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Comparing Hand grip strength in young adult with Prediabetes and Healthy individuals: a cross sectional study

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ABSTRACT

Background: - **The aim** of the study lasting 6 Month is to Comparing Hand grip strength in young adult with Prediabetes and Healthy individuals: a cross sectional study

Objective – Prediabetes is the precursor stage before diabetes mellitus, whereby the blood glucose level is above normal ranges but not crossing the diabetic threshold and therefore not all symptoms are prominent.

Pre-diabetics was defined according to the American diabetic association (ADA) recommendation included those with Postprandial glucose between 140 and 199 mg/dL and fasting glucose between 100 and 125 mg/dL.

Hyperglycemias has detoritating multi system effect and there is evidence supporting that increased level of sugar impacts the musculoskeletal system also very little testing and research is done on young adult age group which only makes the prediabetic condition worse

and also researches suggest handgrip strength can sum up the entire body strength of an individual with this idea in mind

1) to compare and study the relation between healthy individual and prediabetic individual hand grip strength among young adult age group using hand dynamometer

2) to see if hand dynamometer can be use in clinical environment as inexpensive, non-invasive tool for screening for prediabetes risk factor

Methodology – it was a cross sectional study and sampling type was purposive , samples were collected from pune city hospitals and OPD and diabetic clinics and pathological Labs across city , 64 individuals were chosen who fulfilled the inclusion criteria out of which 32 were healthy individual and 32 were prediabetic , the healthy individuals and prediabetic individuals were age, gender, BMI, dominance , matched consent form was signed by the individuals confirming their willingness to participate in the research , and using a Baseline hand-dynamometer an average of 3 Trials were noted down for dominant hand and for non-dominant hand (right hand and left hand)

Results – the Data when analyzed showed the hand grip strength of prediabetic samples when compared to healthy samples were reduced Age, BMI, Dominance, Gender Matched young adults

The paired T test for Age, gender, Dominance, BMI was significant

Whereas the unpaired T test for handripstrength between prediabetic and healthy individual left hand as well as right hand showed significant difference >0.0001

Conclusion

1) The results of this study conclude that hand grip strength is reduced among prediabetic individual, when compared to heathy individual among Young adult age group.

2) And hand-held dynamometer can be used as a screening devise for loss of hand grip strength, which can be indicative of risk of prediabetes. Leading to diabetes mellitus, and functional disabilities due to hand weakness.

Keywords: Diabetes-Myopathy,atrophy,Prediabetes, diabetes mellitis, Muscle strength, hand-grip strength, Young, Adult, screening, tool, Clinical-Tool, Cross sectional study, Indian population, risk factor, musculoskeletal-system, Physical activity, age, BMI, physiotherapy, ICD-10,

I. INTRODUCTION

DIABETES

Diabetes Mellitus [DM] refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. (1) there is impairment of insulin release or impaired function, both type 1 and type 2 diabetes are drastically

different but the symptoms arising often overlap diabetic myopathy is one such condition

Diabetes is fast becoming the epidemic of the 21st century. (6) Over the past 30 years, the status of diabetes has changed from being considered as a mild disorder of the elderly to one of the major causes of morbidity and mortality affecting the youth and middle-aged people.

Diabetes is a progressive disease and thus its important to manage and control diabetes at the prediabetes stage hyperglycemia can lead to many complications that affect musculoskeletal system, cardiac muscle, neurological impairment there are cohort studies that suggest increased BMI has an association with increased risk of hyperglycemia preventing obesity helps reduce that risk,

PREDIABETES

Prediabetes is the precursor stage before diabetes mellitus, whereby the blood glucose level is above normal ranges but not crossing the diabetic threshold and therefore not all symptoms are prominent. The progression of Diabetes type 2 can be halted if detected at prediabetes stage isolating prediabetes as a distinct pathogenic condition is controversial. Evidence suggest that prediabetes is closely related to pathophysiological changes in organs and tissues this could support and help isolate prediabetes as a distinct pathological entity

Pre-diabetics was defined according to the American diabetic association (ADA) recommendation included those with Postprandial glucose between 140 and 199 mg/dL and fasting glucose between 100 and 125 mg/dL.

