



Original Research Article

A Study of Handgrip Strength in Rural and Urban School Going Children of Amritsar, Punjab

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ABSTRACT

Introduction: Handgrip strength is used as an indicator of total physical strength. The purpose of the study was to estimate the handgrip strength of rural and urban school going children of north India and to search the correlations of it with selected anthropometric variables.

Methods: To serve this purpose, a total of eight anthropometric variables, viz. height, weight, body mass index, upper arm length, forearm length, total extremity length, upper arm circumference and humerus biepicondylar diameter were measured on randomly selected 454 healthy school going children (219 rural and 235 urban) aged 12–18 years collected from the one rural and one urban schools of Amritsar district, India during September, 2013 to March, 2014.

Results: The results showed no significant differences of dominant and non-dominant handgrip strength between rural and urban girl students of Amritsar. Significant differences ($p < 0.021$) were found in non-dominant handgrip strength between rural and urban boy students of Amritsar, showing higher mean value for the trait in the rural boy students. Both in rural and urban students, statistically significant positive correlations ($p < 0.01$) of both dominant and non-dominant handgrip strength were found with all the variables studied, except BMI.

Conclusion: The findings of the present study showed no significant differences of dominant handgrip strength between the rural and urban school-going adolescents of Amritsar. Both dominant and non-dominant handgrip strength had significant positive correlation with all the variables studied, except BMI, both in case of rural and urban students.

Key Words: Handgrip strength; anthropometric variables; Indian rural and urban school-going children.

INTRODUCTION

The power of handgrip is the result of forceful flexion of all finger joints with the maximum voluntary force that the subject is able to exert under normal biokinetic conditions, [1,2] which uses several muscles in the hand and the forearm. [3] Handgrip strength is often used as an indicator of overall physical strength, [4,5]

hand and forearm muscles performances, [6] as a functional index of nutritional status, [7-12] morbidity and mortality [13-15] and physical performance. [16,17] It is included in various motor ability measurement test batteries recommended for children. [18-21]

Handgrip strength is 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. [22-29] Effects of socio-economic status on handgrip strength were studied by Henneberg et al. [30,31] It was found that boys attained greater handgrip strength values than their girl counterparts. [26,32] It was found too, that age dependent increase of handgrip strength in boys and girls as well as inter-gender differences was strongly associated with changes of fat free mass during their childhood. [33]

Due to multiple advantages of handgrip strength, it becomes important to have information if there is any difference regarding the handgrip strength of rural and urban populations. Few reports are available [29,34,35] in Indian context. To fulfill the lacunae, the present study was undertaken with the objectives to estimate the grip strength of rural and urban school going students of Amritsar, north India.

MATERIALS AND METHODS

Participants

The present cross-sectional study was based on randomly selected 454 school going children aged 12-18 years. Of those, 219 rural students (112 boys and 107 girls) were collected from a school situated in a rural area of Amritsar district and 235 urban students (123 boys and 112 girls) were collected from a school situated in the heart of the Amritsar city. All the subjects were physically normal and were not suffering from any chronic diseases at the time of collection of data. Subjects were excluded if they had a history of upper extremity injury or deformity. The age of the subjects were recorded from the date of birth registered in their respective institutions. The majority of the rural students were from middle socio-economic status (57.09%), followed by low socio-economic status (40.55%) and high socio-economic status (2.36%), whereas, in

case of urban students, the majority were from middle socio-economic status (67.42%), followed by high socio-economic status (19.34%) and low socio-economic status (13.24%). In rural population, 78.57% participants were from the Sikhs, 20.51% from the Hindus and 0.92% from other religions, whereas, in urban populations, 59.78% participants were from the Sikhs, 38.84% from the Hindus and 1.38% from others. Both the rural and urban populations were of mixed (both vegetarian as well as non-vegetarian) diet takers. A written consent was obtained from the parents of the subjects. The data were collected under natural environmental conditions in morning (between 8 AM. To 12 noon). The study was approved by the local ethics committee.

Anthropometric measurements

Eight anthropometric variables, viz. height (HT), weight (WT), body mass index (BMI), upper arm length (UAL), forearm length (FAL), total extremity length (TEL), upper arm circumference (UAC), Humerus biepicondylar diameter (HBD), and dominant (DHGS) and non-dominant handgrip strength (NDHGS) were measured following standard techniques. [36]

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. BMI was then calculated using the formula $\text{weight (kg)}/\text{height}^2 \text{ (m)}^2$. Upper arm length, forearm length and total arm length was measured by first segment of anthropometer in centimeter. Upper Arm Circumference was measured by steel tape in cm. Humerus biepicondylar diameter was measured by sliding caliper in cm.

