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A Study to Find Out Functional Capacity Among Hypokinetic Workers Using 6mwt: An Observational Study

Dr. Ms. Vidhi Rajesh Parmar[1], Prof. Dr. Meghavi Oza[2], Dr. Ms. Gautami Dnyanesh Gavande[3]

[1,3]Doctor BPT, Physiotherapy, Parul University,
[2]Associate Professor, Physiotherapy, Parul University

ABSTRACT:

Background: Prolonged sedentary behavior, often observed in hypokinetic workers, can lead to a decline in functional capacity and cardiorespiratory fitness. Functional assessment using the 6-Minute Walk Test (6MWT) is a reliable tool to evaluate the submaximal exercise capacity in such populations.

Objective: This study aimed to assess the functional capacity of hypokinetic workers using the 6-Minute Walk Test (6MWT) and to examine the impact of reduced physical activity on their aerobic fitness and overall health.

Methodology: An observational study was conducted over six months on 150 female hypokinetic workers aged over 20 years, working more than 8 hours per day and having at least one year of work experience. Participants were assessed using the 6MWT following the standardized guidelines by the American Thoracic Society. Key parameters, including heart rate, oxygen saturation, respiratory rate, and perceived exertion, were monitored before, during, and after the test. VO_2max was estimated using a validated formula based on the 6MWT distance, age, and weight of the participants.

Results: A moderate to strong positive correlation ($r = 0.64$, $p = 0.001$) was found between the distance covered in the 6MWT and the estimated VO_2max values, indicating that greater functional capacity is associated with higher aerobic fitness. An age-wise comparison revealed a consistent decline in both predicted and observed VO_2max values with advancing age. The observed VO_2max values across all age groups were lower than the predicted normative values, suggesting reduced cardiorespiratory fitness in the hypokinetic worker population.

Conclusion: The 6-Minute Walk Test (6MWT) proved to be an effective and practical tool for assessing the functional capacity and aerobic fitness of hypokinetic workers. The findings highlight a significant decline in functional and aerobic capacity, emphasizing the need for interventions targeting physical activity enhancement in this occupational group.

Keywords: Hypokinetic workers, 6-Minute Walk Test (6MWT), Functional capacity, VO_2max, Sedentary lifestyle

INTRODUCTION

Hypokinetic employees, or sedentary employees or desk workers, are individuals whose occupation or

daily life is characterized by little to no physical activity, thus contributing to a mostly sedentary lifestyle. This term is most commonly used to describe employees in occupations or work settings where physical movement is low, like office work, administrative jobs, call centers, and jobs that necessitate heavy computer use or sitting for hours. These employees typically spend most of their working day sitting or performing non-corporeal work, with minimal chance for activity or exercise.

The term "hypokinetic" is actually a combination of the Greek prefix "hypo" (under or insufficient) and the word "kinesis" (movement), both terms together explaining a condition of insufficient movement or bodily activity. Such employees typically suffer from a deficiency of bodily exercise during the course of a day, sometimes made worse by inadequate posture or routine work that involves muscle straining without any respite or change in movement.

As technology has improved, individuals have become more inclined to live a sedentary lifestyle. Physical activity in our daily lives has decreased due to technological advancements. Sedentary behavior and its extended duration cause numerous health complications.[1] Sedentary lifestyle is now established as a health hazard, with only high volumes of moderate-to-vigorous physical activity (60–75 minutes per day) being protective against excessive sedentary behavior. This is particularly prevalent among office workers, who tend to sit for extended periods without any breaks.[2] Consequently, they are more likely to experience adverse health consequences, such as chronic diseases and mental illness. Office workers who sit at desks are especially susceptible, since their work involves sitting for long hours.[3] Jobs that were previously physically active are nowadays carried out by means of computer-based techniques, and seated technical and office desk work is becoming increasingly prevalent.[4] Consequently, work-related energy expenditure has come down considerably between 1960 and 2008, by around 140 kcal per day for men and 124 kcal per day for women. [5]

Office employees are now the central target in sedentary behavior research given the extended periods of sitting and low physical **activity characteristic of working behind an office desk.**

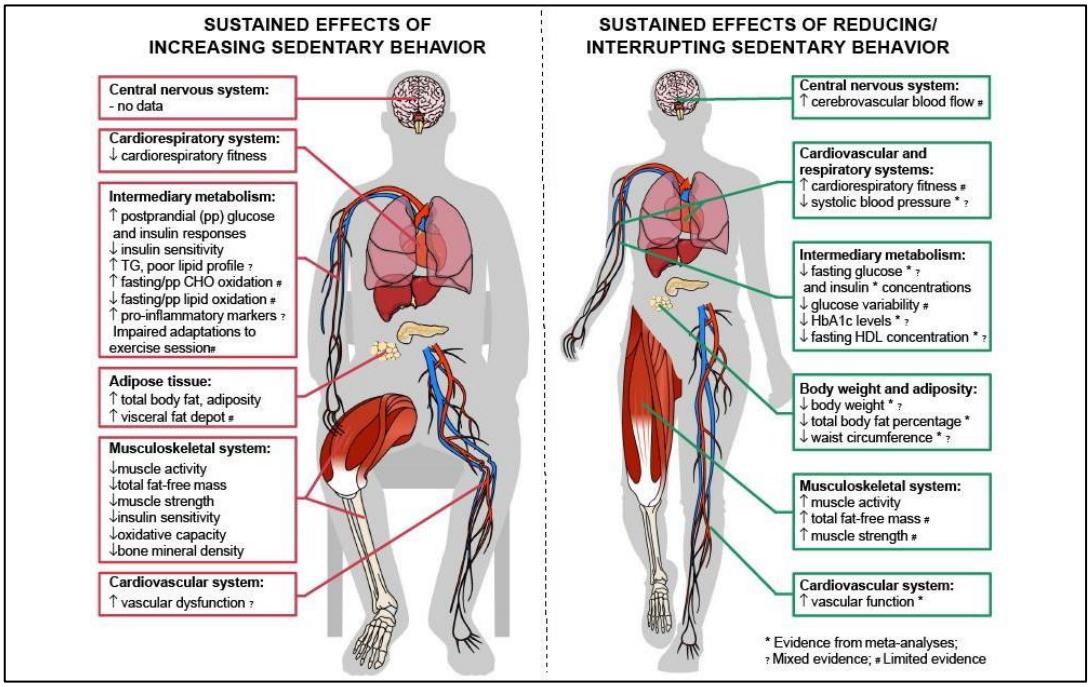


Figure 1: Effect of sedentary behavior and interrupting sedentary behavior

Hypokinetic employees are those whose jobs require very little physical activity, working long hours with much sitting or doing routine tasks that demand little body movement. Typically employed in office jobs, clerical work, and computer occupations, these employees have a greater risk of acquiring diseases because of their low activity levels. Extended sitting and decreased mobility can cause hypokinetic diseases, including obesity, cardiovascular disease, diabetes, and musculoskeletal disorders, like chronic neck and back pain. Moreover, physical inactivity may also lead to low energy levels, poor posture, and mental health issues like stress and anxiety. In order to offset these dangers, hypokinetic workers need to integrate routine movement, ergonomic modifications, and exercise regimens into their daily routines, fostering improved health and productivity in the workplace.

A sedentary job exposes hypokinetic workers to a greater risk of developing health problems such as obesity, cardiovascular diseases, and musculoskeletal disorders. Sitting for extended periods and physical inactivity can cause weight gain, poor circulation, high blood pressure, heart disease, and musculoskeletal disorders such as back pain and neck strain from poor posture.[3]

A systematic review of 794,577 participants revealed that individuals who spent the most time sedentary had a 112%, 147%, and 90% higher risk of developing diabetes, cardiovascular disease, and dying from cardiovascular disease, respectively, compared to those who were least sedentary.[8] Studies have shown that office workers spend a significant portion of their day sitting. In the Stormont study[6], 4,436 employees reported sitting for an average of 625 minutes during work hours, making up 60% of their total daily sitting time. Similarly, Australian office workers reported[7] sitting for 60% of their day at work. Younger, obese, full-time, and single or divorced workers tended to sit more. Additionally, more sitting time was associated with higher body mass index and younger age.[6,7]

Apart from its negative consequences on physical well-being, extended periods of sitting have been consistently associated with compromised mental well-being, such as higher risks of depression, anxiety, and psychological distress. People who spend too much time sitting down, particularly in occupational settings that involve extended periods of computer use, tend to experience increased stress levels, disturbance of mood, and reduced overall well-being. This is clearly seen in office employees, where higher levels of sitting time and longer screen exposure periods have been negatively correlated with mental health and cognitive ability.[3] Lack of consistent movement and exercise leads to hormonal imbalance, lowered endorphin release, and increased stress response, all of which contribute to decreased mental health and work productivity.[4]

