International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Assessment of Objective and Subjective Fatigability in Obese

Shrutika Sunil Kadam[1], Yogesh Kadam[2]

[1]BPTh Intern, RJS College of Physiotherapy, Kopargaon
[2]Associate Professor, Department of Community Physiotherapy, RJS College of Physiotherapy, Kopargaon

Abstract
Aim: This study aimed to quantify objective fatigue using the Long Distance Corridor Walk (2-Minute Walk Test and 400-Meter Walk Test) and evaluate subjective fatigue using the Fatigue Assessment Scale (FAS) in obese adults.
Objective: To assess the prevalence of fatigue in obese.
Methods: An observational study was conducted on 60 obese adults (BMI > 30 kg/m²), aged 18–25 years, recruited from the Kopargaon region. Participants meeting inclusion and exclusion criteria were assessed using the FAS, 2MWT, and 400MWT. Data were analyzed using unpaired t-tests to compare no-fatigue and moderate-fatigue .
Results: Age did not differ significantly between groups ($p > 0.05$). However, BMI was significantly higher in the moderate-fatigue (mean 32.5) compared to the no-fatigue (mean 28.5) ($p < 0.01$). Functional performance outcomes showed that the moderate-fatigue walked shorter distances in the 2MWT (119.4 m vs. 123.5 m, $p < 0.05$) and required longer times in the 400MWT (377.6 s vs. 352.0 s, $p < 0.01$). These findings indicate that higher BMI is associated with increased fatigue and reduced walking performance.
Conclusion: Fatigue in obese young adults is strongly associated with BMI and measurable declines in physical performance, despite their relatively young age. Subjective fatigue, as assessed by the FAS, aligns with objective measures of fatigability. Early identification and management of fatigue in obesity are essential to prevent long-term functional decline and associated comorbidities.

Keywords: Obesity, Fatigue, Fatigue Assessment Scale, 2-Minute Walk Test, 400-Meter Walk Test

Introduction

Obesity, defined as a Body Mass Index (BMI) greater than or equal to 30 kg/m2 , is a significant public health concern. According to the World Health Organization, worldwide obesity has more than doubled since 1980and in 2008 there were about 1.5 billion overweight adults ($25 \leq BMI < 30$ kg/m2). Of these, over 200 million men and nearly 300 million women were obese (1) Recent research has established the physiology of weight regulation, the pathophysiology that leads to unwanted weight gain with establishment of a higher bodyweight set point, and the defence of the overweight and obese state even when reasonable attempts in lifestyle improvement are made. This knowledge has informed our approach to obesity as a chronic disease.(2)The recognition that being overweight or having obesity is a chronic disease and not simply due to poor self-control or a lack of will power comes from the past 70 years of research that has been steadily gaining insight into the *physiology* that governs body weight (homeostatic mechanisms involved in sensing and adapting to changes in the body's internal metabolism, food availability, and activity levels so as to maintain fat content and body weight stability), the pathophysiology that leads to unwanted weight gain maintenance, and the roles that excess weight and fat mal distribution (adiposity) play in contributing to diabetes, dyslipidaemia, heart disease, non-alcoholic fatty liver disease, obstructive sleep apnea, and many other chronic diseases(2-3)

The prevalence and trends in obesity observed in most of developed and developing countries would not be so serious if not because of the harmful effects of obesity on many different physical and mental health outcomes. In the present review, we will discuss in depth how obesity is not only related with cardio-vascular disease (CVD) in the general population but also, as a complex condition, is associated with CVD differently depending on certain relevant factors. Particularly, we will comment on how the number of years that a person lives with obesity affect CVD outcomes, as well as on other important concepts, such as the fat-but-fit paradigm, the metabolically healthy but obese (MHO) phenotype and the obesity paradox in patients with CVD.

Leading risks for cardiovascular disease: Cardiovascular disease continues to be a leading cause of morbidity and mortality throughout the world. In 2008 alone, 770,000 Americans will experience an acute myocardial infarction (AMI) and an additional 430,000 will have a recurrent event . There are strong associations between cardiovascular disease risks and obesity. In a prospective study of over a million people followed for 14 years, obesity was strongly associated with an increased risk of all-cause and cardiovascular mortality.