Hyperglycemias has detoritating multi system effect and there is evidence supporting that increased level of sugar impacts the oxidative stress, musculoskeletal system also very little testing and research is done on young adult age group which only makes the prediabetic condition worse

and also researches suggest handgrip strength can sum up the entire body strength of an individual with this idea in mind

Prediabetes is the precursor stage before diabetes mellitus in which not all of the symptoms required to diagnose diabetes are present, but blood sugar level is abnormally high. The glucose levels are higher than normal but not enough to touch the diabetic thresh hold Pre-diabetics was defined according to the ADA recommendation included those with Postprandial glucose between 140 and 199 mg/dL and fasting glucose between 100 and 125 mg/dL.

Moving ahead in the field of diabetes a number of studied surveyed and studied gives a predominant reflection to this present study. following paragraphs gives the inputs to the study and are of prime importance.

A study of prevalence of prediabetic in 15 states was conducted and had findings supporting Maharashtra to have high number of prediabetics

A recent study demonstrates the effect of diabetes on skeletal muscle mass seems to manifest even in early stages of disease (12) (13)Evidence suggests that diminished strength may be present prior to the onset of diabetes. Further, greater declines in lean mass among undiagnosed diabetics as compared with prevalent cases suggests that the diabetic impact on lean mass occurs early in the disease process. (12) (13)

It must be noted that, while strength declines are highly prevalent during the mid-life stage, it is the early measures of strength as one begins the mid-life stage that are most predictive of incident diabetes. Moreover, the study findings reinforce the importance of achieving maximum physical functioning during young adult stage as a potential intervention to reduce diabetes later in life.

GRIP STRENGTH AND DIABETES

It is also indicated that grip strength has been shown to be an appropriate measure to identify overall muscle weakness the strong association between grip strength and incident diabetes suggests that grip strength assessment may be a promising screening tool for the identification of diabetes risk. In a study by ErcanCetinus Hand grip strength values were found to be lower in patients with Type2DiabetesMellitus than in age-matched control subjects. Therefore ,this study is to assess hand grip strength in Prediabetes young adults and compare it between prediabetes and young healthy adults.

It is understood that there is a strong relationship between grip strength and diabetes.

Individuals that are prediabetic stand at a greater risk for type 2 diabetes compared to normal glucose level individuals also diabetes is a progressive condition so intervening at a prediabetes stage stand at an advantage

Studies have found that Loss of muscle strength is associated to diabetes and that insulin resistance causes muscle protein loss this is due to skeletal muscle being major site of insulin mediated glucose uptake and therefore when muscles capacity decreases the insulin resistance increases that progresses to diabetes

Previously there are studies that found that strengthening muscles with exercise has reported improved glycaemic control in patient with diabetes this is because physical activity which leads to energy expenditure and , skeletal muscle contraction , can activate glucose metabolism also prevent obesity and improve diabetes
Thus, the researcher finds it important to explain the core point further and also has decided to take up the study in light of the significance explained in the following section

SIGNIFICANCE OF THE STUDY

During the past decade the prevalence of type 2 diabetes has increased alarmingly world-wide.India scores second to china as per 2019 and by 2045 India will have the highest number of diabetic in the world 135million expectedly.

The prevalence of prediabetes in Maharashtra is found to be very high and increasing rapidly Most people with prediabetes are at great risk to develop type 2 diabetes and cardiovascular diseases.

Research suggests that diminished strength may be present prior to the onset of diabetes. (14)

A study has proven strong association between grip strength and type 2 diabetes in adults suggesting that, grip strength assessment may be a promising screening tool for the identification of diabetes risk, particularly earlier in the life course before the onset of other hallmark risk factors for disease.Recent data shows that the effect of insulin resistance on the skeletal muscle mass seems to manifest even in the early stage of disease.

There are studies proving reduced hand grip strength in Type 2 Diabetes mellitus in middle age population.

Very few studies have assessed grip strength in prediabetes young adults. Hence the purpose is to asses hand grip strength in young adult with prediabetes.

