

THE IMPACT OF NEW WORLD SYNDROME (OBESITY) ON HAND GRIP STRENGTH AND ENDURANCE TIME IN FEMALES

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ABSTRACT

Background: Obesity is rapidly escalating in India in all age groups. Obesity is an independent risk factor for cardiovascular morbidity and mortality. Muscle strength may be impaired in obesity. Hand Grip Strength (HGS) is an important test to assess physical fitness and nutritional status and considered as a reliable marker of the muscle quality. Among all muscle function tests, Hand Grip Strength measurement has gained popularity since it is a simple, noninvasive marker of muscle strength of upper extremities and is made well suitable for clinical use. **Aim:** To assess Maximum Voluntary Contraction (MVC) / Endurance Time (ET) in obese females and to compare all parameters with non-obese females. **Materials and Methods:** This study included 40 obese females aged 35-45 years with BMI more than 30 Kg/m² as study group and 40 nonobese females in same age group with BMI between 18.5 -24.9 Kg/m² as control. Maximum Voluntary Contraction (MVC) & Endurance Time (ET) were measured using Handgrip Dynamometer in obese and nonobese females and the results were compared. Students 't' test and Pearson's correlation coefficient test were used for statistical analysis. **Results:** The results indicated that the obese females showed decreased maximum voluntary contraction (12.50±2.592 Kg of force) as compared with nonobese females (17.95±4.113 Kg of force); [p value = *.000<0.05 significant] and the test also revealed decreased endurance time (101.03±42.35 seconds) in obese females as compared to nonobese females (140.3±20.35 seconds); [p value = *.002<0.05 Significant]. **Conclusion:** Though our study is not vast, it does provide a glimpse on the influence of obesity on muscle power and revealed decreased muscle strength and endurance in obese females which may be the cause for various complications.

INTRODUCTION

Nowadays, with continued rise in standards of living, obesity is emerging as a global epidemic affecting not only the developed nations but also the developing countries. Obesity has been called as "New World Syndrome" that poses severe challenges for the modern health system.^[1]

Owing to rapid urbanisation, industrialisation, globalisation, lifestyle and dietary habits change and consequent reduction in physical activity, all contribute to the increasing prevalence of obesity in urban areas. Energy dense cheap food, labor-serving devices, motorised transports and sedentary life style has led to obesity.^[2,3]

Obesity is a complex disease arising from multifaceted interactions of genetic and environmental factors. Obesity is abnormal or excess fat accumulation resulting from an imbalance between energy intake and energy expenditure.^[4,5]

Obesity represents a major risk factor for a number of cardiovascular diseases such as hypertension, coronary heart disease, fatal cardiac arrhythmias and sudden death. It is also a risk factor for the development of Type II Diabetes mellitus, various malignancies, and musculoskeletal disorders like osteoarthritis.^[6,7] Obesity in Type II diabetic patients is very common phenomenon and often termed as "Diabesity".^[8]

Obesity is more common among women and at a similar BMI, women may have more body fat than men. Excessive amount of body fat exerts an unfavourable burden not only on cardiac function but also on lung functions by increasing the metabolic demands and work load of breathing. Obesity is an independent risk factor for cardiovascular morbidity and mortality.^[5]

BMI is the method used to assess the body fat content and is an indicator of Obesity. Based on data on substantial morbidity, BMI of 30 Kg/m² is the most

commonly used threshold for obesity in both men & women.^[4,5]

Physical inactivity is estimated as the principal cause for 30% Ischemic heart disease burden. WHO reports show physical inactivity as the 4th leading risk factor for global mortality. Prevalence of obesity is increasing both in children and in adults. The American Heart Association (AHA) has recently added obesity as a major risk factor for heart disease.^[2]

Obesity, also termed as adiposity is preventable. Most of the world's population live in countries where overweight and obesity kills more people than underweight. 39 million children and adolescents aged 5-19 were overweight or obese in 2020. Worldwide obesity has nearly tripled since 1975. About 13% of world's adult population (11% men and 15% women) were obese in 2016.