Obesity is gaining support as an independent risk factor for heart failure (HF), as verified in small population-based study This hypothesis was strengthened in a prospective population study of approximately 6000 subjects followed for over 14 years that reported a two fold increase in the risk of developing HF among those individuals who had a BMI greater than 30 kg/m2, even after adjusting for coronory artery disease(CAD), hypertension, and left ventricular hypertrophy.

A subjective lack of physical and/or mental energy that is perceived by the individual is defined as Fatigue.(4) Fatigue, used interchangeably here with tiredness and exhaustion, has significant health implications in the obese.(5) demonstrated the importance of fatigue in activity limitations among older adults.

The data indicates that fatigue prevalence is significantly lower in individuals aged 64 to 75 compared to those in the 36 to 63 age group. Additionally, in a large sample of French general practice patients, fatigue rates consistently decrease with age from 18 to 64. This suggests a potential trend where older adults experience less fatigue, contrasting with younger population.(6) It is likely that an accurate estimate of the prevalence of fatigue among older adults will remain elusive. It may be equally challenging to characterize the extent to which self-reported fatigue differs between older and younger adults. fatigue increased with advancing age from 18 to >70 years. In contrast, other studies have shown that self-reported fatigue does not increase with age, and in fact, decreases with advancing age. In a previous study fatigue, the intervention has no demonstrated net benefit; that is, overall function has not improved. Similarly, if a treatment results in increased self-reported fatigue, the treatment may be criticized for having a fatiguing side effect. However, without knowing whether activity has also changed over the same period, such a conclusion would be premature. It is possible that activity may have increased despite increased fatigue. Understanding fatigability, therefore, can provide insight into the extent to which fatigue actually interferes with function.

It should be noted here that the activity component of fatigability is equally relevant to both physical and cognitive (mental) effort. In the next section, examples will be given to illustrate how each of these cons-

tructs may apply in the measurement of fatigability.
Numerous instruments for measuring self-reported fatigue have been published However, there are far fewer examples of instruments for measuring fatigability. As discussed previously, the latter may be preferable because such instruments can adjust for self-pacing and varying energy demands, whether actual or perceived, associated with activity. Measurement of fatigability may take one of 2 forms: self-reported fatigability and self-reported fatigue combined with objectively measured activity. no instrument has been published that specifically and validly measures self-reported fatigability. Nevertheless, a few examples are presented here to illustrate how a fatigability self-report scale may differ from a fatigue self-report instrument. In the tiredness scales of respondents are asked whether they get tired (there is no equivalent word for "fatigue" in Danish) while performing each of 15 activities of daily living, such as getting up from a chair/bed, walking on stairs, and washing the lower part of the body. All items describe activities that are relevant to the functional limitations common in older adults. Scores on these scales have been shown to be responsive to intervention.
the Long Distance Corridor Walk (LDCW), provides a valid estimate of peak aerobic capacity for older adults.(7) and has been shown to be associated with the development of cardiovascular disease, mobility limitations, mobility disability, and total mortality.(8-9)This study aims to examine longitudinal changes in LDCW performance with respect to baseline physical activity status, defined using both type and intensity of activities and established cut points. (10)
The Fatigue Assessment Scale (FAS), was proposed in the Michelsen et al. study, a new instrument. This scale was developed initially in a large representative sample of the Dutch working population. Validation studies have been conducted in a representative sample of the Dutch population, and a working population. These studies have demonstrated that the FAS is a reliable and valid unidimensional fatigue questionnaire. Reliability and Validity Developers Michielsen and colleagues analyzed the scale's psychometric properties and found an internal consistency of .90. Results on the scale also correlated highly with the fatigue-related subscales of other measures like the Checklist Individual Strength. In subsequent analyses, four of the scale's ten items were shown to possess a gender bias – women tended to score significantly higher than men . However, when adjusted scores were calculated, researchers found that this bias had only a negligible effect on each individual's total score, indicating that the scale's original simplified scoring method is still appropriate. (11)

Need of Study-

The study of fatigability in obese adults is essential due to the increasing prevalence of obesity and its associated health complications, which significantly impact individuals' quality of life. Fatigability can lead to decreased physical activity, exacerbating obesity related conditions such as diabetes, cardiovascular disease, and mental health disorders. Understanding the factors contributing to fatigability in this population can help identify barriers to engagement in healthy behaviors and inform targeted interventions. Moreover, this research can fill a critical gap in the literature, providing valuable insights for healthcare professionals and policymakers aiming to enhance obesity management strategies and improve the overall well-being of obese adults. By addressing the multidimensional aspects of fatigability, this study can contribute to a more holistic approach to obesity treatment and support better health outcomes.