Handgrip strength is the most cost effective tool , non-invasive , rapid , device to measure muscle strength in fact its use to diagnose sarcopenia , in epidemiologic studies , research suggest early Mid-life handgrip strength loss is associated with functional limitation , and can be Disabling and therefore we consider it as a as predictor for healthy ageing

- Many research articles suggest that there is loss of muscle mass associated with glucose intolerance subject. growing age also contributes diabetes associated sarcopenia can explain this, but among young adult prediabetics one reason of loss of strength can be,
- Cells do not heal rapidly, also muscle mass and strength reduces because there is improper synthesis of glucose into cells as a result energy production is reduced as a result cells start undergoing atrophy this justifies loss of muscle mass and strength there is also muscle mitochondrial dysfunction,
- Other mechanisms such as increased adiposity in muscles tissue, Oxidative stress results from a cell or tissue failing to detoxify the free radicals that are produced during metabolic activity only adds on
- Impaired glucose tolerance has also shown to reduce myofiber size and muscle mass and poor metabolic control disease is associated with a decline in skeletal muscle capillarization and angiogenesis (Kivelä et al., 2006; Krause et al., 2009). These alterations to muscle structure and metabolism often are associated with reductions in muscle function (3) reduced muscle mass causes reduced area of glucose transport and exacerbation of insulin resistance (4)
- The precise mechanisms for the observed associations must be examined in future studies.

The following studies mentioned in the review of related literature will further highlight the mode of the study.

II. REVIEW OF LITERATURE

Review of related literature helps the researcher to take a stand and direction to our study.

1.Dr. Raj Vaishnavi A. R, Dr. D. Selvam.Correlation of hand grip strength [a proxy of lean body mass] among adult males with impaired and normal fasting blood glucose levels.Journal of Applied Research:2019April Conclusion: The study demonstrates reduced handgrip strength even in the earlier stages of diabetes

2. Shan Hu BM et al.Relationship Between Grip Strength and Prediabetes in a Large-Scale Adult Population:American journal of preventive medicine2019 June concluded thatIncreased grip strength is independently associated with lower

prevalence of prediabetes in Chinese adults, suggesting that grip strength may be a useful marker for screening individuals at risk of prediabetes

3. Arch G. Mainous, Rebecca J. Tanner, Stephen D. Anton and Ara Jo.Low Grip Strength and Prediabetes in Normal-Weight Adults:The Journal of the American Board of Family Medicine; March 2016 : Grip strength is associated with prediabetes among healthy-weight US adults. Grip strength may have utility as an indicator for screening healthy-weight individuals for prediabetes.

4.Chrispin Mahala Manda et al.Handgrip strength predicts new prediabetes cases among adults: A prospective cohort study2020 March This study found that baseline relative handgrip strength predicts incident prediabetes among adults in Japan. The findings suggest that relative handgrip strength may be used to identify individuals at high risk of prediabetes especially among normal weight individuals who may benefit from early intervention to reduce the risk of type 2 diabetes and cardiovascular disease.

5. The Association of Handgrip Strength and Type 2 Diabetes Mellitus in Six Ethnic Groups: An Analysis of the HELIUS Study;2015 Sep suggests that handgrip strength may be investigated as a target for intervention or a marker to identify people at risk of type 2 diabetes mellitus.

6. Neha M1, Jitendra L2 and Lata P. Comparison of Hand Grip Strength in Diabetics and Non-Diabetics-An Observational Study: Medical Journal of Clinical Trials & Case Studies2019May31Handgrip strength values were found to be lower in subjects with T2DM than in those without diabetes. As the age and duration of diabetes increased, the handgrip strength decreased.

7. ErcanCetinus et al.Hand grip strength in patients with type 2 diabetes mellitusDiabetes research and clinical practice 2006Jan;Hand grip strength and key pinch power values were found to be lower in patients with T2DM than in age-matched control subjects. Hands, as well as feet, are also affected by diabetes and physicians should be aware of this.

8.Anjana RM, Deepa M 2017Aug - Prevalence of diabetes and prediabetes in 15 state of India: results from the ICMR-INDIAB population-based cross-sectional study. (PubMed research article) conclusion - There are large differences in diabetes prevalence between states in India

III. METHODOLOGY OF THE RESEARCH

AIM- To assess the hand grip strength in young adult with prediabetes

OBJECTIVES-

1.To assess the hand grip strength in young adults with Pre-diabetes

2. To assess the hand grip strength in normal young adults

3. To compare the hand grip strength in pre-diabetes young adults with healthy young adults

HYPOTEHSIS

Null Hypothesis (H0) – There will not be any difference in grip strength of pre-diabetes and normal healthy young adults

Alternative Hypothesis – There will be difference in grip strength of pre-diabetes and normal healthy young adults

Study design- The present study is a **Cross sectional study**

Sampling method –The researcher has selected **Purposive sampling**

Study duration - The duration of the study is **6 months**

Study setting – Diabetes clinics, Hospitals, OPD, Pathology labs around Pune City, Maharashtrastate, India

Sample size – 64

MATERIAL

The material used for the recording of data is as follows.