In 2019, estimated 38.2 million children under the age of 5 years were overweight or obese, almost half among them lived in Asia. Overweight and obesity are defined as abnormal or excess accumulation of fat which may impair the health of the individual.^[9]

BMI is a simple index of weight for height that is commonly used to classify overweight and obesity in adults. It is defined as person's weight in kilograms divided by square of the height in meters (Kg/m^2). For adults, WHO defines overweight as BMI greater than or equal to 25 and obesity as BMI greater than or equal to 30. BMI provides the most useful population-level measure of overweight and obesity as it is the same for both genders and for all ages of adult population. However it is a very rough guide as it may not correspond to same degree of fatness in different individuals.^[9]

The principal cause for obesity and overweight is an energy imbalance between calories consumed and calories expended. Worldwide, there exists an increased intake of energy-dense foods that are high in fat and sugars and an increase in sedentary lifestyle due to the nature of many forms of work, varying modes of transportation, and increasing urbanization. Obesity is a major risk factor for noncommunicable diseases like cardiovascular diseases (mainly heart disease and stroke), which were the leading cause of death in 2012; diabetes mellitus, musculoskeletal disorders (especially osteoarthritis – a highly disabling degenerative disease of the joints, some cancers including breast, endometrial, ovarian, liver, prostate, kidney, gallbladder and colon. The risk for these noncommunicable diseases progressively increases, with increases in BMI.

One convincing fact is obesity and overweight as well as the noncommunicable diseases arising out of them are largely preventable. At the individual level, by limiting the energy intake from total fats and sugars and by increasing the consumption of fruit and vegetables as well as legumes, whole grains and nuts; by engaging in regular physical activity (60 minutes a day for children and 150 minutes spread through the week for adults). At the community level, it is important to support the individuals through

sustained implementation of evidence based and population based policies that make regular physical activity and healthier dietary choices available, easily accessible to everyone, affordable too particularly to the poor.

The 2030 Agenda for Sustainable Development realizes NCDs as a major challenge for sustainable development. Government is entirely committed to develop ambitious national responses, by 2030, to reduce by one-third premature mortality from NCDs through prevention and treatment.

The "Global action plan on physical activity 2018–2030: more active people for a healthier world" provides effective and feasible policy actions to increase the level of physical activity worldwide.^[9]

Obesity affects the muscle quality. Hand Grip Strength has evolved as a significant tool for nutritional status assessment and is a reliable marker of muscle quality. The nutritional status can exert its influence on muscle quality and so the muscle strength.

Indo-Asian countries are facing the raising burden of growing of obesity and overweight and a persistent burden of undernutrition. Muscles of obese individuals may have a fatty infiltration and also change in the distribution of muscle type I and type II muscle fibres.^[10]

Hermosa AG et al concluded that having adequate handgrip strength - a proxy of overall strength capacity, may attenuate obesity related cardiometabolic risk and they recommended weight loss to all obese individuals to increase their level of fitness. Muscular strength is protective against cardiometabolic risk factors.^[11]

Many clinical and epidemiological studies revealed the predictive potential of hand grip strength (HGS) concerned with long term morbidity and mortality. Low HGS in healthy adults is predictive of functional limitation and disability in higher age as well as all cause mortality.^[12]

In a review, Bohannon identified grip strength as an important predictor of future mortality, disability, complications, resource utilization and discharge disposition. Grip strength should be considered as a vital sign useful for screening middle-aged and older adults.^[12]

Fraser et al revealed that being in the lowest tertile of muscle fitness was associated with the risk of metabolic syndrome. Modifiable risk factors which includes strength of muscle and a healthy diet pattern protects youth against cardiometabolic risk factors.^[13]

A clinically feasible, reliable measure of muscle fitness is the handgrip strength determination which may predict the decline in physical as well as mental capacities among older adults and also their mortality.^[14,15]

Among youth, young adults and adults, high muscle strength are also associated with better cardiometabolic risk profile.^[16,17,18]

Vaara et al- in their study showed that greater muscles strength was inversely associated with C-

reactive protein and interleukin 6 in young adult men independent of aerobic fitness.^[17] High adiposity levels and decreased muscular strength with muscle weakness are significant modifiable risk factors for cardiovascular diseases.^[19]

Since muscle function reacts early to deprivation of nutrition, HGS has become a popular marker of nutritional status and increasingly used as an outcome variable in studies of nutritional intervention. Grip strength is considered to have clinical significance because of its ability to characterize the current strength of an individual.