Apart from its psychological effect, extended sitting is a recognized risk factor for chronic diseases like cardiovascular disease (CVD), metabolic disorders, and cancer, which eventually lead to increased all-cause mortality. Nevertheless, studies indicate that the health hazards of extended sitting can differ based on the physical activity level of an individual. There has been evidence of a dose-response relationship where individuals with low physical activity have an increased risk of cardiovascular disease death in response to sitting for long hours, while in those who participate in regular exercise, the association is weaker. This information highlights physical activity as a protective aspect against the detrimental effects of sedentary behavior. Promoting frequent movement, including active breaks, and encouraging workplace interventions—like standing desks, walking meetings, and formal exercise programs—can reduce both the physical and psychological consequences of extended sedentary behavior among office workers and the general population.[9]

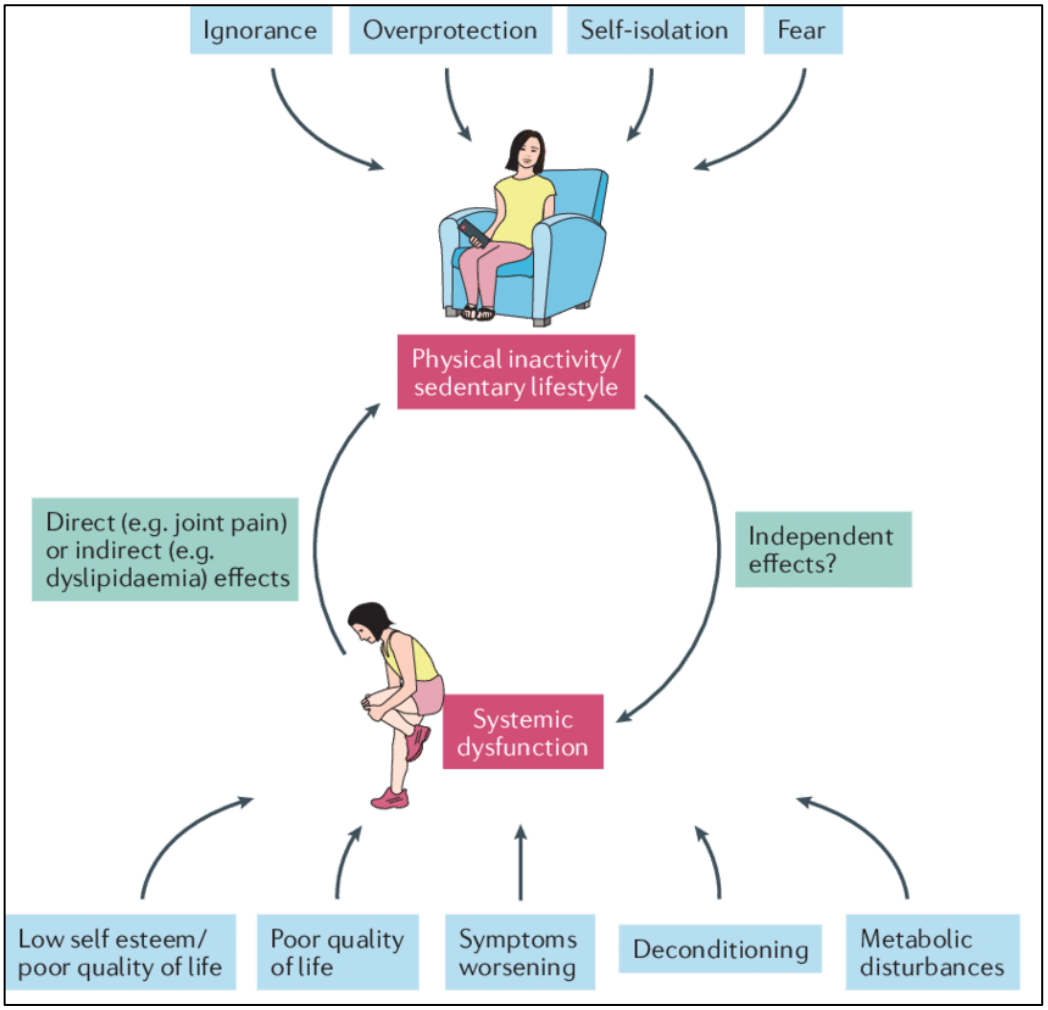


Figure 2: Sedentary Behaviour and Its Impact on Mental and physical Health

Several studies have highlighted the significant relationship between sedentary behavior and decline in functional capacity. Sedentary behavior, defined as prolonged periods of sitting or minimal physical movement, has been linked to negative outcomes in terms of cardiovascular, musculoskeletal, and metabolic health, all of which are integral components of an individual's functional capacity. Research indicates that individuals who engage in prolonged sedentary behaviors experience a gradual decline in their physical fitness, including reduced aerobic capacity, muscle strength, and endurance. This reduction in functional capacity can affect an individual's ability to perform essential daily activities, such as walking, climbing stairs, and lifting objects.[3,5]

Furthermore, sedentary behavior has been associated with a higher risk of cardiovascular diseases and musculoskeletal issues, which further exacerbate the decline in functional capacity. The relationship between sedentary behavior and functional capacity underscores the importance of promoting regular physical activity, as it is crucial for maintaining or improving physical function.[3,11]

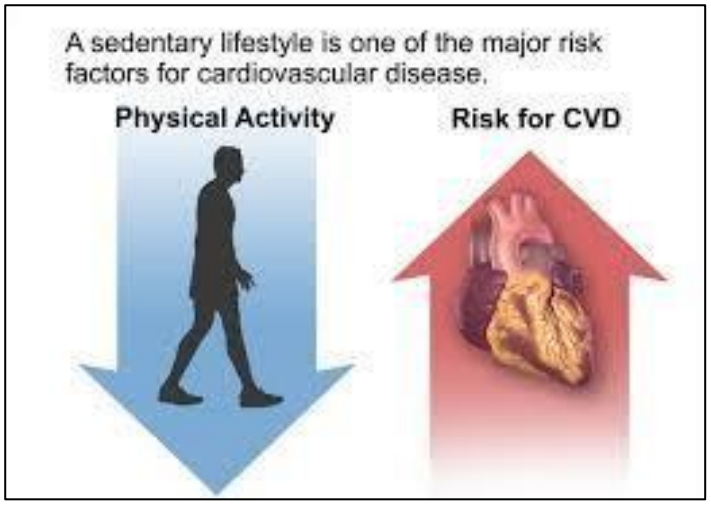


Figure 3: Physical activity and risk of CVD

Aerobic capacity, often measured by VO_2max, is a fundamental indicator of cardiovascular health and plays a critical role in assessing an individual's physical fitness and overall well- being. It reflects the body's ability to transport and utilize oxygen efficiently during sustained physical activity. Higher aerobic capacity is associated with improved heart and lung function, better endurance, and a reduced risk of chronic disease. In contrast, low aerobic capacity is strongly linked to increased rates of morbidity, functional disability, and premature mortality, particularly due to cardiovascular diseases such as coronary artery disease, hypertension, and stroke.[19] Research indicates that sedentary behavior—defined by extended periods of physical inactivity or prolonged sitting—contributes significantly to the decline in aerobic capacity. Individuals leading sedentary lifestyles tend to have reduced cardiorespiratory fitness, which not only diminishes their ability to perform physical tasks but also raises their risk for developing metabolic disorders like type 2 diabetes, obesity, and dyslipidemia.[3]

Additionally, lower aerobic fitness is linked to poorer vascular health, decreased muscle function, and an elevated risk of early death. Regular aerobic exercise, such as walking, jogging, cycling, or swimming, is crucial for improving aerobic capacity, enhancing cardiovascular efficiency, and preventing the detrimental health outcomes associated with a sedentary lifestyle.