1)Hand dynamometer (Baseline)
2) stationary – pen,paper, consent form
3)Measuring tape (height measuring for BMI)
4) weighing scale (weight scaling to determine BMI)

Criteria

The criteria used in the research is separately mentioned as inclusion and exclusion criteria. The details are mentioned as below.

Inclusion criteria:

The inclusion criteria is based on the prediabetic records, age group, exercise routine and patient's willingness. Precisely to be mentioned as below:

- Diagnosed prediabetes since past one year
- Age group 19-30 male and female
- Patient has no gym activities or exercise in routine
- Patient is aware and willingly participating

Exclusion criteria

The exclusion criteria used in the present research is precisely mentioned below. The details are diabetes detected, medical records during the past years, health related habits and medical history. The details are mentioned below precisely,

- Known diabetes

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- Wounds, dressing, or unhealed injury in hand, Trauma in upper limb, facture around the hand within the past year
- History of stroke
- Any history of ongoing medication which could affect the muscle performance
- Intravenous line on the hand
- Inflammatory conditions
- Alcoholism -
- Pregnant women
- History of crushed injury

INSTRUMENT

Moreover, the instrument used to record the data needed was a hand dynamometer. The Hand dynamometer is an instrument and an evaluation tool that is used to measure hand grip strength.

Outcome measure

Hand Dynamometer (baseline):(R=0.95) (v=0.94) used to measure hand grip strength

IV. SAMPLEPROCEDURE AND STEPS FOLLOWED IN THE STUDY

As it is already mentioned that the study was a cross sectional study and sampling type was purposive , samples were collected from pune city hospitals and OPD and diabetic clinics and pathological Labs across city , 64 individuals were chosen who fulfilled the inclusion criteria out of which 32 were healthy individual and 32 were prediabetic , the healthy individuals and prediabetic individuals were age, gender, BMI, dominance , matched consent form was signed by the individuals confirming their willingness to participate in the research , and using a Baseline hand-dynamometer an average of 3 Trials were noted down for dominant hand and for non-dominant hand (right hand and left hand)

The study began after the approval from ethical committee of PES Modern College of Physiotherapy. Study was conducted in and around Pune. Participants were selected according to Inclusion and Exclusion criteria. A written consent was taken of the participants. The participants were properly instructed about the procedure to perform hand grip strength test (HGST).HGST was performed using a hand hold calibrated dynamometer. Grip strength was assessed for prediabetes. The participants of the study were made to sit comfortably. (America society of hand therapist) ASHT proposes with elbow flexed at 90 degree, with their shoulders adducted, forearms in neutral position. 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 were noted in kg. A recovery period of 2 mins interval given. The same procedure was repeated 3 times with 2 mins interval apart. The average of the above three measurements was taken. Same procedure was repeated with the non-dominant hand and data was recorded. The grip strength was assessed for normal young adults. Grip strength of normal young adults was compared with prediabetes grip strength (age, gender and BMI matched individuals). Data was then analyzed using t test.

V. DATA ANALYSIS

- The Data that fulfilled the inclusion criteria, was exported to excel sheet and was further analyzed.
- Statistical analysis was done using Instat GraphPad prism 9.
- The hypothesis was tested using paired- T-test.

Data table	Healthy Individual Mean	Prediabetic Individual Mean	P-Value
BMI	28.469	29.559	0.1062
Age	25.625	26.156	0.4608
Left HGS	29.289	25.830	< 0.0132
Right HGS	29.060	25.938	< 0.0179

The gender wise pie chart distribution is depicted below.