Low-grip strength accompanied with decreased muscle mass and physical function. Low-grip strength is predictive of mortality, longer duration of hospital stays, and limited physical function. Muscle weakness, as measured by hand-grip dynamometry can be used alone or in conjunction with other measures to describe nutritional status or body composition (e.g., muscle mass). Grip strength is associated with chronic diseases, correlated with the severity of Parkinson's disease, lower in patients with depression or reduced self-rated health. The prognostic value of grip strength refers to its ability to forecast future outcomes.^[12]

Many studies reinforced grip strength as a robust predictor of mortality, hospital length of stay, and physical functioning. Weak grip was associated with 10-year mortality rates that were 63–74% higher in men and 48% higher in women.^[20]

HGS estimated by determining maximum voluntary contraction(MVC) is a reliable marker when standardised methods and calibrated equipments are used, even when there are different assessors or different brands of dynamometers are used. HGS can be used as a screening tool for women at risk for osteoporosis.^[21,22,23,25]

BMI is a critical indicator of physical health. Hand grip strength can be used to assess skeletal muscle function. Hand exerts 3 main types of force; Grip, pinch and torque. Of these, Grip, with relevant control of force application is most commonly used. A stronger hand grip strength indicates a firmer grasp/grip.^[24]

Hand grip strength is an important test to assess the physical fitness and nutritional status. It is a physiological variable that is affected by number of factors like age, gender, body size and posture. Power of hand grip is the result of forceful flexion of all joints of fingers with maximum voluntary force that the subject is able to exert under normal biokinetic conditions. Endurance of the muscle is the capacity to withstand the power produced during activity or the ability to sustain a muscular force.^[10]

Handgrip strength varies as a function of developmental factors like nutrition, exercise and health.

Muscle strength may be impaired in obesity and this is impairment may be a consequence of both obesity and decreased physical fitness.^[11,12,21]

Endurance is the ability to sustain contractions by the muscle over a period of time.

It is significantly correlated with the strength of maximal effort. Endurance depends on the nutritive support for the muscle and it is also affected with factors like cardiorespiratory fitness, skeletal muscle function, blood flow and temperature of the muscle.^[22]

BMI is an acceptable measure for thinness and fatness and related to health risk and death rates in population.^[23]

Strong hand grip strength was associated with decreased risk of cognitive impairment in obese women but not in non obese women. HGS may be a simple and useful Marker for predicting future cognitive impairment among obese females. BMI and weight change has been shown to be associated with cognitive decline. HGS is a surrogate Marker for determining muscle strength and is a valid and representative measure of muscle strength that reflects total power from upper limb muscles.^[26]

From this point of view, it is necessary to know the impact of obesity on certain parameters of muscle functional status and thereby to assess the fitness in obese individuals using a simple non-invasive test, which can be done as an outpatient procedure. Literature reveals the impact of overweight on hand grip strength and endurance but not much literature on obesity impact. The outcome of this study may focus the need for management of obesity with life style modification as a potential therapeutic target.

Aim: To assess Maximum Voluntary Contraction (MVC) / Endurance Time (ET) in obese females and to compare with nonobese females.

MATERIALS AND METHODS

This study was done at Research Laboratory of Department of Physiology. For this study, 80 apparently healthy females aged 35-45 years were selected. They were divided into two groups based on their BMI, as study group and control group. The study group consisted of 40 obese females with BMI >30Kg/m². The control group consisted of 40 healthy non-obese females with BMI between 18.5-24.9Kg/m².

Subjects with age less than 35years and more than 45years, subjects who were overweight(BMI =25-29.9Kg/m²), underweight(BMI<18.4Kg/m²), subjects with diabetes mellitus, Hypertension, with cardiovascular diseases, previous H/o Ischemic heart disease, COPD, any other pulmonary diseases, previous H/o head injury, psychological illness, Neurological illness, Orthopaedic abnormalities like arthritis, trigger finger, mallet finger, hand injuries/sprain, previous H/o hand fractures, those who were participating in active muscle training exercises, fractures/pain in upper arm/deformity in upper arm and subjects on chronic medications were all excluded from this study. All the subjects had regular 28 days menstrual cycle for at least 6 months prior to the study. The duration of the study was four months.