Handgrip strength measurement

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 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. Thirty seconds time interval was maintained between each handgrip strength testing.

Statistical analysis

Standard descriptive statistics (mean \pm standard deviation) were determined for directly measured and derived variables. Student's t-test was applied for the comparison of rural and urban data. Simple correlation coefficients were used to establish the correlations of dominant and non-dominant handgrip strength with other anthropometric variables in the school going children. Data were analyzed using SPSS (Statistical Package for Social Science) version 20.0. A 5% level of probability was used to indicate statistical significance.

RESULTS

Table 1 showed the descriptive statistics of dominant and non-dominant handgrip strength and eight anthropometric variables in rural and urban girl students of Amritsar. The rural girls were significantly ($p < 0.013$) taller (158.08 ± 2.62 cm) than their urban counterparts (154.40 ± 2.62 cm) ($t = 2.53$). Proportionately, rural girls have higher mean values for upper arm length (30.80 ± 1.79 cm), forearm length (26.43 ± 2.07 cm) and total extremity length (72.61 ± 2.93 cm) than the urban students (27.04 ± 2.23 cm, 24.37 ± 2.22 cm and 70.18 ± 3.07 respectively). No significant differences of dominant and non-dominant handgrip strength were observed between rural and urban girl students of Amritsar.

The descriptive statistics of dominant and non-dominant handgrip strength and eight anthropometric variables in rural and urban boy students of Amritsar were given in table 2. Significant differences ($p < 0.045-0.001$) were found in BMI ($t=2.031$), forearm length ($t=3.778$), total extremity length ($t=2.269$) and non-dominant handgrip strength between rural and urban boy students of Amritsar, showing higher mean values for these traits in the rural boy students.

Table 1: Descriptive statistics of handgrip strength and selected anthropometric variables in rural and urban girls

Variables	Rural Girls		Urban Girls		t-value	p-value
	Mean	SD	Mean	SD		
Height(cm)	158.08	2.62	154.40	2.49	2.53	<0.013
Weight (kg)	43.10	3.23	44.99	3.62	1.092	0.277
BMI(kg/m ²)	17.16	1.54	18.71	1.66	1.326	0.785
Upper arm length(cm)	30.80	1.79	27.04	2.23	2.125	<0.015
Forearm length(cm)	26.43	2.07	24.37	2.22	3.779	<0.001
Total extremity length(cm)	72.61	2.93	70.18	3.07	2.657	<0.009
Upper arm circumference(cm)	22.38	2.73	22.78	2.62	0.773	0.441
Humerus biepicondylar diameter(cm)	6.12	0.74	5.99	0.40	1.216	0.227
Dominant handgrip strength(kg)	21.83	3.49	21.62	3.27	0.159	0.874
Non-dominant handgrip strength(kg)	20.17	2.65	19.82	2.08	0.296	0.768

Table 3 showed the Pearson's correlation coefficients of handgrip strength and selected anthropometric variables in rural and urban students of Amritsar. Both in

rural and urban students, statistically significant positive correlations ($p < 0.01$) of both dominant and non-dominant handgrip strength were found with all the variables

studied, except BMI where significant negative correlations ($p < 0.01$) were recorded. Among the anthropometric

variables, significant positive correlations ($p < 0.05-0.01$) were noted, except BMI.

Table 2: Descriptive statistics of handgrip strength and selected anthropometric variables in rural and urban boys

Variables	Rural Boys		Urban Boys		t-value	p-value
	Mean	SD	Mean	SD		
Height(cm)	160.98	8.81	159.90	8.21	0.463	0.644
Weight (kg)	46.56	9.38	51.10	8.59	1.562	0.121
BMI(kg/m ²)	17.84	2.64	19.32	4.54	2.031	<0.045
Upper Arm Length(cm)	31.15	2.55	31.18	3.43	0.055	0.956
Forearm Length(cm)	26.48	2.46	23.88	3.32	3.788	<0.001
Total Extremity length(cm)	75.53	4.79	72.80	7.23	2.269	<0.025
Upper Arm Circumference(cm)	24.24	2.75	24.39	4.57	0.197	0.844
Humerus biepicondylar diameter(cm)	6.62	0.78	6.56	0.67	0.430	0.668
Dominant handgrip strength(kg)	30.55	9.90	28.29	9.06	1.229	0.222
Non-dominant handgrip strength(kg)	31.69	9.48	27.38	9.46	2.351	<0.021