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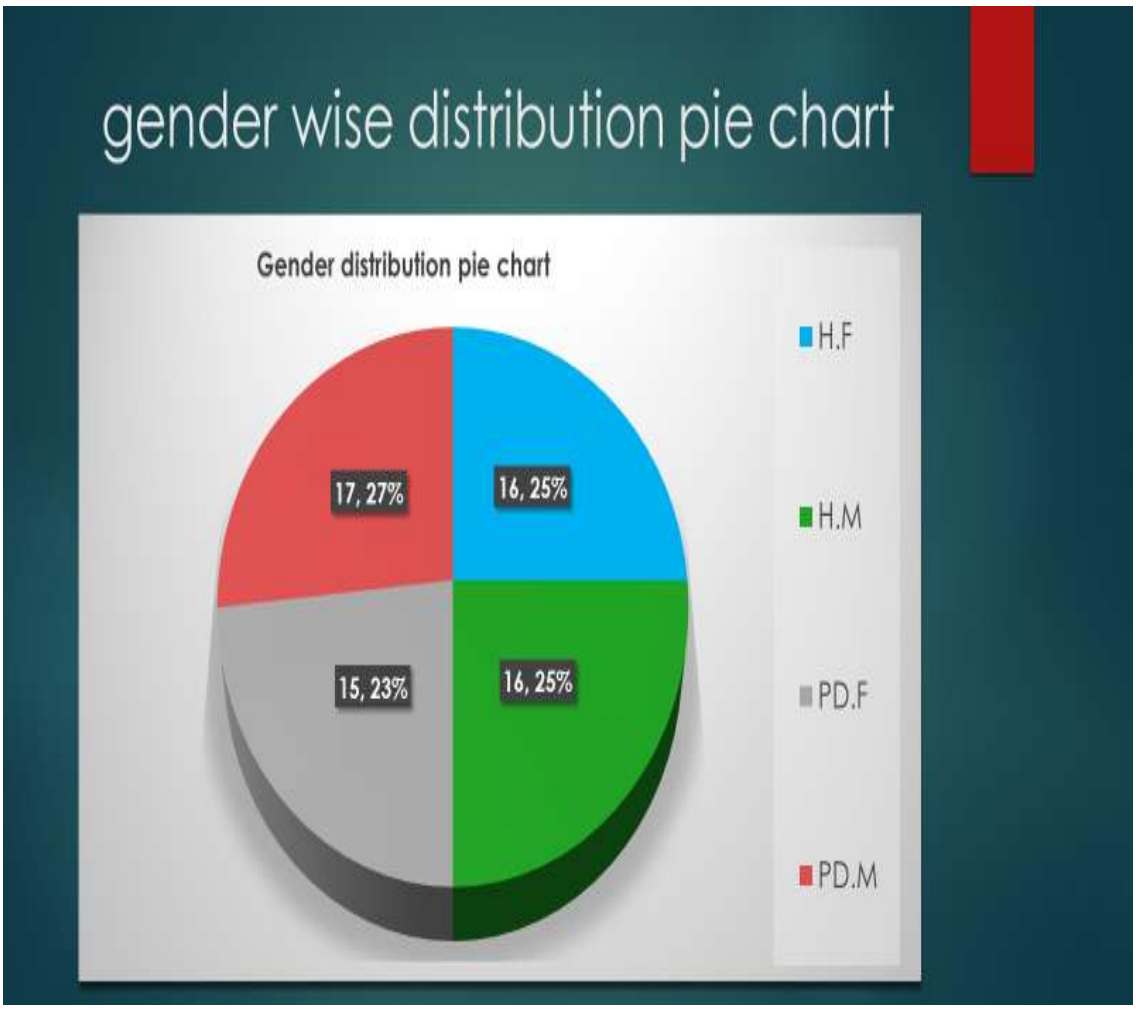

H.f- (Blue colour)	**Healthy female population**	**16**
H.M (Green colour)	**Healthy male population**	**16**
PD.F (Yellow colour)	**Prediabetic Female population**	**15**
PD.M(Red colour)	**Prediabetic Male population**	**17**