Written informed consent was obtained from each subject. The study was approved by Institutional Ethical Committee. Detailed medical history and thorough clinical examination was done to rule out any systemic illness.

Anthropometric Measurement

The standing height of the subjects were recorded with the same stadiometer while they were not wearing footwear, with heels together and with their heels, calves and buttocks, preferably their back touching the stadiometer, to the nearest centimeters.

Weight was measured to the nearest 0.1 Kg in standing position, before lunch with light clothing and without footwear by using standardized weighing scale in kilograms^[12] BMI was calculated using Quetelet's Index^[4,5]

$$\text{BMI(Kg/m}^2\text{)} = \text{Weight (kg)} / \text{height (m}^2\text{)}$$

MVC/ET Measurement:

All the tests were performed in the morning between 9.30am-11am, on thermo neutral conditions in all the subjects. The subjects were allowed to acclimatise to the experimental and environmental conditions.

The subjects were explained about the isometric hand grip exercise testing using handgrip dynamometer (Labotech precision instrument) which is a portable instrument in which the maximal isometric tension achieved can be directly read from the readings on the dial and the value read as kilograms of force. The subjects were asked to do the experiment with their dominant hand. Before determining MVC, one trial was allowed for the subject. After the trial, 10

minutes rest was given before determining MVC. In our study, all the subjects were using their right hand. The dominance was determined by asking questions like which hand they will use for writing, combing etc.

The subjects were encouraged to obtain maximum efficient performance and were asked to achieve Maximal Voluntary Contraction (MVC) by gripping the handgrip dynamometer as hard as possible for 3 seconds. During the test, subjects were asked to sit with back straight, shoulder adducted, elbow flexed at 90° and forearm in neutral position. MVC was determined and the maximal force exerted in kilograms was noted down^(21,22,23).

After rested for 5 minutes of MVC estimation, the subjects were asked to do the sustained hand grip exercise test at 30% of MVC with their dominant hand till the point of fatigue in sitting posture. During the whole course of the procedure, the subjects were instructed to maintain normal breathing pattern to avoid any influence from valsalva manoeuvre. Endurance time was noted in seconds for all individuals⁽²¹⁻²³⁾. After the test procedure, dynamometers were stored carefully in their custom made cases, tested and periodically calibrated by biomedical engineers.

All the data were expressed as mean $\pm$ SD. Students 't' test and Pearson's correlation coefficient test were used for statistical analysis. p value <0.05 was accepted as significant.

RESULTS

The characteristics of the two groups are shown in TABLE 1

Table 1: The characteristics of the two groups

Parameters	Study Group (n=40)	Control Group (n=40)
Age(Yrs)	40.28 $\pm$ 3.45	40.15 $\pm$ 3.06
Height(Cms)	147.25 $\pm$ 6.872	150.7 $\pm$ 6.398
Weight(Kg)	70.95 $\pm$ 10.667	49.78 $\pm$ 6.351
BMI(Kg/m ²)	33.03 $\pm$ 3.27	21.94 $\pm$ 1.973

The mean age of the subjects in study group was 40.28 $\pm$ 3.45yrs and of control group was 40.15 $\pm$ 3.06 yrs. Both groups were matched for age, sex & height. But the weight and the mean BMI were significantly higher (p=.000; p<0.05) in the obese study group (33.03 $\pm$ 3.27Kg/m²) as compared to non obese control group(21.94 $\pm$ 1.97Kg/m²)

Maximum Voluntary Contraction (MVC) & Endurance Time (ET) achieved by obese individuals

are comparatively lesser as compared to non obese subjects and it was found to be statistically significant shown in TABLE 2 & FIGURE 1 and 2.

The Obese females showed a significant negative correlation between the BMI and the hand grip strength as well as endurance which is shown in Table 3.

