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Correlation of Body Mass Index and Work Profile on Hand Grip Strength and Endurance in Healthy Adults

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ABSTRACT

Background and need of research: Hand Grip Strength (HGS) is an integral part of performing precise and refined fine motor activities. Many professions necessitate lifting and holding heavy loads with a proportionately static grip or repetitive or forceful gripping movements. Hence it is important to consider measurement of handgrip endurance (HGE) as an important component of assessment of physical performance. Most of studies have shown that HGS and BMI is associated with mortality and cardiovascular disease. So, need of this study is to fulfill the lacunae of literature.

Method: A cross-sectional study-conducted on 80 healthy adults(age:18-40) after obtaining Institutional Ethical Committee clearance. Participants who met with the inclusion criteria were invited for study. BMI was calculated using the formula weight(kg)/height(m)^2.HGS and HGE were measured in office worker and labourer using hand grip dynamometer.

Results: Mean age, BMI, strength and endurance of office worker is (32.78±5.96), (26.15±5.36), (29.04±9.34), (44.63±28.53) and labourer is (32.47±4.46), (25.35±3.33), (37.26±8.57), (32.82±29.44) respectively. Spearman correlation test was used for analysis. Significant negative correlation ($r=-0.507$, $p<0.05$) is found between labourer BMI and HSG and very weak correlation found between BMI and HGE ($r=-0.010$, $p>0.05$). Weak and very weak correlation found between office worker's BMI, HGS and HGE ($r=-0.274$, $p>0.05$ and $r=0.110$, $p>0.05$) respectively.

Conclusion and clinical implication: There is significant negative correlation found between BMI and grip strength in labour group. This result supports that HGS can be effective tool for predicting physical fitness. Moreover, through normative value of HGS, clinician can detect low level of physical fitness at early stage in order to prevent future health problems.

Keywords: BMI, hand grip strength, hand grip endurance, work profile

INTRODUCTION

Hand Grip Strength (HGS) is an integral part of performing precise and refined fine motor activities. In the physical assessment of various diseases affecting musculoskeletal, neuromuscular and cardio respiratory systems in children, elderly and obese populations, HGS measurement is also used as a commonest part of the assessment [1-6].

Many people are suffering from disease such as diabetes, hypertension and coronary artery disease, which are mainly due to sedentary lifestyle and unhealthy eating habits. The main aim of all the physical activities, diet, and lifestyle measures are to maintain normal range of body mass index. Evidence has shown that there were strong correlations between grip strength and various anthropometric parameters, such as weight, height, hand length, and BMI reported by some earlier studies [7].

Most of the activities of daily living (ADLs) require exertion of a sustained effort over a period of time [8].

Hence it is important to consider measurement of handgrip endurance as an important component of assessment of physical performance, in addition to handgrip strength. Endurance is the ability of a muscle group to perform repeated contractions over a time period, sufficient to cause muscular fatigue or to maintain a specific percentage of maximum voluntary contraction for a prolonged time. An exercise induced reduction in the maximal force capacity of the muscle is Muscle Fatigue [9].

Many professions necessitate lifting and holding heavy loads with a proportionately static grip or repetitive or forceful gripping movements [10]. A varied range of tasks, from relatively dynamic movements involving concentric and eccentric contractions, to relatively static tasks mainly producing an isometric contraction, comprise the manual activities involving grip at work place [10].

Manual activities under poor ergonomic conditions can predispose an individual to work related musculoskeletal disorders (WRMDs).

There are studies which have done on different work profile regarding HGS and BMI. And have shown that hand grip strength and BMI is associated with mortality and cardiovascular disease.

So, the aim of this study is to evaluate the impact of BMI and work profile on handgrip muscle strength and endurance among healthy adults and also to find the correlation of BMI and work profile with hand grip muscle strength and endurance.

MATERIALS & METHODS

Study design- Observational Study
Study setting- Ahmedabad
Sample size- 80
Duration of study- One month
Sampling design-Random sampling

INCLUSION CRITERIA

Right hand dominance
Both male and female

EXCLUSION CRITERIA

History of cardiovascular diseases
Metabolic disease
Regular gym going person
Players involving upper limb like basketball, volleyball
Person without musculoskeletal or neurological deformity

PROCEDURE

Study was approved by our institutional ethical council under no PTC/IEC 89/2022-23. Subject falling in inclusion criteria were invited for study. Prior written informed consent was be taken.