Materials & Methodology

- Source of data - SJS OPD , IPD
- Study design – observational study
- Sample population- obsess adults in kopargoan region
- Sampling method – conventional sampling
- Sample size – 60
- Study duration- 6 month

Materials

- Countdown timer (or stopwatch)
- Two small cones to mark the turnaround points
- A chair that can be easily moved along the walking course
- Sphygmomanometer
- Pulse oximeter
- Stethoscope
- Fatigue assessment scale

Selection Criteria

Inclusion criteria –

1. BMI > $30kg/m^2$
2. Presence of breathlessness
3. Age rang 18-25yeaes
4. Stable health condition
5. Willing to participate

Exclusion criteria –

1. Congnitive Impairment
2. Functional Limitations
3. Chronic Disease
4. Cancer
5. Cardiovascular Disease

Outcome Measures-

Fatigue assessment scale:

Reliability and Validity Developers Michielsen and colleagues analyzed the scale's psychometric properties and found an internal consistency of .90. Results on the scale also correlated highly with the fatigue-related subscales of other measures like the Checklist
Individual Strength. In subsequent analyses, four of the scale's ten items were shown to possess a gender bias – women tended to score significantly higher than men . However, when adjusted scores were calculated, researchers found that this bias had only a negligible effect on each individual's total score, indicating that the scale's original simplified scoring method is still appropriate.
Scoring Each item of the FAS is answered using a fi ve-point, Likert-type scale ranging from

1 ("never") to 5 ("always"). Items 4 and 10 are reverse-scored. Total scores can range from 10, indicating the lowest level of fatigue, to 50, denoting the highest.

Procedure

The 100 participants were chosen based on specific inclusion and exclusion criteria, using convenient sampling method and written consents were taken. The procedure was fully explained to them. After that, participants proceeded with the Long Distance Corridor Walk (LDCW). Initially, have the patient walk for 2 minutes. Measure standing blood pressure, and if the systolic pressure exceeds 199 mmHg or diastolic pressure is over 109 mmHg, do not conduct the 2-minute or 400-meter walk tests. Review ECG records, and if there are any abnormalities, avoid performing the LDCW. Provide a brief overview of the LDCW and ask the participant the exclusion questions listed on the first page of the LDCW data collection form.

Script: "The following tests will evaluate your physical fitness by having you walk briskly for 2 minutes and then walk about 1/4 mile at a consistent pace." "Before we start, I need to ask a few questions to determine if you're able to take the test." "In the last 3 months: Have you had a heart attack (such as angioplasty or heart surgery)?" If the participant answers "yes" to any of these questions, do not proceed with the LDCW. "In the past 3 months, have you consulted or considered consulting a healthcare professional for new or worsening chest pain (angina)?" If the answer is "yes" to any of these, only conduct the 2-minute walk.

Check the heart rate, and if it's below 40 bpm or above 110 bpm, ask the participant to sit. After 5 minutes, recheck the heart rate. If it's still below 40 bpm or above 110 bpm, do not conduct the test. Explain the testing process, demonstrate how to walk around the cone, and provide instructions on what to do if symptoms arise. Script: "This walking test has two parts. First, you'll walk for 2 minutes, covering as much distance as possible at a steady pace. Start at the line labeled START, walk to the cone at the other end of the hallway, circle it, and return. Continue walking in this pattern until the 2 minutes are up. I will inform you when to stop. Please stay where you are so I can record the distance you've walked." Script: "Please inform me if you experience any chest pain, tightness, shortness of breath, lightheadedness, dizziness, or pain in your knees, hips, calves, or back. If you feel any of these, you can slow down or stop. Do you have any questions?"

Minute Walk Administration:

Guide the participant to the START line.

Record the participant's heart rate.