Table 2: Comparison of Maximal isometric tension(MVC) & Endurance Time (ET)

Parameter	Study Group(n=40)	Control Group(n=40)	p Value
MVC (Kg of Force)	12.50 $\pm$ 2.592	17.95 $\pm$ 4.113	*.000<0.05 Significant
EnduranceTime (sec)	101.03 $\pm$ 42.35	140.3 $\pm$ 20.35	*.002<0.05 Significant

(p<0.05 accepted as significant)

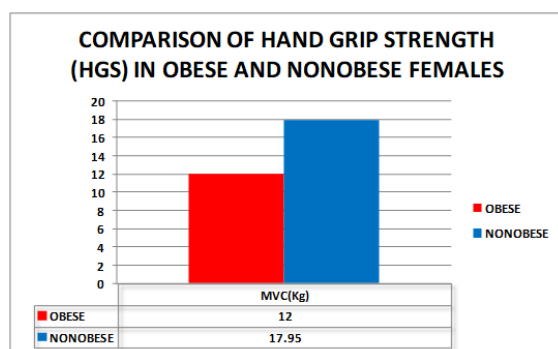


Figure 1: Comparison of Maximal Voluntary Contraction (MVC) in Obese and Nonobese females

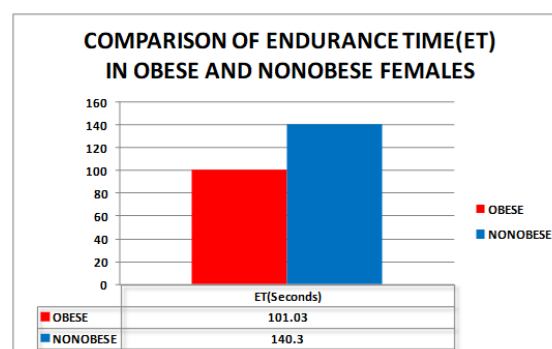


Figure 2: Comparison of Endurance Time (ET) in Obese and Nonobese females

Table 3: Correlation of BMI with Maximal Isometric Tension(MVC)&Endurance Time (ET)

Pearson's Correlation	R value	p Value
BMI(Kg/m ²) and MVC (Kg of Force)	-0.8088	*.000<0.05 Significant
BMI(Kg/m ²) and EnduranceTime (sec)	-0.8215	*.000<0.05 Significant

(*p*<0.05 accepted as significant)

DISCUSSION

Obesity, a common more significant health hazard today is associated with increased incidence of hypertension, congestive cardiac failure, arrhythmias and unexplained sudden death with overall increase in mortality rates.^[4,5]

Muscle strength is determined by muscle girth. Muscles with larger cross sectional area can generate more force and can lift more weight.^[22,25,27] Excess amount of adiposity leads to decreased muscle strength and decreased muscle mass termed sarcopenic obesity.^[25]

Obesity has become a colossal epidemic causing serious public health concern. The increase in the prevalence of obesity is primarily due to the increasingly obesogenic environment rather than 'pathology' in metabolic defects or genetic mutations within individuals.^[4,5] In the studies showing the relationship between total mortality and obesity, it is seen that when BMI reaches above 30Kg/m², the incidence of mortality increases dramatically.^[4,5]

Laxmi et al concluded that BMI can be used in clinical settings to estimate body fat as it is a rapid and inexpensive method.^[28]

Obesity is an epidemic disease now emerging as pandemic. Body weight depends on balance between calorie intake and utilization of calories. Obesity results in obstructive sleep apnea syndrome and osteoarthritis.^[4,5,9]

It is well known that body weight and the calories stored in humans remain constant over long periods of time. This shows that an integrated control mechanism involving neural, hormonal, metabolic and psychological factors which couple energy expenditure and food intake exists. It has been suggested that the autonomic nerve system may be central in the integration of this system.^[4,5,9,7]

Lad UP et al studied the correlation between BMI, the Body Fat Percentage, the Handgrip Strength and the Handgrip Endurance in Underweight, Normal Weight and Overweight Adolescents and concluded that the underweight and overweight groups had a lower grip strength and endurance than the normal weight group. The increase in the body fat percentage might decrease the handgrip endurance.^[10]

Hermoso AG et al concluded that hand grip strength attenuates the adverse effects of overweight on cardiometabolic risk factors among college students. Being physically fit, confers added benefit of maintaining healthy body composition and collectively suggested the improvement of muscle fitness and decrease in fat mass are both important factors for prevention of metabolic syndrome. One possible mechanism linking muscle strength and favourable health is through reduction of chronic inflammation and they suggested that weight loss should be recommended for all obese individuals even those who are fit.^[11]