There was two group:
Group 1: Labourer group
Group 2: Office worker group

For BMI [11]:

- Body weights were measured using digital weighing machine with light clothing on, without any footwear standing straight on the machine and looking straight ahead.
- Heights were measured (in cm) using measuring tape with each subject in upright position against a wall looking ahead.Participants were asked to remove shoes and body should touch the wall at some point, preferably with heels, buttocks, upper back and head.
- The formula weight (kg)/height $(m)^2$ was used to calculate BMI.

WHO Asian-BMI classification [12]

Nutritional status	BMI (kg/m^2)
Underweight	<18.5
Normal range	18.5-22.9
Overweight	23-24.9
Obese I	25-29.9
Obese II	>30

For hand grip muscle strength[13]:

- The hand grip muscle strength of right hand was measured using a standard hand grip dynamometer in sitting position with feet on the floor.
- The dominant arm was placed on the table in such a position that elbow flexed at 90^{o}, forearm in mid prone position and the wrist in neutral position .
- The participants were encouraged to squeeze the handles as hard as possible and to sustain for atleast three seconds.
- Three values were measured within 30 seconds duration in between and best value was recorded.

For hand grip muscle endurance [7]:

Subjects were asked to maintain 1/3 of maximal voluntary contraction for as long as he/she could to determine Handgrip endurance (HGE) and the time was recorded in seconds.

OUTCOME MEASURE:

Body mass index

Hand grip muscle strength

Hand grip muscle endurance

Body mass index and work profile was correlated with hand grip muscle strength and endurance.

STATISTICAL ANALYSIS

Statistical analysis was be done using SPSS version 16 by keeping level of significance 5%. Spearman correlation test was used for analysis.

RESULT

The data was analyzed in 80 participants in this study. Table 1 shows mean value of age, BMI, hand grip strength and hand grip endurance of both the groups. Table 2 shows correlation of BMI with hand grip strength and hand grip endurance.

Table 1: Mean value of AGE, BMI, HGS, HGE of both group

Outcomes	Labourer	Office worker
Mean age(In year)	32.47±4.46	32.78±5.96
BMI	25.35±3.33	26.15±5.36
HGS	37.26±8.57	29.04±9.34
HGE	32.82±29.44	44.63±28.53

BMI: Body Mass Index, HGS: Hand grip strength, HGE: Hand grip endurance

Table 2: Correlation of BMI with HGS and HGE

Variable	HGS		HGE	
	r-value	p-value	r-value	p-value
LBMI	-0.507	P<0.05	-0.010	P>0.05
OBMI	-0.274	P>0.05	0.110	P>0.05

LBMI=BMI in labourer, OBMI =BMI in office worker

DISCUSSION

Result of our study shows significant negative correlation (r=-0.507, p<0.05) is found between labourer BMI and HSG and very weak correlation found between BMI and HGE (r=-0.010, p>0.05).Weak and very weak correlation found between office worker's BMI, HGS and HGE(r=-0.274,p>0.05 and r=0.110,p>0.05) respectively.

Better HGS in normal BMI category could be explained by the change in muscle quality with change in BMI. The decrease in muscle strength in underweight subjects can be interpreted by deficiency in energy. Fatty infiltration in the muscle and decrees in amount of type 1 red muscle fibers, slow oxidative and increase in type 2b white muscle fibers fast glycolytic, fast fatigable in obese subjects could alter the muscle quality [14,15]. Office worker is related to desk work only and not having much manual activities. Labourer are worker who are engaged in manual tasks and exert forceful activities with their upper extremities in work place and because of this it prevents accumulation of fat in the body [16].

Ved Prakash (2022) did study on correlation between BMI and hand grip strength among healthy young adults of Uttarakhand and found result that there was statically non-significant positive correlation between HGS and BMI in normal females and in overweight and obese females there was statically significant correlation was found [17].

C. rai (2022) also found in his study that normal BMI had significant relation with HGS and highest endurance time which support our result as in labourer almost all subject has normal BMI[18].

Heidy heidy (2021) also found in his study that there is no significant correlation between grip strength and all BMI which also support result of our present studies [19].

Limitation of our studies are smaller sample size, gender un equality which could be the reason for no correlation found in our studies.

CONCLUSION

There is significant negative correlation found between BMI and grip strength in labour group as compared to office workers.

Future studies

- It can be done on large sample size, all BMI and different type of work (light, moderate and severe).

Clinical implication

- Through normative value of HGS, clinician can detect low level of physical fitness at early stage in order to prevent future health problems and can be effective tool for predicting physical fitness.
- According to that exercise protocol can be taught to prevent further cardiovascular diseases.

Declaration by Authors

Ethical Approval: Approved (Approval no: PTC/IEC 89/2022-23)

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Conflict of Interest: The authors declare no conflict of interest.

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