Prepare the stopwatch. Script: "Let's begin the 2-minute walk. Cover as much ground as you can at a steady pace. Ready? GO."

Begin timing when the participant's first foot crosses the start line. Provide standard encouragement throughout the walk and inform the participant of the remaining time.

suggested Scripts: "Keep up the good work," "You're doing well," "1.5 minutes to go." Throughout the test, mark a line on the form for each lap completed. When the stopwatch reads 1:30, inform the participant, "30 seconds remaining." At 1:50, say, "10 seconds remaining." Approach the participant at the 2-minute mark and say, Script: "STOP."

Record the heart rate, laps completed, and the meter mark on the form. If the participant does not proceed to the 400-meter walk due to stopping rules, document the reason and remove the heart monitor. If they stop during the 2-minute walk, check the corresponding box on the LDCW data collection form and record the reason in both the 2-minute and 400-meter sections. If contraindications for the 400-meter walk arise after the 2-minute walk, note on the form that the participant "did not attempt due to symptoms during the 2-minute walk.“

400-Meter Walk Administration:

Escort the participant to the START line and record their heart rate.

Explain the 400-meter walk. Script: "For this part, you will walk 10 laps around the course, which is about 1/4 mile. Walk as quickly as you can without running and at a pace you can maintain over 10 laps. I will tell you when to stop and measure your heart rate and blood pressure." "Start walking when I say ‘GO,’ and aim to finish the 10 laps as fast as you can, without running. Ready? GO."

Start the stopwatch and press the SPLIT/RESET button as the participant completes each lap. Record the time for each lap.

Provide encouragement and announce the number of completed and remaining laps (e.g., "4 down, 6 to go"). Suggested Scripts: "Keep up the good work," "You’re doing well," "Looking good," "Well done," "Good job."

When the participant completes the 400 meters (10 laps), stop the stopwatch.

If the participant’s heart rate exceeds 90% of the estimated maximum or 135 bpm for those over 70 without symptoms, instruct them to slow down but continue walking. Note this on the data collection form, along with whether they completed the walk. If the participant reports chest pain, shortness of breath, dizziness, or any leg pain, stop the test and record the reason on the LDCW form.

Record the final time and heart rate. Start the stopwatch again to measure the 2-minute recovery time. If the test completion takes greater than 15 mins stop the test at 15 minutes and record non completion. A 400 m walk test greater than 6 mins is equivalent to speed of 1.1m per sec or slower and indicates low physical performance. After the LDCW is complete, the fatigue assessment scale is used for interpretation.

Stastistical Analysis

Gender distribution for fatigue				
No fatigue			Moderate fatigue	
Gender	Observed	Percentage	Observed	Percentage
Males	13	52	13	37.1
Females	12	48	22	62.9
Total	25		35	