Table 3. Correlation matrix of handgrip strength and selected anthropometric variables in rural and urban students of Amritsar

Variables	HT	WT	BMI	UAL	FAL	TEL	UAC	HBD	DHGS	NDHGS
HT	1	0.726**	-0.238*	0.657**	0.446**	0.696**	0.451**	0.322*	0.593**	0.580**
WT	0.844**	1	0.839**	0.680**	0.546**	0.784**	0.689**	0.519**	0.727**	0.657**
BMI	-0.261*	0.769**	1	-0.251*	-0.266*	-0.292*	-0.347*	-0.026	-0.553**	-0.465**
UAL	0.798**	0.638**	0.273*	1	0.559**	0.796**	0.694**	0.490**	0.655**	0.712**
FAL	0.805**	0.705**	-0.281*	0.491**	1	0.720**	0.533**	0.597**	0.641**	0.623**
TEL	0.946**	0.801**	-0.303*	0.868**	0.842**	1	0.739**	0.628**	0.772**	0.683**
UAC	0.749**	0.945**	-0.299*	0.560**	0.615**	0.708**	1	0.602**	0.699**	0.573**
HBD	0.708**	0.695**	-0.157	0.545**	0.602**	0.690**	0.694**	1	0.622**	0.445**
DHGS	0.796**	0.735**	-0.541**	0.658**	0.600**	0.760**	0.729**	0.695**	1	0.804**
NDHGS	0.746**	0.720**	-0.436**	0.615**	0.555**	0.719**	0.729**	0.658**	0.804**	1

Upper triangle indicated the rural and lower triangle indicated the urban students of Amritsar; HT = height, WT = weight, BMI = body mass index, UAL = upper arm length, FAL = forearm length, TEL = total extremity length, UAC = upper arm circumference, HBD = humerus biepicondylar diameter, DHGS = dominant handgrip strength and NDHGS = non-dominant handgrip strength; *Significant at 0.05 level (2 tailed); **Significant at 0.01 level (2 tailed).

DISCUSSION

Handgrip strength is commonly used as an indicator of overall physical strength. [4,5,37] It is reported that contractile properties of human skeletal muscles become mature early in infancy. [38] Age is one of the important factors of handgrip strength. [33] It was also reported that considerable increase of grip strength was noted in post-adolescent period, especially in females. [34,35,39] Neimpoog et al. [40] estimated the grip strength during puberty in Thai populations. As the socio-economic status in rural and urban populations are different, [28,29] it was hypothesized that there would be significant differences in handgrip strength between these two populations.

In the present study, no significant differences were found between rural and

urban girl students, whereas, significant differences were found between rural and urban boy students only for non-dominant handgrip strength. In fact, only 4% participants were of left hand dominant. The reasons might be the similar food habits, physical and physiological development, and nutritional care taken by parents in spite of differences in their socio-economic status. The earlier findings showed that the dominant right handgrip strength continued to be increased both in boys and girls from age group 11 years up to 14 years in rural as well as urban populations. [34] That increase in the strength can be attributed to the hormonal changes taking place after entering the pubertal period. In boys, growth hormone and testosterone have more effects on performance levels than girls. [41,42] Both

rural and urban students were reported to be engaged in physical activities, as they reached to the school by foot or bicycle, agile and active in school games. Not much difference was noted in the dietary patterns of the rural and urban students. Significant sex differences were observed both in rural and urban students in the present study. These differences were due to structural and physiological differences between the two sexes.

In the present study, both in rural and urban boys and girls, handgrip (both dominant and non-dominant) strength had significant positive correlations with all the anthropometric variables studied. In fact, handgrip strength had strong correlations with number of anthropometric variables. [22-31] Thus anthropometric variables might be used as one of the determinants of individual's physique and physical strength along with handgrip strength. The limitation of the study was that, only pubertal periods were considered for the study, more age groups covering vast sample size and vast rural and urban areas might be considered in the future study.

CONCLUSION

In the present study, both dominant and non-dominant handgrip strength had significant positive correlation with all the variables studied, except BMI, both in rural and urban students. Though no significant differences of dominant handgrip strength were found in the present study between the rural and urban school-going adolescents of Amritsar, the scenario may alter in other parts of the country, as Punjab is a economically prosperous state in India.

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