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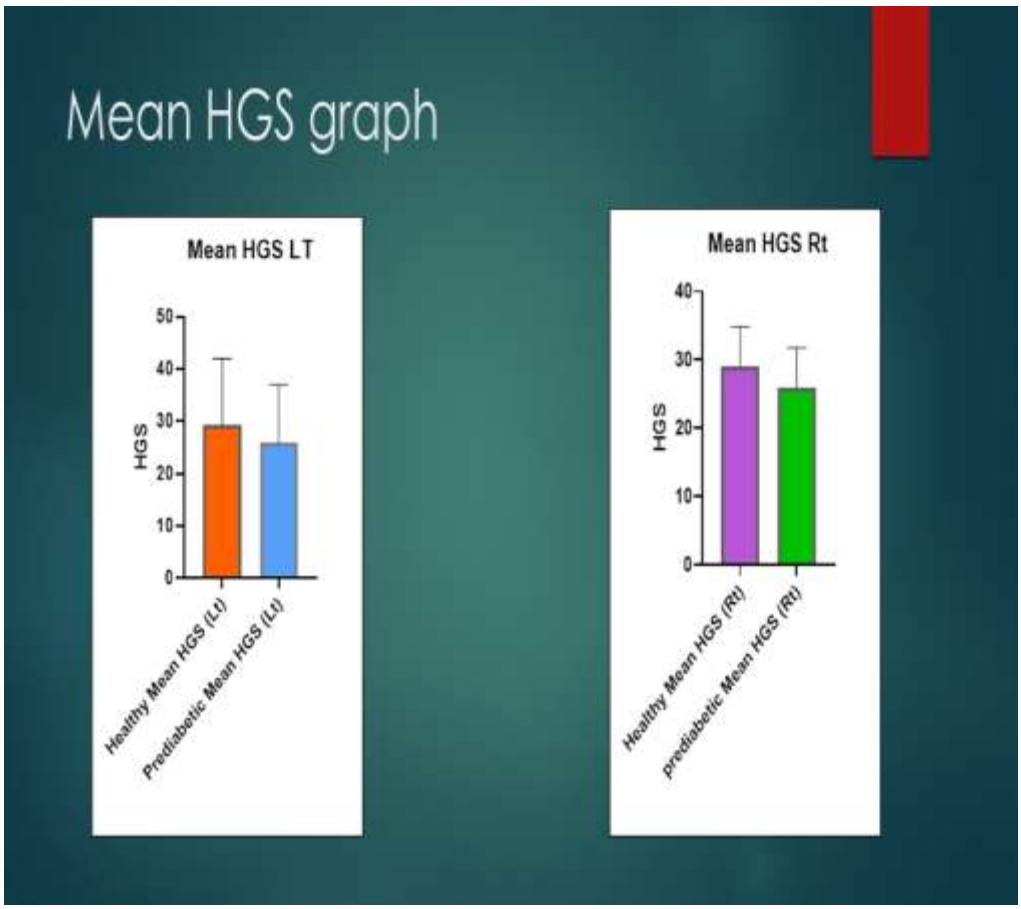

VI. RESULTS AND CONCLUSION

The Data when analyzed showed the hand grip strength of prediabetic samples when compared to healthy samples were reduced Age, BMI, Dominance, Gender Matched young adults

The paired T test for Age, gender, Dominance, BMI was significant

Whereas the unpaired T test for hand grip strength between prediabetic and healthy individual left hand as well as right hand showed significant difference >0.0001

- The anthropometric characteristic of the subjectswere mentioned in the above data table. It was observed that there was no significant difference in the BMI and the Age of the subject.
- The mean age of healthy individuals was 25.62, whereas mean age of prediabetic was 26.15. The P value was 0.4608 which was non-significant.
- The mean BMI of healthy individual was 28.46, whereas mean BMI of prediabetic was 29.55. The P value was 0.1062 which was non-significant.
- Hand grip strength was measured using a baseline hand dynamometer, Comparison was made.
- The mean hand grip strength of left hand of Healthy subject, was 29.28. And of left-hand grip strength of prediabetic was 25.83.
- The mean hand grip strength of right hand of healthy subject was 29.06. Compared to the mean right-hand grip strength of prediabetic was 25.93.
- The unpaired T test results showed significant difference >0.0001 between the hand grip strength, Of prediabetic subject and healthy subject.
- The results of this study conclude that hand grip strength is reduced among prediabetic individual, when compared to heathy individual.
- And hand-held dynamometer can be used as a screening devise for loss of hand grip strength, which can be indicative of risk of prediabetes. Leading to diabetes mellitus and functional disabilities due to hand weakness

VII. CONCLUSION AND DISCUSSION

3) The results of this study conclude that hand grip strength is reduced among prediabetic individual, when compared to heathy individual among Young adult age group .
4) And hand-held dynamometer can be used as a screening devise for loss of hand grip strength, which can be indicative of risk of prediabetes. Leading to diabetes mellitus, and functional disabilities due to hand weakness.