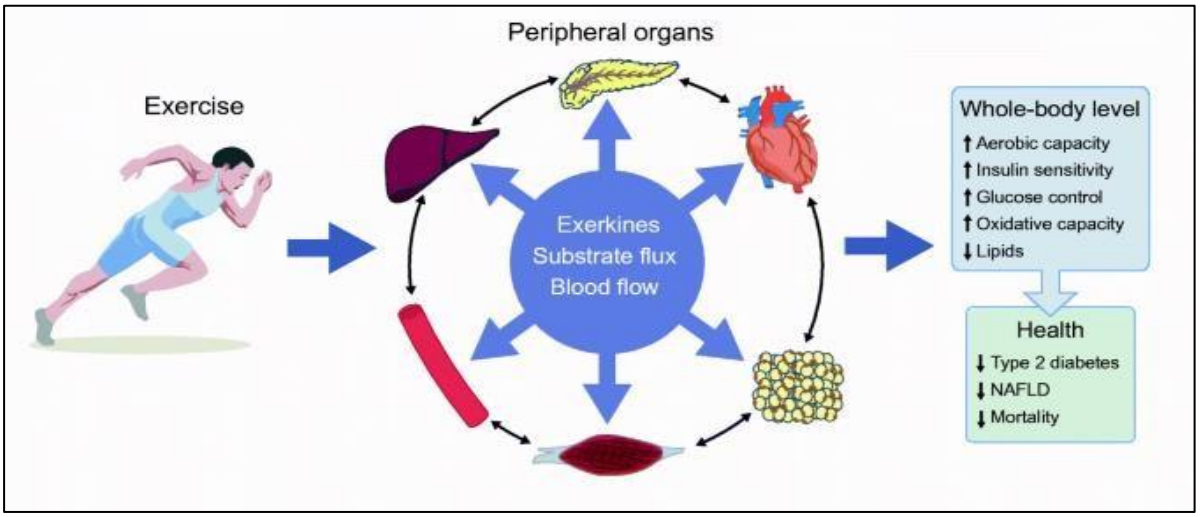


Figure 4: Exerkines substrate flux blood flow

VO_2max, the maximum rate of oxygen consumption during intense exercise, is widely recognized as a key measure of functional capacity and cardiorespiratory fitness. Several factors, including sedentary behavior, influence VO_2max.[13] Studies have consistently shown that prolonged inactivity and reduced physical movement are major contributors to low cardiorespiratory fitness. Sedentary behavior accelerates the decline of VO_2max, especially as individuals age.[14] In contrast, regular physical activity, such as aerobic exercises, helps improve or maintain VO_2max within an individual's potential range, highlighting the importance of reducing sedentary time to preserve functional capacity and cardiovascular health.

Several factors influence VO_2max, including genetics, age, gender, physical activity levels, body fat percentage, smoking habits, and medical conditions such as metabolic syndrome and diabetes. VO_2max naturally declines with age, decreasing by approximately 1% per year or 10% per decade after the age of 25. Furthermore, recent evidence suggests that an individual's ability to improve their VO_2max is largely determined by genetic predisposition. Each person has a genetically defined range within which VO_2max can fluctuate depending on their levels of physical training or inactivity. VO_2max values can vary greatly, ranging from as low as 10 ml/kg/min in severely ill cardiac patients to as high as 80–90 ml/kg/min in elite athletes like world-class runners and cross-country skiers. Despite these genetic limitations, endurance training can significantly enhance VO_2max within an individual's potential range.[17]

Despite the inherent genetic limitations that influence an individual's maximal oxygen uptake (VO_2max), research consistently shows that regular and sustained physical activity can significantly enhance aerobic capacity. While genetic factors may set an upper limit on one's potential VO_2max, lifestyle choices play a critical role in determining how much of that potential is realized.[14] Engaging in consistent aerobic exercise, such as brisk walking, cycling, swimming, or running, has been shown to improve cardiovascular efficiency, increase oxygen delivery to working muscles, and boost overall functional capacity. This is particularly important in reducing the health risks associated with sedentary behavior, including cardiovascular disease, obesity, type 2 diabetes, and musculoskeletal dysfunction.[16]

The World Health Organization (WHO) recommends that adults perform at least 150 minutes of moderate-intensity aerobic physical activity or 75 minutes of vigorous-intensity activity throughout the week, which equates to about 30 minutes a day, five days a week. These guidelines emphasize the importance of regular movement to maintain and improve cardiorespiratory fitness, reduce sedentary time, and support overall health and well-being. Implementing active lifestyle interventions is crucial in modern societies where sedentary habits, such as prolonged sitting during work or leisure activities, have become increasingly common. Encouraging populations to participate in structured exercise programs or incorporate more physical activity into daily routines can lead to measurable improvements in VO_2max, reduce the adverse effects of inactivity, and promote better quality of life and functional independence across different age groups.[15]

Functional capacity can be measured through various methods, each focusing on different aspects of physical ability. However, one of the easiest and most widely used methods is the Six-Minute Walk Test (6MWT). This simple test measures an individual's aerobic capacity and endurance by having them walk as far as possible within six minutes, making it both accessible and effective for assessing overall functional capacity. While more detailed methods like cardiopulmonary exercise testing (CPET) and treadmill or cycle ergometry tests can provide insights into cardiovascular and pulmonary function, the 6MWT offers a reliable and practical assessment. Other tests such as the Timed Up and Go (TUG) test and the Sit-to-Stand test evaluate mobility, balance, and lower body strength. For strength-specific assessments, tests like the one-repetition maximum (1RM) measure the ability to perform heavy physical tasks. Although

more specialized assessments, like the Functional Movement Screen (FMS) and the Short Physical Performance Battery (SPPB), provide a comprehensive evaluation of movement patterns and overall function, the 6MWT remains the most accessible and efficient method for measuring functional capacity in a wide range of individuals.

The Six-Minute Walk Test (6MWT) is a simple, non-invasive assessment used to measure an individual's functional capacity, primarily focusing on aerobic endurance and cardiovascular fitness. During the test, the participant is asked to walk as far as possible within six minutes on a flat surface. The distance covered during the test provides an estimate of the person's overall functional status and endurance. Several factors can influence the results of the 6MWT. These include age, as older individuals may have reduced endurance; gender, with men typically walking further than women; body mass index (BMI), as higher BMI can limit walking capacity; physical conditioning, where more active individuals tend to perform better; comorbidities, such as heart or lung disease, which can significantly reduce walking distance; medications, particularly those affecting heart rate or muscle function; and motivation or psychological factors, as mental readiness can influence effort during the test. Environmental factors like temperature and terrain may also impact performance, although the test is typically conducted on a controlled, flat surface.[31,16]

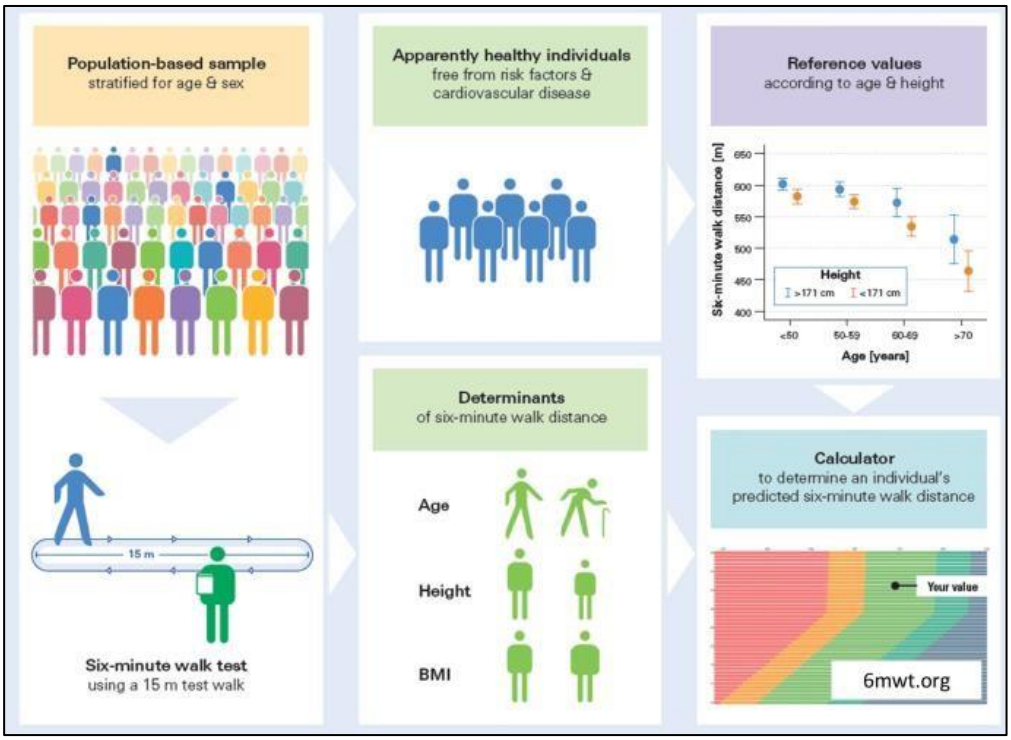


Figure 5: 6 min walk test

The increasing prevalence of sedentary behavior among hypokinetic workers has raised concerns regarding its impact on overall health and functional capacity. Prolonged sitting and limited physical activity associated with desk-based jobs contribute to a decline in cardiorespiratory fitness, which can lead to several chronic health conditions. By assessing functional capacity through the 6-Minute Walk Test (6MWT), this study aims to explore the relationship between sedentary behavior and the aerobic capacity of hypokinetic workers. The findings from this study will help in understanding the effects of prolonged sitting on workers' health and provide insights into strategies to improve their functional capacity and well-being.