Richard W. Bohannon in his review on Muscle strength: clinical and prognostic value of hand-grip dynamometry substantiated the use of hand-grip dynamometry as a fundamental element of the physical examination of patients.^[12]

Roopam Bassi et al in their study on Handgrip dynamometry in elderly individuals and its relation with body mass index concluded that increase in BMI leads to decrease in HGS.^[22] This simple, noninvasive method of measurement may provide valuable clinical data for medical professionals before proceeding with more invasive tests. Mechanism for this can be explained as with increase in adiposity, depresses the anabolic activity of insulin in stimulating protein synthesis leading to loss of protein of muscle mass and thereby leads to decline in muscle strength and quality. Fat tissue also secretes many adipocytokines like IL-6, TNF- α and Leptin leading to catabolic effect on muscles which in turn

resulting in decline in muscle mass and strength. Longterm exposure to obesity is associated with poor hand grip strength later in life. Maintaining ideal body weight throughout life ,maintains adequate muscle strength. Physical inactivity leads to fatness and low lean body mass and muscle strength. All these are supporting our study results.^[9,22,25]

Usharani Y S et al studied the Influence of body composition on handgrip strength and handgrip endurance in adult females aged 22-40 years and concluded that the obese females showed poor handgrip strength and handgrip endurance compared to the non obese individuals.^[25]

Dhananjaya J R et al done a study as a comparative study of body mass index, hand grip strength, and handgrip endurance in healthy individuals and revealed that there is correlation between BMI, HGS, and HGE. HGS and HGE depend on various factors such as age, sex, built, strength of muscle, arm span, and diet.^[23]

Smrithy Shetty et al studied the influence of various anthropometric parameters on hand grip strength and endurance in young males and females and found hand grip strength was greater among males as compared with females and a significant negative correlation between the HGS and weight in overweight males.^[21]

Muscle strength determined mainly by muscle girth. Muscles with increased cross sectional area can generate more force and can lift more weight than muscles with small cross sectional area .Impairment of muscle strength (negative correlation between hand grip strength in overweight and obese males) may be a consequence of both obesity and low physical fitness. Physical activity hindered the body fat accumulation and profound use of hands and fingers during physical activity leads to greater muscle strength. The study concluded that hand grip strength is the powerful predictor of health and vitality in both men and women.^[21]

The maximal isometric tension (MVC) and Endurance Time (ET) exerted by obese were found to be comparatively lower and this could be due to the underlying autonomic dysfunctions leading to decreased work performance.^[22,25]

Grip strength measured by Dynamometry can be used as an indicator of muscle status. Also it carries number of clinical and prognostic value.^[12]

HGS refers to maximum voluntary force/Torque of short duration that skeletal muscles can bring to bear on the environment. Although the respiratory/pelvic floor muscles/trunk muscles bring force to bear on the environment, it is the limb muscles whose strength is most often of interest. Of many limb muscles, those generating grip force are commonly used for determining muscle strength. Grip strength is the simplest and least complicated. HGS tends to reflect the overall muscle strength.^[12]

The determination of HGS is of immense importance in determining the efficiency of different treatment plans and rehabilitation procedures. Grip strength determines the handedness of the individual. It is an

indicator of overall physical status. HGS is an important physical variable affected by number of factors such as age, gender and body weight. HGS has got significant predictive validity and simplicity, to be considered as a vital sign for nutritional assessment.^[12,22]

Hand grip strength is an important test to evaluate physical fitness and nutritional status. It is regarded as the most reliable measure of clinical assessment of human strength. The power of handgrip is the result of forceful flexion of all finger joints with the maximal voluntary force that the subject is able to achieve at normal bio-kinetic conditions. Hand grip endurance is the ability to sustain a muscular force. Muscle strength may be impaired in obese persons and this impairment may be a consequence of both obesity and low physical fitness.^[10]

HGS is a simple index of skeletal muscle function and a functional index of nutritional status, influenced by effort and skeletal muscle bulk and contractility.^[10,12] All are supporting our study outcomes.