Table No.4.1

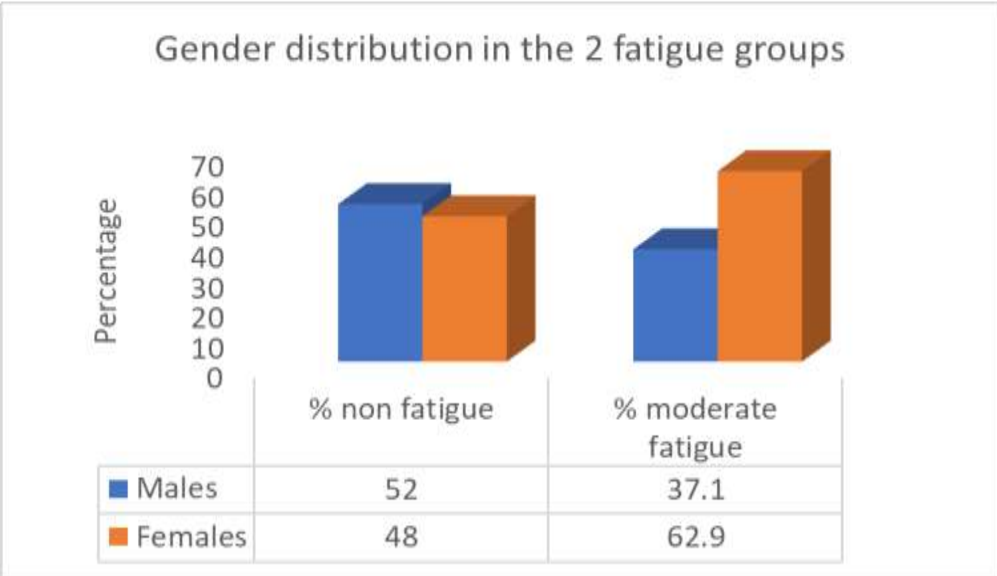

Fig no.4.1 Gender distribution in fatigue

Participant distribution for fatigue				
No fatigue			Moderate fatigue	
OBESE CLASS	Observed	Percentage	Observed	Percentage
Class I	18	72	2	5.7
Class II	7	28	33	94.3
Total	25		35	

