired handgrip strength. In the present study too, both younger and older female laborers have lesser mean values for BMI than controls. From the results of the present study, it may be stated that both younger and older female laborers have lower mean values in all variables used as nutritional indicators and also they have lower values of handgrip strength as compared to sedentary females, lend support to the findings that handgrip strength is positively associated with nutritional status as reported in Japan [11], in central Malawi [16] and in Rwanda (north Tanzania) [17]. In fact, women working in different constructional sites have poor nutritional status due to their lower socioeconomic conditions.

Figure 4

Table 4: Descriptive statistics of handgrip strength and some anthropometric variables in older adults (26 – 40) of female laborers and sedentary counterparts.

Variable	Older adults (26 - 40 yrs)						t value
	Female laborers (n = 53)			Sedentary females (n = 60)			
	Mean	SD	SE	Mean	SD	SE	
Height (cm)	149.07	5.33	0.733	153.11	6.31	0.815	3.643**
Weight (kg)	44.45	7.75	1.06	62.95	11.04	1.43	9.550**
BMI (kg/m^2)	19.98	3.15	0.433	26.80	4.138	0.534	9.455**
Triceps skinfold (mm)	16.61	0.80	0.110	17.28	0.816	0.105	4.48**
Arm muscle cir. (cm)	23.79	2.69	0.370	30.31	3.511	0.453	11.433**
Arm muscle girth (cm)	18.84	1.897	0.260	23.24	2.859	0.369	9.519**
Arm muscle area (cm^2)	28.73	5.853	0.804	43.67	10.59	1.367	9.110**
Arm area (cm^2)	45.65	10.46	1.436	74.16	16.57	2.140	10.76**
Arm fat area (cm^2)	17.10	6.085	0.835	30.49	6.95	0.897	10.83**
Arm fat index (%)	36.72	6.86	0.943	41.16	3.93	0.507	4.28**
Hand grip strength Right (kg)	20.13	3.206	0.440	22.36	3.84	0.496	3.324**
Hand grip strength left (kg)	18.94	3.920	0.538	20.93	3.88	0.502	2.715**

*indicates $P \leq 0.05$; **indicates $P \leq 0.001$

CONCLUSION

Thus the results of this study support the hypothesis that the poor nutritional status is associated with poor handgrip strength in female laborers. Further studies in this line are required to determine whether improved nutritional status can strengthen the handgrip of an individual.

References

1. Bassey EJ and Harries UJ: Normal values for handgrip strength in 920 men and women aged over 65 years, and longitudinal changes over 4 years in 620 survivors. Clin Sci; 1991; 84: 331-337.
2. Bassey EJ: Tests of muscle strength. In: Collins KJ, ed. Handbook of Methods for the Measurement of Work Performance, Physical Fitness and Energy Expenditure in Tropical Populations. London: International Union of Biological Sciences, Medical Research; 1990; pp. 59-65.
3. Richards L, Olson B and Palmiter Thomas P: How forearm position affects grip strength. Am J Occup Therap; 1996; 50: 133 – 139.
4. Bohannon R W: Reference values for extremity muscle strength obtained by handheld dynamometer from adults aged 20 to 79 years. Arch Phys Med & Rehab; 1997; 78: 26 – 32.
5. Skelton DA, Greig CA, Davies JM and Young A: Strength, power and related functional ability of healthy people aged 65±89 years. Age & Ageing; 1994; 23: 371-377.
6. Klidjian AM, Foster KJ, Kammerling RM, Cooper A and Karran SJ: Relation of anthropometric and dynamometric

variables to serious post-operative complications. Br Med J; 1980; 281: 899-901.
7. Phillips P: Grip strength, mental performance and nutritional status as indicators of mortality risk among female geriatric patients. Age & Ageing; 1986; 15: 3-56.
8. Wickham C, Cooper C, Margetts BM and Barker DJP: Muscle strength, activity, housing and the risk of falls in the elderly people. Age & Ageing; 1989; 18: 7-51.
9. Hughes S, Gibbs J, Dunlop D, Edelmas P, Singer R and Chang RW: Predictors of decline in manual performance in older adults. J Am Geriatr Soc; 1997; 45: 905-910.
10. Hyatt RH, Whitelaw MN, Bhat A, Scott S and Maxwell JD: Association of muscle strength with functional status of elderly people. Age & Ageing; 1990; 19: 330-336.
11. Guo C, Zhang W, Ma D, Zhang K and Huang J: Hand grip strength: an indicator of nutritional state and the mix of post-operative complications in patients with oral and maxillofacial cancers. Br J Oral Maxillofac Surg; 1996; 34: 325-327.
12. Vaz M, Thangam S, Prabhu A and Shetty PS: Maximal voluntary contraction as a functional indicator of adult chronic under nutrition. Br J Nutr; 1996; 76: 9 – 15.
13. Brozek J: The assessment of motor functions in adults. In malnutrition and behavior: assessment of key issues, Nestle foundation publication series, edited by J. brozek and B. schurch (Lausanne: Nestle foundation); 1984; 4: 268 – 279.
14. Jeejeebhoy K N: Nutritional assessment. Gastroentero Clin North Am; 1998; 27: 347 – 369.
15. Chilima DM and Ismail SJ: Anthropometric characteristics of older people in rural Malawi. Eur J Clin Nutr; 1998; 52: 643-649.
16. Chilima DM, Ismail SJ: Nutrition and handgrip strength of older adults in rural Malawi. Pub Health Nutr; 2001; 4 (1): 11 – 17.
17. Pieterse S, Manandhar M and Ismail S: The nutritional status of older Rwandan refugees. Pub Health Nutr; 2002; 1: 259-264.
18. Lohmann TG, Roche A and Martorell R: Anthropometric Standardization Reference Manual. Champaign, IL: Human Kinetics Books; 1988.
19. McArdle WD, Katch FI and Katch VL: Exercise physiology. Lippincott Williams and Wilkins; 2001; Pp 403.
20. Smith T, Smith S, Martin M, Henry R, Weeks S, et al.: Grip Strength in Relation to Overall Strength and Functional Capacity in Very Old and Oldest Old Females. Phys Occup Th Geriatr; 2005; 24: 63 - 78.
21. Foo LH: Influence of body composition, muscle strength, diet and physical activity on total body and forearm bone mass in Chinese adolescent girls. Bri J Nutr; 2007; 98: 1281-1287.

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