



CORRELATION OF HAND GRIP STRENGTH [A PROXY OF LEAN BODY MASS] AMONG ADULT MALES WITH IMPAIRED AND NORMAL FASTING BLOOD GLUCOSE LEVELS.

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ABSTRACT

Introduction: Hand grip strength is important for performing all day to day routine activities. The purpose of this test is to measure the maximum isometric strength of hand and forearm muscles. It is measured by handgrip dynamometer. Impaired fasting glucose individuals or prediabetes is a “pre-diagnosis” of Diabetes mellitus. Healthcare providers nowadays view the prediabetics as an important target population to prevent their transition to diabetes.

Aim: To assess and correlate hand grip strength in adult males with impaired and normal fasting glucose levels.

Materials and methods: Study population: 100 adult males [35 to 55 years] with healthy BMI [18.5-24.9].

Handgrip strength test performed in the dominant hand using hand hold dynamometer and the average of the three measurements taken as T max in terms of kg. Hand grip strength was compared and correlated among the prediabetics and normal fasting glucose level adults.

Conclusion: The study demonstrates reduced handgrip strength even in the earlier stages of diabetes.

KEYWORDS : hand grip strength, prediabetes, lean body mass.

INTRODUCTION :

Skeletal muscle constitutes the major site for the disposal of ingested glucose. Insulin resistance refers to impairment in insulin action in the target tissues such as skeletal muscle, adipocytes and liver.² Insulin resistance particularly in type II diabetes is manifested not merely by reduced insulin action but also by delay in the insulin action to stimulate glucose uptake. Obesity induced insulin resistance in the skeletal muscle is a multifactorial process. Individuals with normal healthy weight may have “normal weight obesity” characterized by high body fat and lower lean mass. Hence only focussing on obese may lead to missed opportunities to detect normal weight obesity, which is associated with increased risk of developing cardiovascular disease and diabetes. Similarly importance to be given to the prediabetic individuals to avoid further progression and its complications.

ADA [American Diabetes Association]³ recommends that blood sugar screening for adults usually to be started earlier if they are overweight with additional risk factors for diabetes. The overall prevalence of diabetes in India was 7.3% and the overall prevalence of prediabetes was 10.3%.⁴

Insulin resistance is a characteristic feature of normal ageing process and usually associated with decrease in mitochondrial ATP synthesis rate and increase in the intramyocellular fat content.⁶ Muscle function reacts earlier to insulin resistance. Therefore handgrip strength assessment can be used as a tool to detect and monitor the progression of disease.

Detection of prediabetics is an important step in diabetes prevention in primary care settings. Majority of the individuals were unaware of it. Detection of Prediabetics is a fundamental strategy in preventing the transition to diabetes.

There are several blood glucose screening tests for prediabetes.³

- Glycated hemoglobin [A1C] test. {An A1C level between 5.7 and 6.4 percent}
- **Fasting blood sugar test** {A fasting blood sugar level from 100 to 125 mg/dl is considered prediabetes [impaired fasting glucose]}
- Oral glucose tolerance test { A blood sugar level 140 to 199mg/dl after 2 hours.

Among the several tests available we have taken the fasting blood glucose levels to categorise the individuals as prediabetes, diabetes and normal.

Muscle mass and strength found to be lower with diabetes with each being worse with longer duration and poorer control. However recent study demonstrates the effect of diabetes on skeletal muscle mass seems to manifest even in early stages of disease. Studies has shown

that for each 10% increase in skeletal muscle index (ratio of muscle mass to total body weight), there is an 11% reduction in insulin resistance and a 12% reduction in prediabetes.

Lean body mass is a component of body composition, calculated by subtracting body fat from total body weight.
LBM+ BF=BW (Lean body mass plus body fat equals body weight).¹⁰

Materials for study:

Study design:

- Cross sectional study.

Study population:

- 100 adult males [35 to 55 years] age with normal BMI [18.5 – 24.9] according to [Revised Asian Indian Consensus Guidelines], attending master health check up unit.

Exclusion criteria :

Women, individuals with h/o trauma, chronic medical illness, gym trainouts, heavy manual workers were excluded from the study. The study involves 2 important tools

I. Assessment of hand grip strength

II. Fasting blood glucose levels measurements

I. Assessment of Hand grip Strength :

Reference: [ASHT -The American Society of Hand therapists.]

Initially the participants were properly instructed about the procedure to perform hand grip strength test. Hand grip strength test [HGST] is performed after intake of food. HGST is performed in the dominant hand using a hand hold calibrated dynamometer [INCO AMBALA COMPANY ,Pvt LTD. INDIA]. The participants of the study were made to sit comfortably. ASHT proposes assessment of grip strength with elbow flexed at 90 degree with the subject in sitting position, with their shoulders adducted, forearms in neutral position.⁵

The participants were asked to hold the dynamometer in their dominant hand with full grip. Advised to close their eyes. The participants were asked to squeeze the handles with maximal effort and the tension developed by hand grip is noted in kg. A recovery period of 2 mins interval given. The same procedure is repeated still 2 times with 2 mins interval apart. The average of the above three measurements taken - referred as T max [maximal isometric tension] expressed in terms of kg.