Table No 4.2 Participant distribution for fatigue

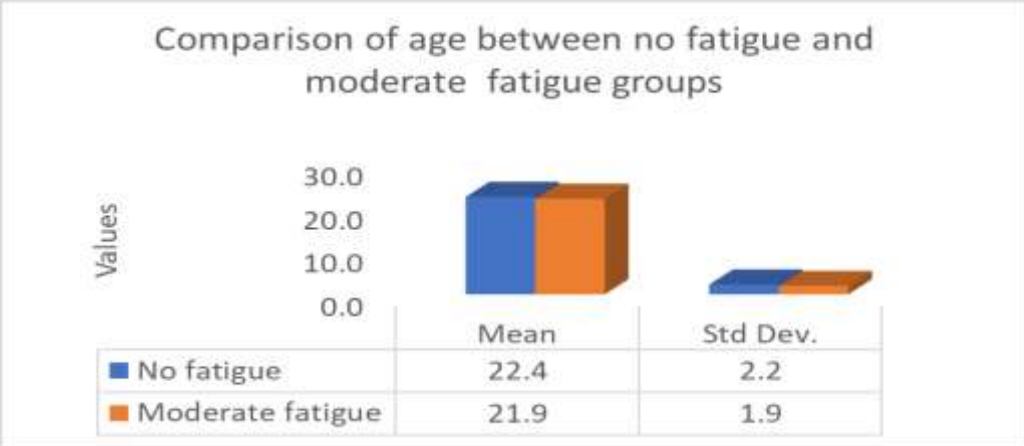

Figure no.4.2 Comparison of age between fatigue

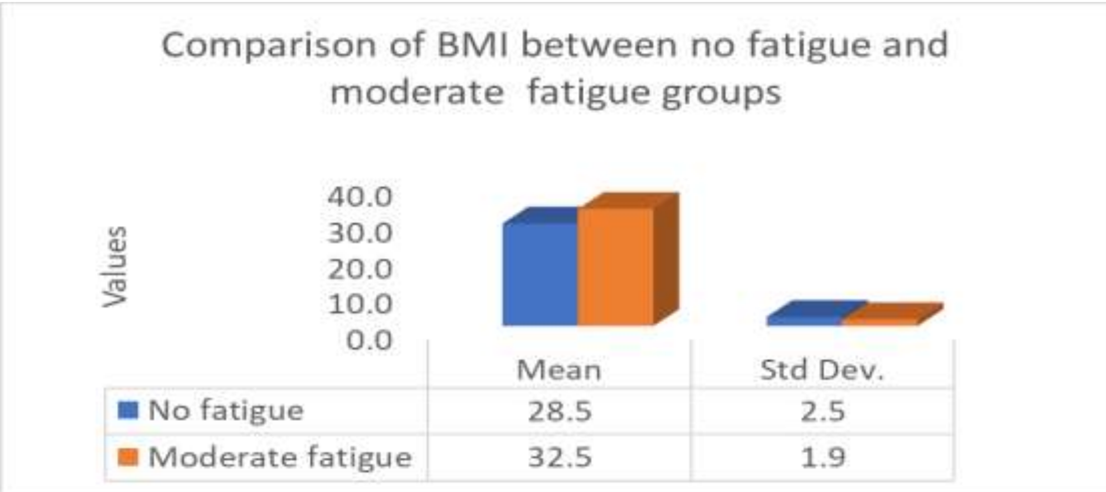

Figure no.3 Comparison of BMI between fatigue

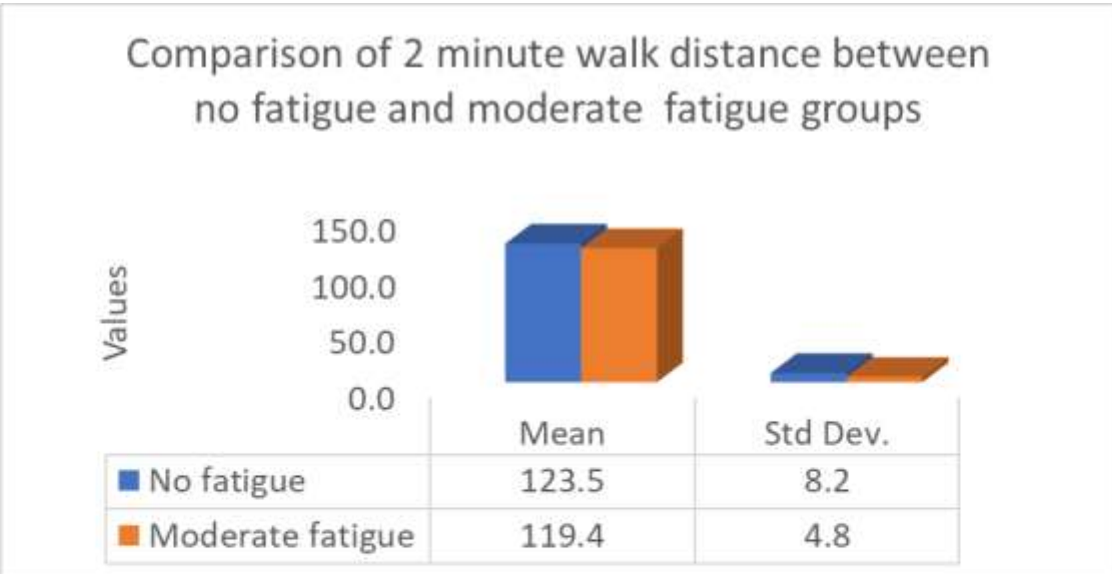

Figure no. 4.4 Comparison of 2 min walk distance between fatigue

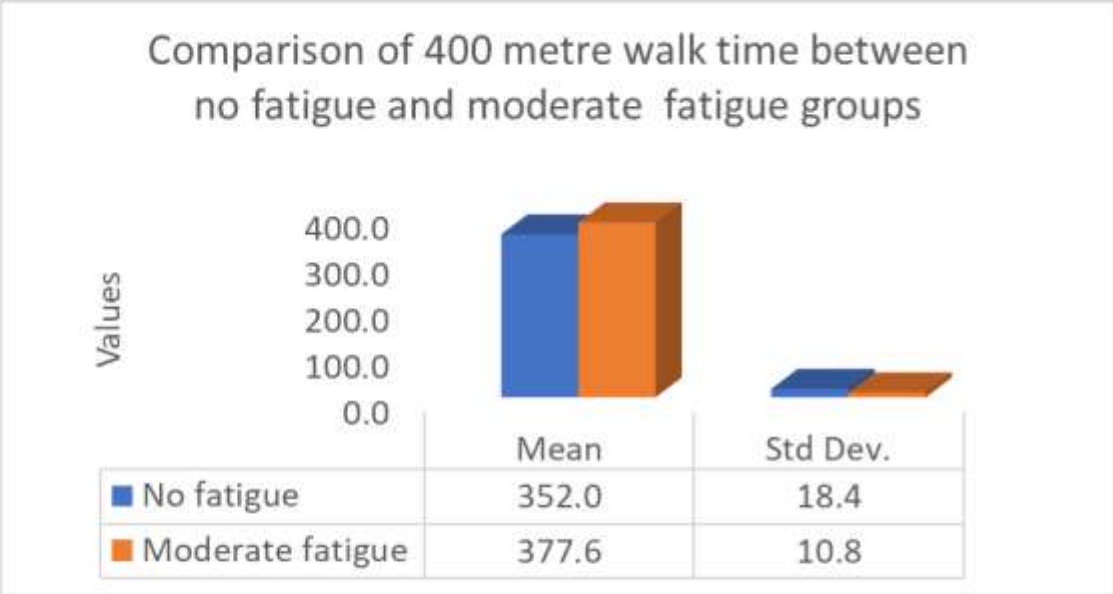

Figure no.4.5 Comparison of 400 metre walk time between fatigue

Stastical Result

Gender distribution for fatigue				
No fatigue			Moderate fatigue	
Gender	Observed	Percentage	Observed	Percentage
Males	13	52	13	37.1
Females	12	48	22	62.9
Total	25		35	