NEED OF THE STUDY:

In today's fast-paced world, many people work in desk jobs where they sit for long hours and don't get enough physical activity. This lack of movement, known as hypokinesia, can lead to health problems like heart diseases, body pain, and reduced fitness levels. It's important to check how well these workers' bodies are coping so that we can help them stay healthy.

One simple and effective way to measure their fitness is the 6-Minute Walk Test (6MWT), where a person walks at their normal pace for six minutes, and we see how far they can go. This test helps us understand their stamina and overall health.

Through this study, we aim to assess the fitness levels of such workers and identify the physical challenges they face. The findings could help in creating health programs and workplace policies to keep employees fit, active, and productive.

AIM AND OBJECTIVES

AIM OF THE STUDY

The aim of this observational study is to assess the functional capacity among hypokinetic workers using the 6-Minute Walk Test (6MWT).

OBJECTIVES OF THE STUDY

To evaluate the functional capacity of hypokinetic workers by measuring the distance covered during the 6-Minute Walk Test (6MWT).

REVIEW OF LITERATURE

1. "Introduction to Functional Capacity and Hypokinetic Workers Functional capacity is a person's capacity to carry out work-related physical tasks and is often measured in occupational health studies. Hypokinetic workers, including office workers, drivers, and factory workers with extended sedentary duties, are at risk of low physical fitness, cardiovascular risk factors, and musculoskeletal disorders. It is important to measure their functional capacity to comprehend the effects of physical inactivity on general well-being and work productivity (Booth et al., 2017)."
2. "The 6-Minute Walk Test (6MWT) as an Assessment Tool of Functional Status The 6-Minute Walk Test (6MWT) is a valid, reliable, and widely accepted test for the assessment of submaximal exercise tolerance. It is a measure of the distance that a person can walk in a straight line over six minutes and gives information about endurance, cardiovascular fitness, and functional limitation. Normative reference values for the 6MWT have been determined in different age groups by Enright & Sherrill (1998).

   ATS Guidelines (2002) formalized the technique to provide consistency in clinical and research environments.

   Bohannon (2015) validated the 6MWT as a reliable predictor of general physical fitness and functional capacity."
3. "Effect of Sedentary Work on Functional Capacity

   Sedentary behaviour over a long period results in reduced functional capacity as a result of physical deconditioning. A number of studies have pointed out its adverse effects: Biswas et al. (2015) established a significant correlation between sitting for long periods and cardiovascular disease risk. Thorp et al. (2011) showed that sedentary employees have lower cardiopulmonary function and higher rates of metabolic disorders.

Parry & Straker (2013) indicated that office workers with little physical activity show musculoskeletal discomfort and postural impairments."

4. "6MWT in Hypokinetic Workers: Evidence from Research
   Research measuring the functional capacity of inactive office workers with the 6MWT indicates that long sitting time drastically decreases walking distance and stamina: Lee et al. (2018) discovered that workers with extended desk work hours performed worse on the 6MWT compared to workers whose jobs were more mobile.
   Straker et al. (2016) indicated a causal link between extended sitting and disrupted functional mobility among workers.
   Miyamoto et al. (2019) proposed that workplace interventions like standing desks and active breaks enhanced 6MWT results."
5. "Research Gaps and Conclusion
   Although current literature highlights the effect of sedentary work on health, few studies have directly assessed functional capacity with the 6MWT in hypokinetic workers. More observational studies are needed to establish the degree of functional impairment and to create intervention strategies."

MATERIALS AND METHODOLOGY

- **RESEARCH DESIGN**: An Observational study
- **STUDY POPULATION**: Hypokinetic workers
- **STUDY DURATION:** 1 month
- **SAMPLE SIZE:** 150 subjects
- **SOURCE OF DATA:** Hupetch, QDev Technology, TTEC

CRITERIA:

- **INCLUSION CRITERIA:**

1. Subjects willing to participate
2. Female
3. Hypokinetic workers more than age 20 year and >8 hours/ day working
4. Experience year of job is >1 year
5. Able to perform physical activity (6MWT)

- **EXCLUSION CRITERIA**

1. Pregnancy
2. any injuries or medical conditions that influence the result of outcome
3. cardiovascular disease, previous heart surgeries, arrhythmias, or history of myocardial infarction
4. less than one year of work experience
5. not willing to participate

Resources employed in the investigation:

- Assessment form and Consent form
- Pen, Paper, Pencil
- Measure tape,
- Stop Watch,
- Pulse Oximeter

- Rectangular walking area
- 2 Cones to mark the turnaround points
- A chair that can be easily moved along the walking course
- Sphygmomanometer,
- Stethoscope
- Weighing machine
- Stadio – Meter, Calculator
- Telephone
- Automated electronic defibrillator

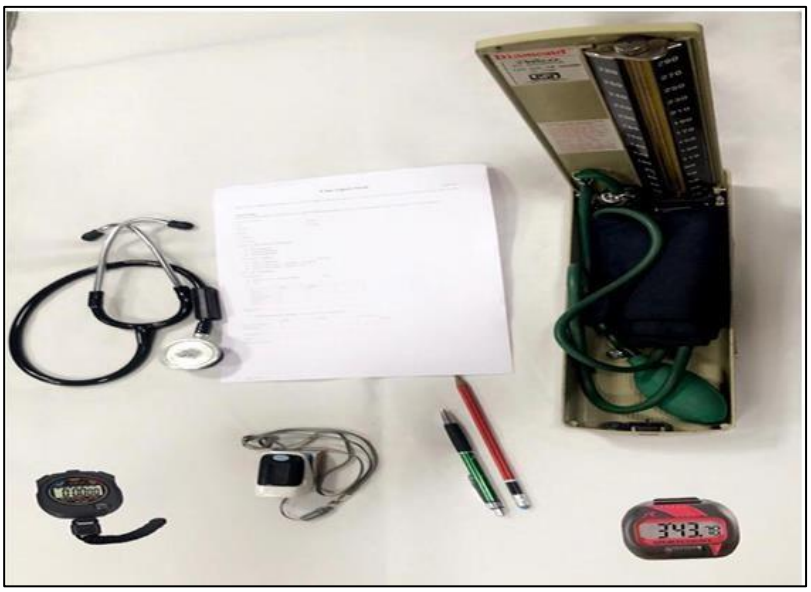


Figure 6: materials

OUTCOME MEASURES:

6 MIN WALK TEST:

The 6-Minute Walk Test (6MWT) is a simple, practical, and self-paced walking assessment that measures submaximal functional exercise capacity. It is used to evaluate the effectiveness of therapeutic interventions by monitoring changes in the distance walked during the test (6MWD). Key metrics such as heart rate, respiratory rate, continuous pulse oximetry, and perceived exertion are tracked before, during, immediately after, and 2 minutes following the test. Detailed guidelines for conducting and interpreting the test are provided by the American Thoracic Society. Gender, age, weight, and height-based prediction equations for healthy Indian individuals' 6MWD are available. The test has been validated for use in individuals with kidney disease to assess functional aerobic capacity. Conducted in a 30-meter indoor corridor, it measures the distance a person can walk in six minutes on a flat surface, providing insights into the integrated responses of various systems during exercise, including the pulmonary, cardiovascular, systemic circulation, and neuromuscular systems. The 6MWT is most commonly used to assess the effectiveness of medical treatments for individuals with moderate to severe heart or lung diseases. It also serves as a one-time measure of functional status and can predict morbidity and mortality.

Figure 7: 6 Min Walk test

EXPLANATION OF TEST:[32]

- Before the application, the purpose of the study and procedure was explained to subjects. All parameters (Age, Height, Weight, BMI) and pre-vitals were taken.
- The test was conducted according to a standardized protocol, using a rectangular pathway with a 30-meter distance marked with chalk, and two cones were used at the end of the distance.
- The following instructions were given to subjects before performing the 6MWT on how they have to walk!
- The subject of this test is to walk as far as possible for 6 minutes, and they will walk back and forth in this hallway, turning around the markers, with care taken to ensure the subject does not run.
- The test was self-paced, and the subject could rest if they wished. A light meal was acceptable before the test, and vigorous exercise was avoided 2 hours prior to the testing.
- The test was started. The subject stood near the starting line, and the investigator was also present. The subject started walking, and the timer was started. Subjects were not allowed to talk to anyone during the walk test.
- An even tone of voice was used for the standard phrases to encourage the subject. Each time the participant returned to the starting line, the number of laps was marked on the worksheet.
- After the first minute, the subject was encouraged (in even tones): "You are doing well. You have 5 minutes to go."
- At 4 minutes remaining: "Keep up the good work. You have 4 minutes to go."
- At 3 minutes remaining: "You are doing well. You are halfway done."
- At 2 minutes remaining: "Keep up the good work. You have only 2 minutes left."
- At 1 minute remaining: "You are doing well. You have only 1 minute to go."
- Other words of encouragement (or body language to speed up) were not used. The wording of encouragement during testing was standardized and was given by the same person at set times during the test every 1 minute to the subjects.
- The 6MWT was carried out by the therapist, who counted the number of laps covered and thus

calculated the distance, also noting the time with the help of a watch.