Discussion

- Numerous studies have been performed where by, hand grip strength has been associated with diabetes mellitus suggesting inverse relationship between glucose level and hand grip strength.
- This research study emphasizes on analyzing, hand grip strength in prediabetic young adult population, comparing the data with healthy subjects with health matched.
- The data obtained from this research suggest, that handgrip strength of prediabetic individual is lower compared to hand grip strength of healthy subjects.
- Many research articles suggest that there is loss of muscle mass associated with glucose intolerance subject. growing age also contributes diabetes associated sarcopenia can explain this, but among young adult prediabetics one reason of loss of strength can be,
- Cells do not heal rapidly, also muscle mass and strength reduces because there is improper synthesis of glucose into cells as a result energy production is reduced as a result cells start undergoing atrophy this justifies loss of muscle mass and strength there is also muscle mitochondrial dysfunction,
- Other mechanisms such as increased adiposity in muscles tissue, Oxidative stress results from a cell or tissue failing to detoxify the free radicals that are produced during metabolic activity only adds on
- Impaired glucose tolerance has also shown to reduce myofiber size and muscle mass and poor metabolic control disease is associated with a decline in skeletal muscle capillarization and angiogenesis (Kivelä et al., 2006; Krause et al., 2009). These alterations to muscle structure and metabolism often are associated with reductions in muscle function (3) reduced muscle mass causes reduced area of glucose transport and exacerbation of insulin resistance (4)
- The precise mechanisms for the observed associations must be examined in future studies.
- Studies have been performed to evaluate hand grip strength and various grips, where comparison was drawn between diabetic population and healthy individual this is possibly a first study done where comparison is being drawn between prediabetic individual and healthy young subjects.
- This study is in close relation most researches done evaluating hand grip strength of diabetics and healthy subjects, its consistently shows reduced hand grip strength when compared to healthy individuals irrespective of the dominance gender and BMI.
- In this study, Based on the results we can emphasize on , the importance of measuring hand grip strength . And this can be used for screening purpose early intervention and treatment purpose. as we know prediabetes condition leads on to develop into diabetes mellites, which is a burden on health system itself and for patient as well, with multiple complications associated.

VIII. LIMITATIONS

- Daily Physical activities of subject, has influence upon the hand grip strength. Regardless of the health condition when health matched. This was not taken into consideration (eg-motor mechanics or plumber working with wrench for long durations)
- greater sample size would have made this study more strong and reliable

IX. FUTURE SCOPE

- Some research articles are suggestive that along with loss of hand grip strength, there is also quadriceps strength loss. And Ankle dorsiflexor, which may also be taken into consideration
- Along with BMI of individual, their waist hip ratio may also be considered
- Size of hand may also be measured of prediabetic and healthy subject. Health matched as it influences hand grip strength

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Annexure

Consent Form

Name of subject –
Gender -
Age –
Dominance -

I Mr. / MISS / Mrs.
Acknowledge that I have been explained the nature of the study to me and its purpose and the appropriate procedure was explained and or demonstrated to me I willingly participate in the study and give my authorization to the physiotherapist to carry out His / Her study and collect data for the purpose of their project research Titled
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Signature Date

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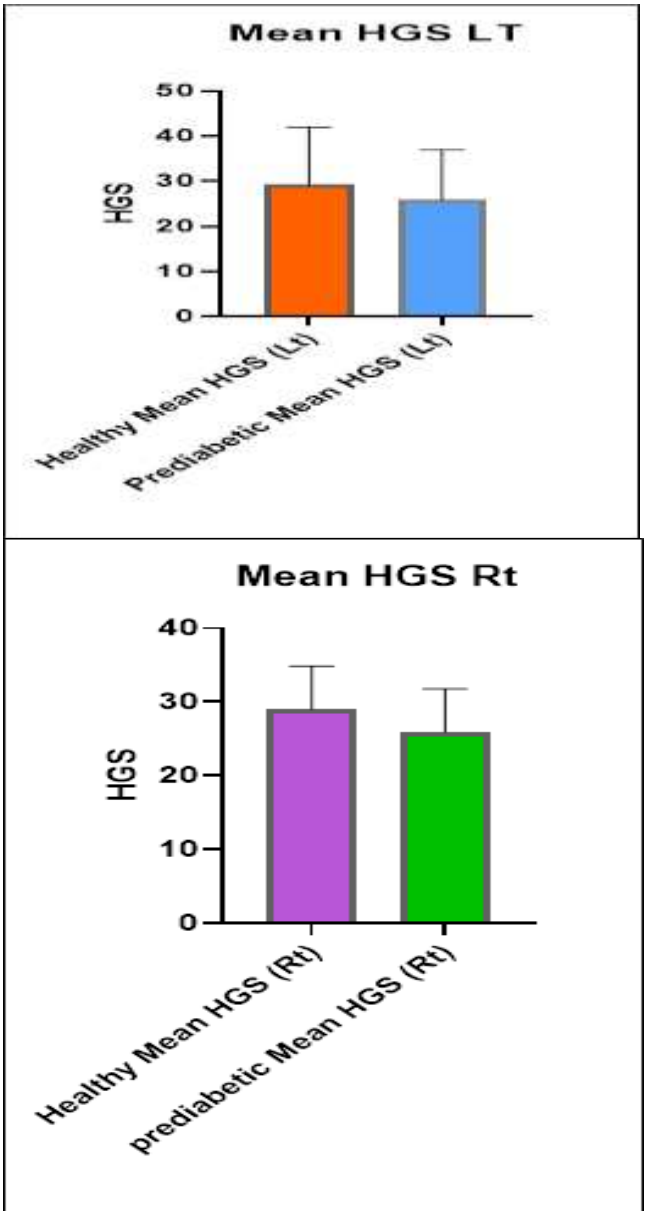
Data Table for paper record