Table No.1

Participant distribution for fatigue				
No fatigue			Moderate fatigue	
OBESE CLASS	Observed	Percentage	Observed	Percentage
Class I	18	72	2	5.7
Class II	7	28	33	94.3
Total	25		35	

Table No.2

t-Test Result: Unpaired 't' test comparing age between no fatigue and moderate fatigue groups Inference The 't' value 0.829 is NOT significant ['p' > 0.05] Hence, there no significant difference in age between the two groups.

Table 1 makes it clear that there is no substantial difference in the mean age 22.4 of the no fatigue and in the mean age 21.9 of the moderate fatigue group The two mean values are almost same.

t-Test Result: Unpaired 't' test comparing BMI between no fatigue and moderate fatigue groups

Inference:

The 't' value 7.187 is significant ['p' < 0.01]

Hence, there is significant difference in BMI between the two groups. It can be seen from Table 2 that the mean BMI 32.5 of the moderate fatigue group is GREATER than that of the mean BMI 28.5 of the no fatigue group

The BMI is greater in the moderate fatigue group.

t-Test Result: Unpaired 't' test comparing 2-minute walk distance between no fatigue and moderate fatigue groups.

Inference:

The 't' value 2.238 is significant ['p' < 0.05]

Hence, there is significant difference in the 2-minute distance between the two groups.

It can be seen from Table 3 that the mean walking distance 119.4 of the moderate fatigue group is LESS than thatof the mean walking distance 123.5 of the no fatigue group

The distance covered in 2 minutes is definitely less in the moderate fatigue group **t-**Test Result: Unpaired 't' test comparing 400 metre walk time between no fatigue and moderate fatigue groups

Inference:

The 't' value 6.228 is significant ['p' < 0.01]

Hence, there is significant difference in the 400 metre walk time between the two groups.

It can be seen from Table 4 that the mean 400 metre walk time 377.6 of the moderate fatigue group is HIGHER than thatof the mean 400 metre walk time 352.0 of the no fatigue group.The 400 metre walk time is higher in the moderate fatigue group

Discussion

The present observational study assessed objective and subjective fatigue in obese adults using the Fatigue Assessment Scale (FAS), the 2-Minute Walk Test (2MWT), and the 400-Meter Walk Test (400MWT). The results provide meaningful insights into the relationship between obesity, fatigue, and physical performance. Firstly, the analysis revealed no significant difference in age between the no-fatigue and moderate-fatigue groups. Both groups were relatively young, with mean ages of 22.4 and 21.9 years, respectively. This finding suggests that age did not confound the fatigue outcomes in this sample of young adults. Previous research has also demonstrated that within younger populations, fatigue levels are less likely to vary with age compared to older adults, where fatigue becomes more prevalent due to comorbidities and age-related physiological decline.In contrast, body mass index (BMI) showed a highly significant difference between groups, with the moderate-fatigue group demonstrating a higher mean BMI (32.5) compared to the no-fatigue group (28.5). This aligns with existing literature indicating that higher BMI is associated with increased fatigue, reduced exercise tolerance, and impaired energy efficiency. Excess body weight places additional biomechanical and metabolic demands on the individual, contributing to earlier onset of fatigue during physical activity.

Performance outcomes from the walk tests further reinforce these findings. The 2-minute walk distance was significantly shorter in the moderate-fatigue group (119.4 m) compared to the no-fatigue group (123.5 m). While the absolute difference is modest, it reflects reduced endurance and pace maintenance even during a brief walking task. Similarly, the 400-meter walk test showed a strong significant difference, with the moderate-fatigue group requiring more time (377.6 seconds) than the no-fatigue group (352.0 seconds). A prolonged 400MWT time indicates reduced functional capacity and slower gait speed, which are both predictive markers of lower physical performance. These results corroborate earlier studies suggesting that fatigue not only influences subjective well-being but also has measurable effects on objective physical performance in obese adults.