- After 6 MWT done Post vitals(HR) and parameters (6MWD) were taken.
- After the completion of the 6-minute walk test, a number of parameters and vital signs, such as distance walked, heart rate, oxygen saturation, and respiratory rate, will be recorded. These values, along with the individual's age, weight, and gender, will then be used in a formula to estimate VO_2max (maximum oxygen consumption), which is a key indicator of aerobic capacity.
- The calculation of VO_2max for men and women is typically done using a formula derived from the 6MWT, such as the following:[16]

FOR WOMEN

VO_2max (ml/kg/min) = $VO_2max = 22.506 – 0.271 \times$ (weight) $+ 0.051 \times$ (6MWD) $– 0.065 \times$ (age)

- This formula provides an estimate of VO_2 max based on the distance walked during the 6MWT. The result gives insight into an individual's cardiorespiratory fitness, which is crucial for assessing their ability to perform daily tasks and engage in physical activity.
- By using the 6-minute walk test in combination with vital signs and the calculation of VO_2max, this study will be able to assess the functional capacity of hypokinetic workers, offering a reliable measure of their functional fitness and overall cardiovascular health.
- Numerical values were put in formula and calculation of vo2 max was done.

PROCEDURE:

Subjects were selected based on predefined inclusion and exclusion criteria. This study included female hypokinetic workers aged over 20 years who had been employed full-time for at least one year. After obtaining informed consent, demographic data were collected, including name, age, gender, height, weight, BMI, educational qualifications, occupation, duty hours, years of experience, lifestyle factors (e.g., physical activity level, smoking, and dietary habits), and any relevant medical or surgical history.

Height (H) was measured in centimeters using a stadiometer while participants stood without shoes. Weight (W) was recorded in kilograms using a calibrated weighing scale, with participants wearing light clothing and no footwear. Body mass index (BMI) was calculated using the formula:

BMI = Actual Body Weight (kg) / Height² (m^2).

These measurements provided valuable insights into participant's physical health, helping contextualize the study results.

This observational study used the 6-Minute Walk Test (6MWT) to assess the functional capacity of hypokinetic workers. Participants—who were engaged in sedentary or low-activity occupations—were instructed to walk at their own pace on a 30-meter track for six minutes, aiming to cover the maximum possible distance.

after the test, key physiological parameters such as heart rate, oxygen saturation, and symptoms (e.g., breathlessness or fatigue) were monitored. The total distance walked served as the primary measure of functional capacity, providing insights into cardiovascular endurance and overall physical fitness. This helped evaluate the impact of prolonged sedentary work on physical health and functional performance.

Using the distance covered in the 6MWT and recorded vital signs, VO_2max was estimated using a standard predictive formula. The measured VO_2max values were then compared with the predicted normal values for the subjects, allowing for a better understanding of their cardiorespiratory fitness levels relative to expected norms.

Figure 8: Pre-test procedures

STATISTICAL ANALYSIS

he collected data was compiled and analyzed using Microsoft Excel. Descriptive statistics, including mean, standard deviation (SD), frequency, and percentage, were used to summarize demographic characteristics (age, height, weight, BMI, years of experience).

The primary outcome measures—distance covered in the 6-Minute Walk Test (6MWT) and the estimated VO_2 max—were calculated and compared with predicted normal values across different age groups.

Age-wise comparisons were presented using descriptive statistics, and trends were observed based on the differences between predicted and observed VO_2 max values.

The relationship between 6MWT distance and VO_2 max was evaluated using Pearson's correlation coefficient (r). A p-value of less than 0.05 was considered statistically significant for correlation analysis.

DATA ANALYSIS AND RESULTS:

Table 1: Age Distribution

AGE	Frequency of subjects & Percentage	Mean ± SD (In Years)
18-29	65 (65%)	26.70± 1.72
30-39	65 (65%)	33.53±1.96
40-49	18 (18%)	44.66±3.36
50-59	2 (2%)	50.5±0.70

Chart 1: age distribution

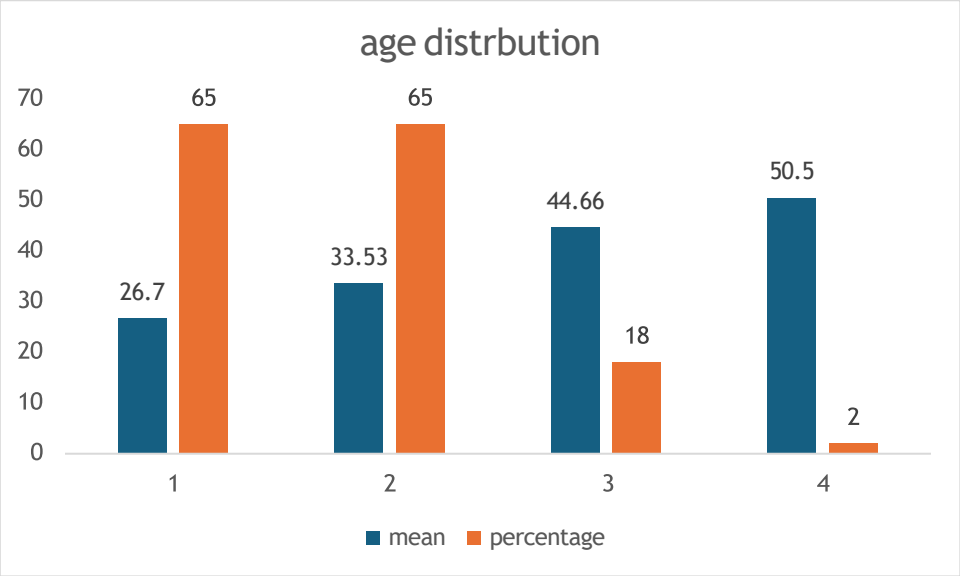
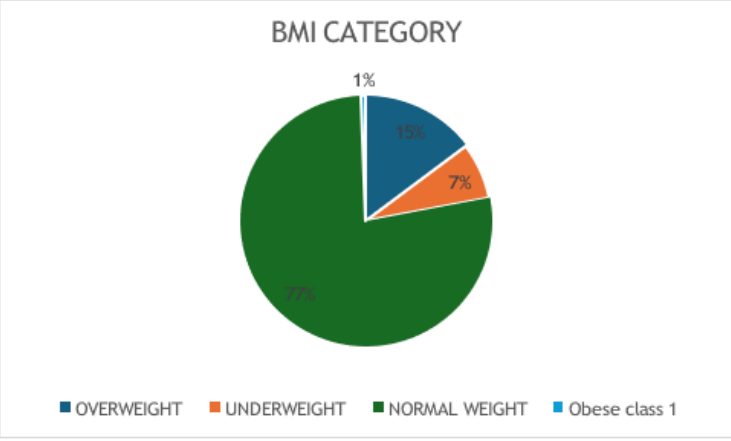


Table 1 and chart 1 shows the age distribution of subjects in four groups. The majority are aged 20-29 years (65%) with a mean age of 26.70 ± 1.72 years, and another 65% are in the 30-39 years group with a mean of 33.53 ± 1.96 years. Fewer subjects are in the 40-49 years group (18%), averaging 44.66 ± 3.36 years, and only 2% are aged 50-59 years with a mean of 50.5 ± 0.70 years. This indicates that most in the sample are younger, with a smaller proportion in older age groups.

Table 2: BMI classification

BMI		**ency of subjects & Percentage**
<18.5	Underweight	11
18.5-24.9	Normal weight	116
25-29.9	Overweight	22
30.0-34.9	Obese class 1	1
total		150

Chart 2: BMI classification

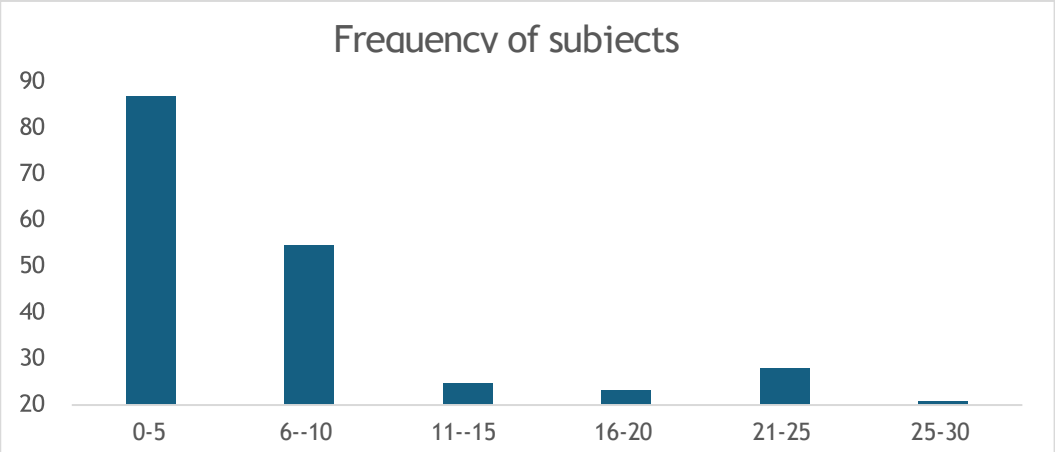


This table and chart present the BMI classification of 150 subjects. Most participants (116 out of 150, or about 77%) fall in the normal weight category (BMI 18.5-24.9). There are 22 overweight individuals (BMI 25-29.9), making up around 15%. 11 subjects (about 7%) are underweight (BMI less than 18.5), and only 1 subject (less than 1%) falls into obese class 1 (BMI 30-34.9). This indicates that the majority of the sample maintains a normal BMI range.