II. Fasting blood glucose measurement.

A blood sample is taken from the participants after an overnight fast for atleast 8 hours. Fasting blood glucose values were assessed using fully automatic XL Auto Analyser [Erba Company] by using Glucose Oxidase [GOD] Peroxidase [POD] method. The fasting blood glucose

values of the participants are entered in terms of mg/dl. Among the fasting blood glucose levels entered 2 subgroups were made namely, *A.FBG levels ranging from 100 to 125 mg/dl is considered as Prediabetes or called as impaired fasting glucose levels.*³ *B. FBG levels < 100 mg/dl were considered as individuals with normal fasting blood glucose levels.*³

Methodology:

Institutional ethics committee clearance obtained. Adult males [35 to 55] years age with normal BMI [18.5 – 24.9 willing to participate in the study attending Master health check up unit, CMCH were included as participants.

ON DAY1:

Informed oral and written consent to be obtained from the persons who are attending the study .Hand grip strength test , the procedure as mentioned earlier performed in the dominant hand using hand hold dynamometer. The average of three measurements taken referred as T max [maximal isometric tension] in terms of kg were entered in excel master sheet for statistical analysis.⁵

ON DAY2:

The fasting blood glucose values of the participants measured on day 1 were entered in terms of mg/dl in excel master sheet for statistical analysis. The relationship between hand grip strength and participants[with impaired and normal fasting glucose levels] were noticed. Grip strength compared between the two subgroups.

RESULT:

Figure 1: Parameters of the participants

	Minimum	Maximum	Mean	SD
Age	27	57	44.08	6.50
Height	139	182	167.52	8.57
Weight	45	92	65.71	8.21
BMI	13.60	31.80	23.38	3.19
Hand Grip Strength	16.60	46.00	26.69	6.28
FBS	84.00	140.00	105.87	13.47

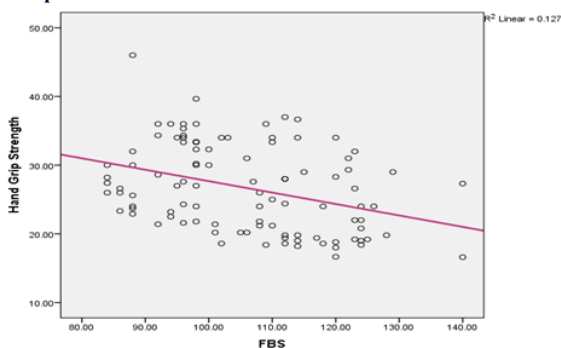
Among the participants 41% were prediabetes and 59% were normal participants .

Hand grip strength was found to be lower in case of prediabetes [24.7510+/-6.00948]when compared to normal participants [29.4863+/-5.64677] and found to be statistically significant.[fig 2]

Figure 2: comparison of handgrip strength among the prediabetes and normal participants:

	Diabetic status	Number	Mean	SD	Independent t test value	P value
Hand grip strength	Pre-diabetic	59	24.7510	6.00948	3.97	<0.001
	Normal	41	29.4863	5.64677		

Figure 3:comparison of handgrip strength among the study participants:



Statistical analysis:

The data was entered in excel and analysed using SPSS version 21. The association of handgrip strength between the prediabetic and normal participants were analysed using independent sample t test and was found to be statistically significant.

DISCUSSION:

Insulin initiates its stimulatory effect on glucose metabolism by binding with its specific receptor present on the muscle cell surface.Once insulin receptor is activated ,it generates second messenger that activates a cascade of reactions that leads to the stimulation of intracellular glucose metabolism.Prediabetic individuals like the diabetes are characterised by a day long elevation of plasma free fatty acids¹, which fails to suppress normally after ingestion of mixed meal. In insulin resistant individuals ,the ability of insulin to inhibit lipolysis and reduce plasma FFA concentration is markedly impaired.

Many evidences suggest that high muscle mass and strength shows a stable control over the glucose metabolism. Increased muscle mass shows protective effect on insulin resistance.Majority of fat oxidation takes place in the mitochondria.Impaired fat oxidation in case of insulin resistant individuals shows the presence of a mitochondrial defect which in turn contributes to impaired fat oxidation and increased intramyocellular fat contents.Insulin resistant individuals has recently been shown to be associated with skeletal muscle loss over time.⁵

Leaner individuals with more muscle mass and strength were associated with lower risk to develop insulin resistance. Both muscle quality and strength are affected by natural course of diabetes .Recent data shows that the individuals with undiagnosed insulin resistance show greater decline in muscle mass than those with longstanding disease .Therefore the effect of insulin resistance on the skeletal muscle mass seems to manifest even in the early stage of disease.

Hand grip strength reflects the physical fitness and it has shown that higher physical activity is associated with healthy muscle mass and lower diabetes risk.As muscle function reacts early , hand grip strength can be employed as a non invasive precise tool and as a marker of metabolic disorders like insulin resistance.

Mainous et al study suggests strongly that accumulation of lipids within the skeletal muscle leads to poor muscle quality and lead to metabolic disorders .⁶

In future hand grip strength assessment can be used as an accessory tool to screen those with metabolic disorders ,so that complications of the disease can be prevented earlier.

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