Interestingly, despite being young, participants in the moderate-fatigue group already displayed functional limitations in both short and longer walking assessments. This highlights that fatigue in obesity is not merely a subjective complaint but a quantifiable phenomenon impacting mobility and endurance. Furthermore, it underscores the potential long-term risks, as early functional decline may predispose individuals to cardiovascular, metabolic, and musculoskeletal complications later in life if unaddressed.

Conclusion

This study demonstrates that fatigue in obese adults is closely associated with higher BMI and diminished walking performance, despite the participants being young. While age did not significantly influence fatigue levels, the presence of higher BMI was a key determinant of both subjective fatigue scores and objective functional capacity.

The Fatigue Assessment Scale was reliable in differentiating between fatigue levels.

Higher BMI correlated with increased fatigue and poorer performance in both the 2MWT and 400MWT.

The moderate-fatigue group walked shorter distances in 2 minutes and required significantly more time to complete the 400 meters, confirming reduced physical performance capacity.

These findings suggest that interventions aimed at weight management, structured exercise programs, and fatigue monitoring are essential for obese young adults to prevent early functional
decline. Early detection and targeted interventions may improve both subjective fatigue and objective physical performance, ultimately reducing long-term health risks.

References

1. WHO: Obesity and overweight. http://www.who.int/mediacentre/factsheets/ fs311/en/.\Schwartz MW, Seeley RJ, Zeltser LM, Drewnowski A, Ravussin E, Redman LM, Leibel RL.
2. “Obesity Pathogenesis: An Endocrine Society Scientific Statement.” Endocr Rev. 2017;38(4):267–296. [Abstract]
3. Kirsten Schultz-Larsen, Kirsten Avlund“Tiredness in daily activities: a subjective measure for the identification of frailty among non-disabled community-living older adults.” Archives of Gerontology and Geriatrics
4. Volume 44, Issue 1, January–February 2007, Pages 83-93 4-5. K. Schultz-Larsen Alison H. Affinati, MD, PhD and Martin G. Myers, Jr., MD, PhD.” Neuroendocrine Control of Body Energy Homeostasis” National library of medicine, Bookshelf ID: NBK570658 PMID:34033309
5. Eleanor M. Simonsick, PhD, z Ellen Fan, MD,w and Jerome L. Fleg, MD “Estimating Cardiorespiratory Fitness in Well-Functioning Older Adults: Treadmill Validation of the Long Distance Corridor Walk” J Am GeriatrSoc 54:127–132, 2006.
6. Anne B. Newman, MD, MPH;Eleanor M. Simonsick, PhD;Barbara L. Naydeck, MPH, “Association of Long-Distance Corridor Walk Performance With Mortality, Cardiovascular Disease, Mobility Limitation, and Disability.” JAMA. 2006;295(17):2018-2026. doi:10.1001/jama.295.17.2018
7. Eleanor M. Simonsick, Anne B. Newman, MarjoleinVisser, Bret Goodpaster, Stephen B. Kritchevsky, Susan Rubin, Michael C. Nevitt, Tamara B. Harris, for the Health, Aging and Body Composition Study”, Mobility Limitation in Self-Described Well-Functioning Older Adults: Importance of

Endurance Walk Testing." The Journals of Gerontology: Series A, Volume 63, Issue 8, August 2008, Pages 841–847,https://doi.org/10.1093/gerona/63.8.841

8. Jennifer S. Brach, PhD, PT, GCS, Eleanor M. Simonsick, PhD,§k Stephen Kritchevsky, PhD,z Kristine Yaffe, MD,# and Anne B. Newman, MD, MPH,wz for the Health, Aging and Body Composition Study Research Group, "The Association Between Physical Function and Lifestyle Activity and Exercise in the Health, Aging and Body Composition Study."
9. De Vries, J.; Michielsen, H.J.; van Heck, G.L.; Drent, M, (2004). "Measuring fatigue in sarcoidosis: The Fatigue Assessment Scale (FAS)." British Journal of Health Psychology, (9), 279-291