Table 3: Experience Year wise Categorization

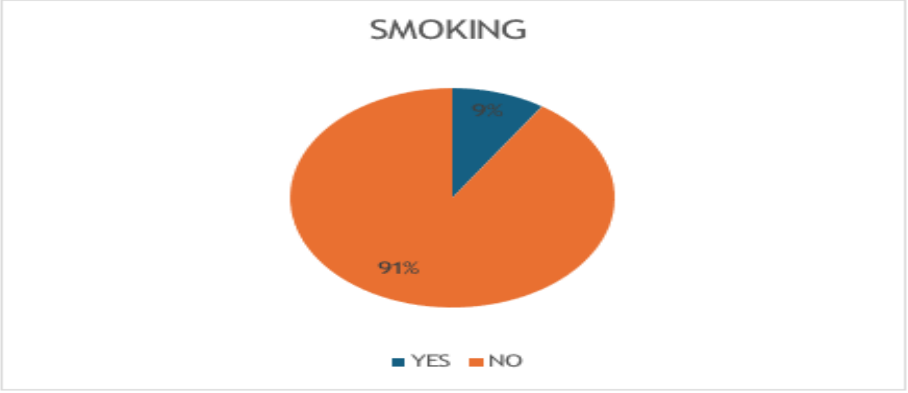
Experience year	Frequency of subjects
1-5	85
6-10	44
11-15	6
16-20	4
21-25	10
25-30	1

Chart 3: Experience Year wise Categorization



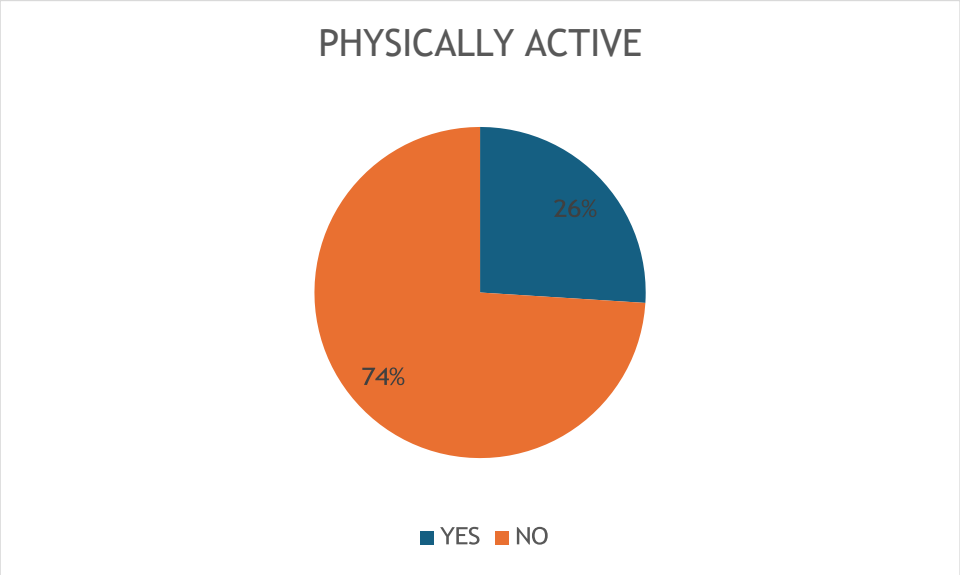
The table shows the distribution of subjects based on their years of experience. The majority, 85 subjects, have 1-5 years of experience, followed by 44 subjects with 6-10 years. Fewer subjects have longer experience: 6 have 11-15 years, 4 have 16-20 years, 10 have 21-25 years, and only 1 subject has 25-30 years of experience. This indicates most participants are relatively early in their careers.

Chart 4: smoking history



The chart shows the smoking status of the subjects. Out of 150 participants, 14 (9.3%) are smokers, while the majority, 136 (90.7%), are non-smokers. This indicates a low prevalence of smoking in the group.

Chart 5: physically active subjects

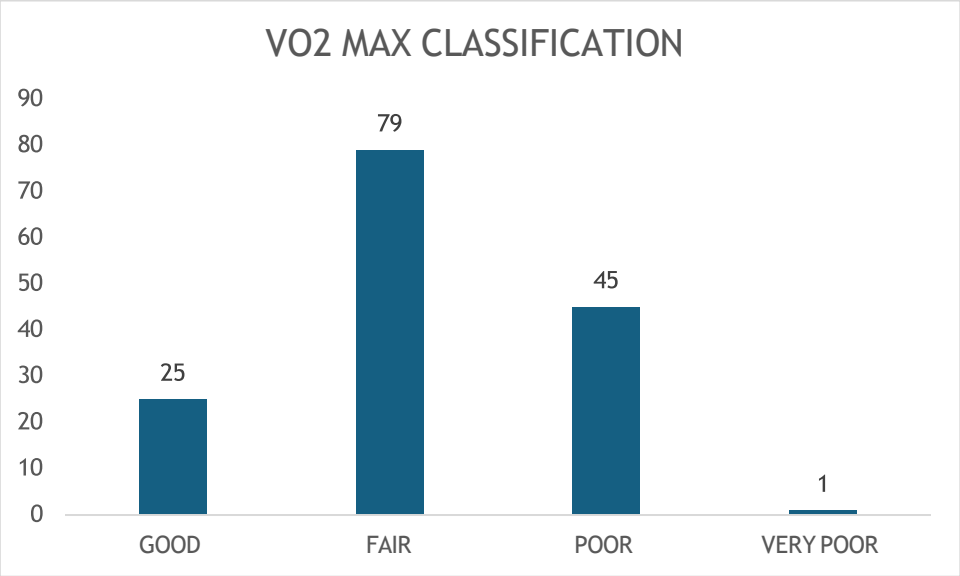


The chart shows the physical activity status of the subjects. Out of 150 participants, 39 (26%) are physically active, while 111 (74%) are not physically active. This indicates that the majority of participants lead a sedentary lifestyle.

Chart 6: Dietary habits

The chart shows the dietary habits of the subjects. Out of 150 participants, 42 (28%) follow a non-vegetarian diet, while 108 (72%) follow a vegetarian diet. This indicates that the majority of participants prefer vegetarian food.

Chart 7: VO2 MAX classification



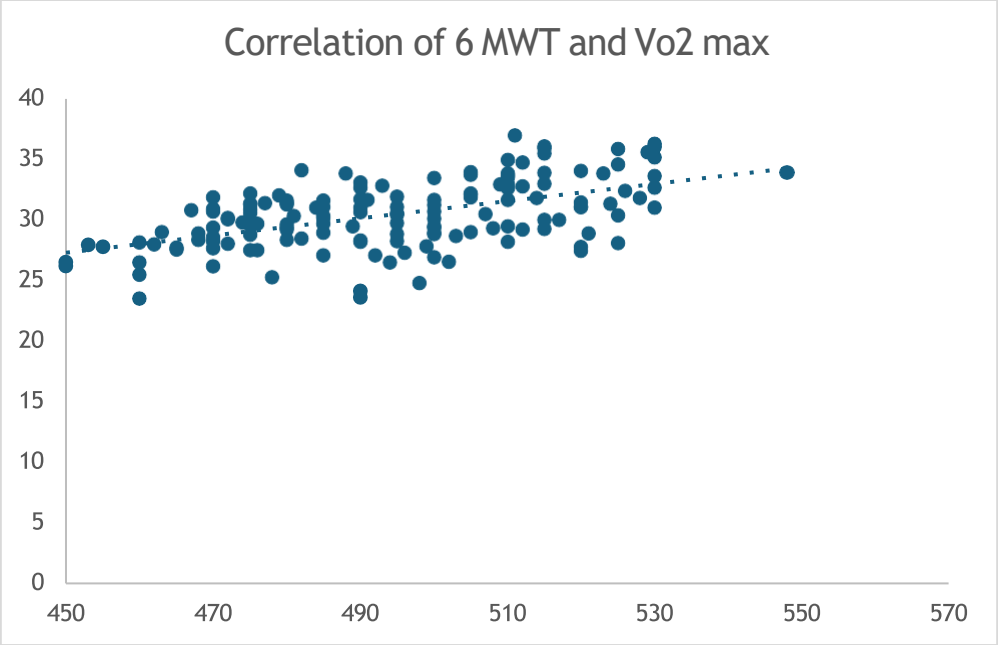
The bar chart illustrates the distribution of VO2 Max classifications among the study participants. The majority of individuals fall under the "Fair" category, with a total of 79 participants, representing the largest group in the sample. This is followed by 45 participants classified as having "Poor" VO2 Max levels. A smaller number, 25 participants, fall into the "Good" category, indicating higher aerobic fitness. Notably, only 1 participant is categorized as having "Very Poor" VO2 Max. The chart highlights that most participants have average to below-average aerobic fitness, with relatively few exhibiting good or very poor cardiorespiratory endurance.