	Trial 1	Trial 2	Trial 3	Mean
Name				
Age				
Dominance				
Gender				
Height in Cms				
Weight in Kgs				
BMI				
Left Hand HGS in Kg				
Right Hand HGS in Kg				

Graphs and Data table



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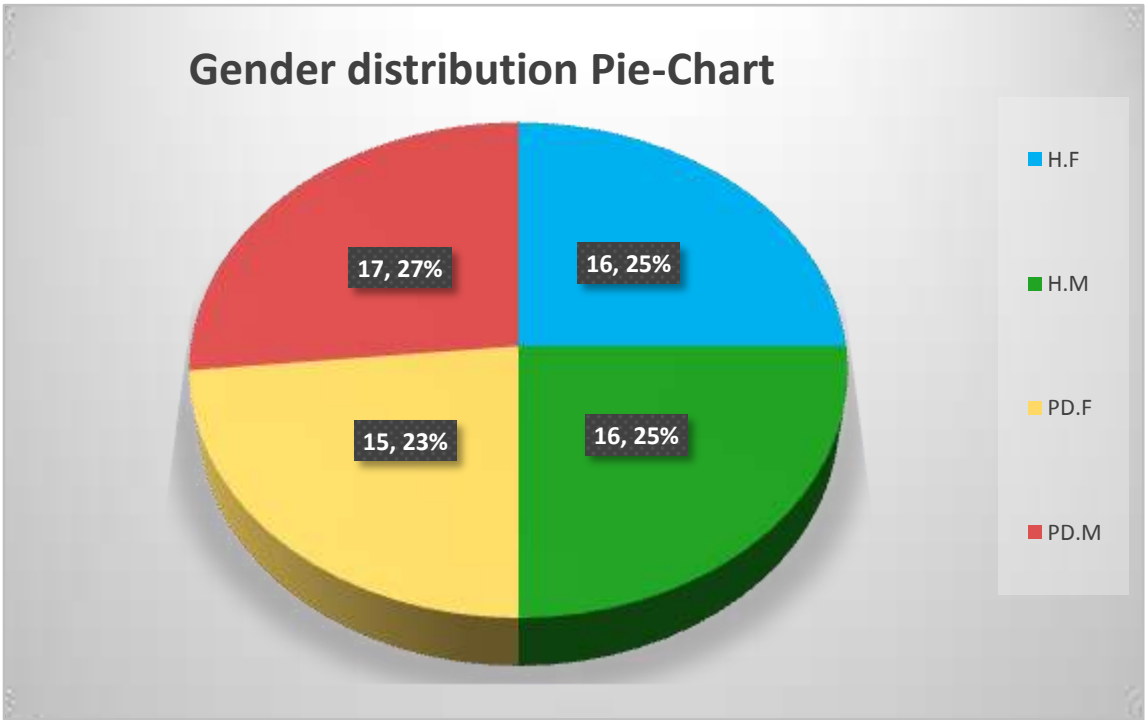

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H.M (Green colour)	**Healthy male population**	**16**
PD.F (Yellow colour)	**Prediabetic Female population**	**15**
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DataanalysisTable

Baseline - Handheld dynamometer used
Hand Dynamometer (baseline): (R=0.95) (v=0.94) used to measure hand grip strength

(Image credit to www.sport-thieme.com)