Long term exposure to obesity is associated with poor HGS in later life. HGS can be us as a proxy for overall functional status of the individual.^[12] Obesity is associated with functional limitations of muscle performance and there occurs increased likelihood of developing functional disability such as mobility, strength, posture and dynamic balance limitations.^[12] Muscle endurance is the ability of a muscle/group of muscles to sustain contractions over an extended period of time. Power of handgrip is the result of forceful flexion of all finger joints with maximum voluntary force under normal biokinetic conditions.^[25]

Hand Grip Strength and Endurance have evolved as an important tool for the assessment of the nutritional status and as a marker of muscle quality. In obese, there is a possibility of change in muscle quality. Obese persons have fatty infiltration and change in the distribution of Type I and Type II Muscle fibres which will alter the muscle strength and endurance. Literature revealed similar results.^[10]

In both men and women, better grip strength was associated with a significantly reduced risk of mortality from all causes in age adjusted analyses. Longitudinal studies suggest that poor grip strength is predictive of increased mortality from cardiovascular diseases.^[29]

Being a predictor of morality, hospital length of stay and physical function, Grip strength should be considered for routine use as a vital sign. Grip strength also informs regarding nutritional status and muscle mass, physical function, and health status. Grip strength can provide an indication of an individual's overall strength.^[12]

Maximum voluntary contraction of a muscle is determined both by neural drive from motor cortex to muscle and by the muscle mass, hence it can be used as indicator of function of both the neural and muscle systems and an overall indicator of person's vigour.^[26]

Greater strength may mark some general intrinsic vitality in midlife/stamina that tracks into health status of old age and mark the characteristics of long lived phenotype. Genes that determine muscle strength are therefore the potential candidate genes for longevity.^[22-26]

BMI is an indicator of body mass. It does not take the fat percentage into account and hence it is not able to differentiate between the weight changes which are due to either increase or decrease in muscularity and body fat percentage.^[10]

Increased HGS which involves intact neuromuscular activity is associated with decreased risk of dementia and cognitive decline. Weak HGS may be an early risk of cognitive impairment as hand grip strength could be reflected by change in neuronal activity or white matter integrity. Strong HGS needs better neuromuscular coordination especially in frontal cortex. HGS is a simple and useful marker in predicting future cognitive impairment. Increase in body fat leads to brain atrophy and decreased hippocampal function through altered DNA methylation of genes involved in memory. Weak muscle strength and cognitive impairment share some common pathophysiological mechanisms such as systemic inflammation, insulin resistance and oxidative stress resulting in decreased muscle strength and cognitive impairment.

Sarcopenia aggravate the risk of cognitive decline by decreasing the secretion of insulin like growth factor.^[26]

Muscle strength is determined mainly by the size of the muscles, with a maximal contractile force between 3 and 4 kg/m² of muscle cross-sectional area. Besides BMI, several other factors like grip span, body size, skeletal muscle bulk, arm muscle circumference, strength, efforts, all influence the handgrip strength as well as the hand grip endurance.^[27]

Leong et al determined that hand grip strength was related to all causes, cardiovascular and non-cardiovascular mortality over a median 4 years follow up and pointed that grip strength was a strong predictor of all-cause and cardiovascular mortality than systolic blood pressure.^[29]

CONCLUSION

Though our study is no means exhaustive, it provides a glimpse relating to the impact of obesity showing decline in hand grip strength and endurance as excess adipose tissue accumulates. which may make the obese subjects prone for hypertension and other cardiovascular complications in later life.

This study highlights the need for aggressive reduction of weight in obese individuals, which may be a potential target for the management of obesity and its complications.

Thus it is the need of the hour to set guidelines for detection of obesity in our population to enable early detection of obesity, so that early & prompt treatment

or prevention strategies can be framed and huge hidden burden of future obesity health consequences can be reduced.

Limitations

1.This study included only obese females of 35-45 years and not males. More studies are needed involving males and also females of different age groups, involving larger sample size.

2.Muscle strength was assessed using handgrip dynamometer and also the endurance time.

In future, nerve conduction studies will also be done for assessing the nervous dysfunctions in obesity.

3.In future, studies can be done to determine the effects of gender on HGS/HGE and also to employ Waist Hip Ratio(WHR), Waist Circumference(WC), Skinfold thickness parameters to assess obesity in addition to BMI.

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