Table 4: **Correlation of 6 MWT and Vo2 max**

	r value	**p value**	**significant**
max with 6 MWT	0.64	0.001	yes

Table 4 presents the correlation between the 6-Minute Walk Test (6MWT) distance and VO2 max values. The r value of 0.64 indicates a moderate to strong positive correlation, suggesting that higher distances covered during the 6MWT are associated with higher VO2 max values. This relationship demonstrates that as the functional exercise capacity measured by the 6MWT improves, the aerobic fitness level (VO2 max) also tends to be higher. The p value of 0.001 indicates that this correlation is statistically significant, meaning the likelihood that this result occurred by chance is very low (less than 0.1%). Therefore, the data supports a meaningful and reliable association between the performance on the 6MWT and the VO2 max values among the participants in this study.

Chart 8: Correlation of 6 MWT and Vo2 max



The chart shows the correlation between the 6-Minute Walk Test (6MWT) distance and VO2 max values. An r value of 0.64 indicates moderate to strong positive relationship, meaning that participants who walked longer distances during the 6MWT generally had higher VO2 max levels, reflecting better aerobic fitness. The p value of 0.001 confirms that this relationship is statistically significant, so it's unlikely to have occurred by chance. This suggests a clear connection between functional exercise capacity and cardiorespiratory fitness in the participants of this study.

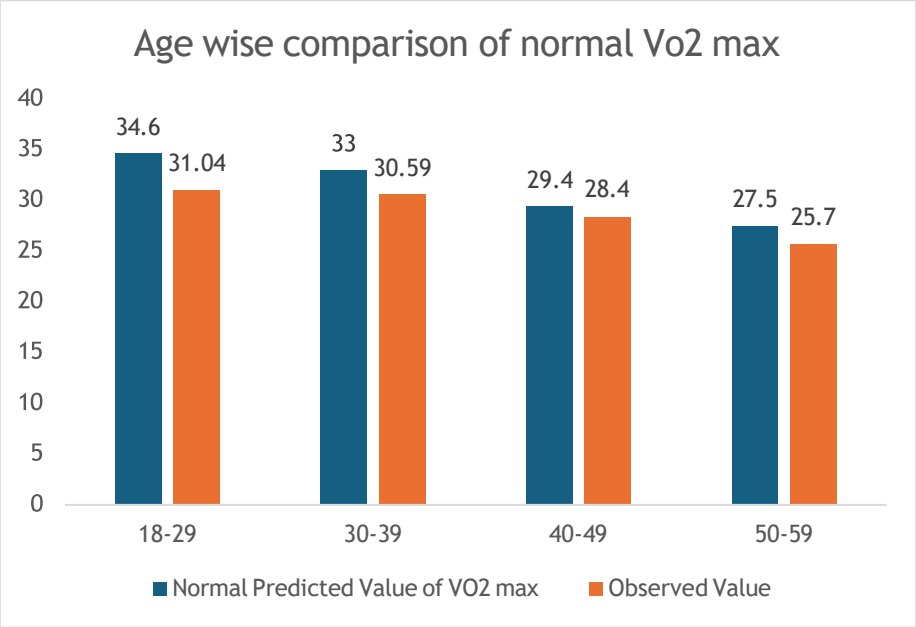
Table 5: Age wise comparison of normal Vo2 max value among female subjects

Age groups	Predicted Value of VO2 max	Observed Value (Mean ± SD) of VO2 Max (ml/kg/min)
18-29	34.6	31.049 ± 2.53
30-39	33	30.59 ± 2.72
40-49	29.4	28.40±2.10
50-59	27.5	25.7±0.70

Table 5 presents an age-wise comparison of the normal predicted VO2 max values with the observed VO2 max values (Mean ± SD) among female subjects. The data illustrates a progressive decline in both predicted and observed VO2 max values with increasing age. For the youngest age group (18–29 years), the normal predicted VO2 max is 34.6 mL/kg/min, while the observed mean value is slightly lower at 31.049 ± 2.53 mL/kg/min. In the 30–39 years age group, the normal predicted value is 33 mL/kg/min, with an observed mean of 30.59 ± 2.72 mL/kg/min. Similarly, for the 40–49 years group, the predicted VO2 max is 29.4 mL/kg/min, whereas the observed value is 28.40 ± 2.10 mL/kg/min. In the oldest age group (50–59 years), the normal predicted VO2 max decreases to 27.5 mL/kg/min, and the observed value further declines to 25.7 ± 0.70 mL/kg/min. This comparison suggests trend of lower observed VO2 max values compared to the normal predicted values across all age groups, suggesting a decline in

cardiorespiratory fitness that may be influenced by factors such as aging, lifestyle, or physical activity levels among the studied female population.

Chart 9: Age wise comparison of normal Vo2 max value among female subjects



The bar chart compares the normal predicted VO2 max values with the observed VO2 max values across four age groups (18-29, 30-39, 40-49, and 50-59 years). In each group, the observed VO2 max is consistently lower than the predicted values, indicating a decline in aerobic fitness relative to expected norms. The difference between predicted and observed values becomes slightly more noticeable with increasing age. Overall, the chart highlights an age-related decrease in both predicted and observed VO2 max levels.

DISCUSSION:

In today's world, many jobs involve sitting for long hours, leading to less physical activity (hypokinesia). This lack of movement can increase the risk of health problems like heart disease and poor fitness. It is important to check the physical ability of such workers to understand their health status.

The 6-Minute Walk Test (6MWT) is a simple and effective way to measure how well a person's body can handle physical activity. This study, titled "A Study to Find Out Functional Capacity Among Hypokinetic Workers Using 6MWT: An Observational Study," was conducted to assess the physical capacity of workers with low activity levels and understand how reduced movement affects their health. The test results provide useful data on endurance and can help in planning health programs and workplace changes. By focusing on the challenges faced by sedentary workers, this study aims to improve their health and support a more active and productive work environment.

We included only women in our study to specifically check their physical ability. Research by Sheel et al.[49] says that women generally have lower physical capacity than men because of body differences like lower hemoglobin levels, smaller lungs, and weaker heart pumping, which make it harder to deliver and use oxygen during exercise. Bishop[50] also explained that women usually have more body fat, less muscle,

and changes in hormones like estrogen, which can affect their endurance and fitness. Because of these factors, women tend to have lower VO_2 max (a measure of aerobic fitness) and walk shorter distances in the 6-Minute Walk Test (6MWT). This highlights the need for special programs to help women, especially those in sitting jobs, improve their physical health.

The findings of this observational study provide important insights into the functional capacity of hypokinetic female workers engaged in sedentary occupations. Using the 6-Minute Walk Test (6MWT) as a measure of submaximal functional capacity, we observed a moderate to strong positive correlation ($r = 0.64$, $p = 0.001$) between the distance covered in the 6MWT and estimated VO2 max values. This statistically significant association indicates that participants who walked longer distances during the test demonstrated higher aerobic fitness levels, underscoring the effectiveness of the 6MWT as an indicator of cardiovascular endurance in this population. Similar results have been reported in previous studies by manttari and burr, where 6MWT performance was found to be a reliable predictor of cardiorespiratory fitness, particularly VO_2 max.[16,18] This relationship can be explained by ross et al [45], the fact that both VO_2 max and 6MWT reflect the efficiency of the cardiovascular and respiratory systems in transporting and utilizing oxygen during exercise. The ease of administering the 6MWT makes it a practical tool for estimating functional capacity and aerobic fitness, especially in occupational settings where more complex testing may not be feasible. Also, These results are consistent with previous literature highlighting the negative impact of prolonged sedentary behavior on cardiovascular fitness and overall functional capacity.[33,34]

The age-wise comparison between the observed and predicted VO2 max values revealed a consistent decline in aerobic capacity with advancing age, which is in line with the expected physiological changes associated with aging. Notably, across all age groups, the observed VO2 max values were lower than the normal predicted values, suggesting a potential adverse impact of prolonged sedentary behavior on cardiorespiratory fitness. For instance, participants aged 18–29 years had an observed VO2 max of 31.049 ± 2.53 mL/kg/min compared to the predicted

34.6 mL/kg/min, with the trend of decline becoming more pronounced in the older age groups.

Our findings are supported by Jamie burr indicating that sedentary lifestyles contribute significantly to reduced functional capacity and physical fitness. In healthy working-aged adults, the intensity of the 6MWT typically corresponds to 70%–75% of VO2 max, classifying it as moderate-to-vigorous intensity activity according to both the American College of Sports Medicine (ACSM) and the Canadian Society for Exercise Physiology. However, prolonged physical inactivity in hypokinetic workers may result in diminished cardiovascular efficiency, reduced muscle strength, and compromised endurance, all of which are reflected in their lower- than-predicted VO2 max values.[35]

Prolonged inactivity increases the risk of cardiovascular and musculoskeletal issues and lowers aerobic fitness. Factors such as age, gender, physical activity, BMI, smoking, diet, and medical history influence 6MWT performance. Older age, higher BMI, and poor lifestyle habits often reduce walking distance, while physically active individuals and males tend to perform better. Early assessment through the 6MWT can help guide interventions to improve health and fitness in this population.

Furthermore, Fleg et al[38] highlighted an age-related decline in functional capacity, with observed VO_2 max values progressively decreasing in older age groups. This finding aligns with previous research indicating that both aging and sedentary lifestyles contribute to reduced cardiorespiratory fitness The lower-than-predicted VO_2 max values observed in our participants underscore the need for workplace interventions that promote physical activity and reduce sedentary time. This study highlights the need to assess and

improve the physical health of hypokinetic workers. Regular aerobic exercise and workplace wellness programs can help boost functional capacity and lower the risk of chronic diseases linked to inactivity.

As age increases, functional capacity tends to decline, which is evident through reduced distances in the 6-Minute Walk Test (6MWT) and lower VO2 max values. This decline is primarily due to several physiological changes associated with aging. One significant factor is the reduction in maximal cardiac output, resulting from both a decreased maximal heart rate and reduced stroke volume[38]. Additionally, aging is associated with a loss of muscle mass, known as sarcopenia, which contributes to decreased strength and endurance, further limiting exercise capacity.[39] Another important consideration is the decline in pulmonary function with age. Older adults experience reduced lung elasticity and diminished ventilatory capacity, which impair oxygen exchange and delivery to working muscles.[40] These factors collectively lead to lower oxygen consumption and reduced VO2 max, a key indicator of aerobic fitness. Studies have shown that the 6MWT distance also decreases with advancing age, as it reflects the combined effects of cardiovascular, respiratory, and musculoskeletal aging. Enright and colleagues (2003)[41] found that older adults walked significantly shorter distances in the 6MWT compared to younger individuals, reinforcing the impact of aging on functional status.

Studies have demonstrated that the 6MWT is effective in assessing functional capacity across diverse populations. For instance, in patients with chronic obstructive pulmonary disease (COPD), the 6MWT has been utilized to evaluate exercise tolerance and predict morbidity. Similarly, in individuals with chronic heart failure, the test has been used to assess physical functional capacity, although it may not accurately reflect peak oxygen uptake (VO_2). [36,37] Applying the 6MWT to hypokinetic workers can provide valuable insights into how sedentary lifestyles affect functional capacity. This information is crucial for developing targeted interventions aimed at improving physical activity levels, thereby enhancing overall health and productivity in the workplace.

Body Mass Index (BMI) is an important anthropometric measure commonly used to assess body fat based on a person's weight and height. It plays a significant role in evaluating health status and physical fitness, particularly in occupational and clinical settings. Elevated BMI is often associated with reduced functional capacity, lower cardiorespiratory fitness, and poor performance in physical endurance tests such as the 6-Minute Walk Test (6MWT). Individuals with higher BMI typically exhibit decreased aerobic capacity and VO_2 max levels due to the increased energy demand of carrying excess body weight during physical activity.[42] Excess adipose tissue also contributes to mechanical inefficiencies and can impair respiratory function by reducing lung volumes and increasing the work of breathing.[43] Additionally, obesity is linked to metabolic disturbances, inflammation, and cardiovascular strain, all of which negatively impact exercise tolerance and endurance.[44] In contrast, individuals with a normal BMI generally demonstrate better exercise performance and functional capacity. Maintaining a healthy BMI through physical activity and balanced nutrition is essential for improving or preserving cardiorespiratory fitness and overall health.

Lifestyle factors such as smoking, physical activity, and diet significantly influence functional capacity and overall health outcomes. Gronseth[46] suggests that Smoking adversely affects the lungs and cardiovascular system, reducing oxygen-carrying capacity and contributing to chronic conditions like chronic obstructive pulmonary disease (COPD) and coronary artery disease. This leads to diminished aerobic capacity, lower VO_2 max, and reduced endurance during physical tasks, including walking. Conversely, World Health Organization, 2020[47] said that regular physical activity enhances cardiovascular efficiency, muscular strength, and aerobic endurance, which are vital for maintaining functional capacity, particularly among hypokinetic workers who are at higher risk of deconditioning due to prolonged

inactivity. Additionally, micha[48] et al conclude that balanced diet rich in essential nutrients supports energy metabolism and muscle function, while poor dietary habits are associated with obesity, diabetes, and cardiovascular diseases. A healthy diet, combined with regular exercise and smoking cessation, can improve VO_2 max, enhance 6MWT performance, and promote overall physical fitness.

Straker et al., 2016[51] had done a study in which he said that Longer job experience in sedentary roles is associated with postural issues, musculoskeletal discomfort, and decreased physical fitness due to repetitive movements, poor ergonomics, and lack of physical activity. Additionally, a longer duration of sedentary work can lead to an increase in body mass index (BMI), reduced muscle strength, and flexibility, all of which negatively affect 6MWT outcomes

Kodama et al in 2009[52] and ross et al in 2016[45] suggested that Low 6-Minute Walk Test (6MWT) distance and low VO_2 max are indicators of poor cardiovascular fitness and reduced functional capacity. Over time, these factors are associated with a higher risk of developing chronic diseases such as cardiovascular disease, diabetes, obesity, and musculoskeletal disorders. Low aerobic capacity can also lead to decreased work productivity, increased fatigue, and a lower quality of life. To mitigate these risks, Garber et al in 2011[53] suggested that regular aerobic exercise, strength training, and active lifestyle interventions are recommended. These can improve VO_2 max, enhance functional capacity, and reduce the risk of chronic illness.

Workplace wellness programs promoting physical activity, healthy eating, and periodic health screenings are effective strategies for improving long-term health outcomes among sedentary workers.

CONCLUSION

This study shows that female workers who are sedentary, have lower physical fitness, as measured by the 6-Minute Walk Test (6MWT), Sitting for long hours, higher body weight, low physical activity, and natural body differences in women can reduce their endurance and ability to use oxygen. The results highlight the need to check fitness levels early and take steps to improve heart health and overall well-being in these workers. Regular exercise, an active lifestyle, and healthy eating can help boost fitness, prevent long-term illnesses, and improve their quality of life. More research with a larger and more varied group of people is needed to confirm these findings and help create better workplace health programs.

FUTURE SCOPE OF THE STUDY

1. Future studies should include both genders to compare functional capacity differences and provide broader insights.
2. Studies evaluating the effectiveness of workplace interventions, such as exercise programs, ergonomic improvements, or wellness initiatives, on improving 6MWT performance and VO2 max are recommended.
3. Expanding the sample size and including workers from various occupational settings and regions can enhance the generalizability of the findings.
4. Future research could examine the impact of factors such as mental health, sleep quality, dietary intake, and chronic conditions on functional capacity.
5. Incorporating devices like accelerometers or fitness trackers can provide more precise data on physical activity levels in relation to functional capacity.

LIMITATIONS OF THE STUDY

- This study included only female hypokinetic workers, which limits the generalizability of the findings to male populations or mixed-gender groups.
- The sample size was relatively small (150 participants), which may not represent the larger population of hypokinetic workers.
- As an observational cross-sectional study, it provides a snapshot of functional capacity but does not establish causal relationships or assess changes over time.
- The study primarily focused on BMI, age, and basic demographic factors. Other variables, such as psychological stress, sleep patterns, and detailed medical histories, were not thoroughly examined.
- Participants were selected from specific industries, which may limit the applicability of results to workers in other occupational sectors.

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