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Original Research Article

Comparison of functional capacity among android versus gynoid obese individuals

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ABSTRACT

Background: Obesity may affect functional capacity. Differences in how fat is distributed throughout the body can also impact physical performance in a variety of ways. Two of the most common patterns of fat distribution are android and gynoid. However, it is not clear whether these differences in fat distribution are reflected in functional capacity.
Methods: This study was a cross-sectional design and included 60 obese adults (30 android and 30 gynoid), aged 18-45. Participants' functional capacity was assessed with the six-minute walk test. The distance walked in the test was recorded and used to evaluate the participants' functional capacity. The normality of the data was assessed using the Shapiro-Wilk test. In the case of normality, Welch's independent t-test was performed. A paired t-test was performed to evaluate each group's functionality based on the predictions.
Results: The mean actual 6MWD was 335.47±78.53 m in the android group and 349.77±69.07 m in the gynoid group. The between-group difference was not statistically significant ($t=-0.749$, $p=0.457$). Actual 6MWD was lower than predicted 6MWD in both groups, with mean differences of 272.56 m in the android group and 289.76 m in the gynoid group (both $p<0.001$).
Conclusions: No, statistically significant difference in actual functional capacity, as assessed by 6MWD, was observed between the android and gynoid groups. Both groups walked significantly shorter distances than their predicted values.

Keywords: Obesity, Waist-hip ratio, Android obesity, Gynoid obesity, Functional capacity, Six-minute walk test

INTRODUCTION

Obesity, a form of malnutrition, is rapidly increasing in the developed and developing world. It can begin at any age, and is often a precursor to other health conditions including hypertension and cardiovascular diseases. Obesity related renal conditions including kidney failure are rising globally.[1]

The distribution of excess body fat can also be classified in obesity types. In central or android obesity, excess fat is deposited in the abdomen and upper body and gives the individual an apple shaped body. This type is more common in men. Gynoid or peripheral obesity, more common in women, is characterized by excess fat deposits in the thighs, buttocks and other body regions, giving an individual a pear-shaped body. Evidence suggests that Android type obesity increases risk of cardiovascular conditions and mortality and "abdominal obesity is associated with impaired lung function.[2]

There are several other measures of obesity, including body mass index (BMI), waist hip ratio (WHR) and waist height ratio. BMI does not indicate where body fat is deposited and thus, in the context of assessing obesity and health, other measures of regional body fat should be considered. Abdominal obesity is indicated by increased circumference of the waist, and is associated with other health conditions including cardiovascular conditions.[2] Waist-hip ratio is another simple measure used to describe

body fat distribution. It is calculated by dividing waist measurements by hip measurements. In the present study, WHR was used to classify participants according to their pattern of fat distribution. Participants were classified as having an android pattern when WHR was >0.85 in females or >0.90 in males. Those who did not meet these cut-offs were placed in the gynoid group.[3] Waist circumference was measured approximately midway between the lower margin of the last palpable rib and the top of the iliac crest. Hip circumference was measured around the widest part of the buttocks and hips.[4] Functional capacity is the ability to perform physical activities required in everyday life. In people with obesity, it may be affected by excess body mass, cardiorespiratory fitness, muscle strength, musculoskeletal loading, changes in gait, and habitual physical activity. The six-minute walk test (6MWT) is a simple and practical test used to assess functional exercise capacity. During the test, the participant walks as far as possible for six minutes on a flat course, and the distance covered, known as the six-minute walk distance (6MWD), is recorded. The test is practical because walking requires the combined response of several body systems.[5,6]

The 6MWD has also been shown to reflect functional capacity in people with obesity. In obese adults, walking distance has been associated with physical functioning, age, quadriceps strength and BMI, indicating that it can provide useful information about limitations during everyday activities. The 6MWT therefore offers a practical way to assess functional exercise capacity without the need for sophisticated laboratory-based testing.[7] Obesity can negatively affect functional capacity by reducing physical performance and mobility. Excess body weight may limit the ability to perform daily activities and exercise and is also associated with an increased risk of chronic conditions that can further affect physical function and quality of life.[8] Previous research has established that obesity can reduce physical performance and functional capacity. However, there is less information on whether the distribution of body fat itself is associated with differences in functional capacity. Therefore, the present study was undertaken to compare functional capacity between individuals with android and gynoid obesity and to examine whether different patterns of fat distribution are reflected in 6MWD.

METHODS

Study design

A cross-sectional study design was used for this study.

Study setting and participants

This study took place at Dr. Ulhas Patil College of Physiotherapy, Jalgaon, Maharashtra, India, over a six-month period i.e., from 16th March 2026 to 18th September 2026. A total of sixty participants were enrolled in the study, of whom 30 had android obesity and 30 had gynoid obesity.

Sample size calculation

The minimum sample size was determined based on the anticipated difference in six-minute walk distance (6MWD), which was assumed to be 60 m between the two groups. A standard deviation (SD) of 68.28 m, a significance level of 0.05, and 80% power were used.[9] The sample size was computed using the formula below for independent groups:

$$n = 2(Z\alpha/2 + Z\beta)^2\sigma^2 / \Delta^2$$

The calculated sample size was approximately 42 participants for two groups. To increase the adequacy of the sample size, it was raised to 60, with 30 participants in each group.

Eligibility criteria

Participants aged 18-45 years with a BMI >25 kg/m^2 were considered for the study. Female subjects with a waist-hip ratio >0.85 and male subjects with a waist-hip ratio >0.90 were considered to have an android obesity. All other subjects were considered to have gynoid obesity.

Participants with a history of recent injury or trauma, those who were bedridden, and those who had a known cardiovascular or respiratory disorder, musculoskeletal disorder, neurological disorder or psychiatric disorder or addiction, or those taking medicine for obesity-related disorder were excluded from the study. Those who had disturbed, inadequate, or poor-quality sleep also were excluded from the study.

Classification of android and gynoid obesity

BMI and waist-hip ratio were assessed for each participant. Waist-to-hip ratio (WHR) determines android and gynoid obesity. Waist circumference was measured halfway between the costal edge and iliac crest. Hip circumference was measured over the widest part of the gluteal folds.

Functional capacity assessment

Functional capacity was evaluated through a six-minute walk test (6MWT) on a 30-meter walk test course. Subjects were instructed to walk back and forth on the course for 6 minutes. Subjects were permitted to walk as slowly as needed, and to take rest breaks as needed. Standardized encouragement was provided. To minimize the effects of confounding factors on the results, subjects were required to rest for at least 10 minutes prior to testing. Contraindications to testing were assessed. Additionally, resting pulse and blood pressure were recorded. The Borg scale was used to assess resting levels of dyspnea and fatigue. At the end of the 6-minute walk test, the distance

covered was recorded. When needed, test procedure and encumbrance were explained to assist subjects in understanding the evaluation process. The number of laps, and additional distance covered were recorded. Post-test Borg scales and, when applicable, pulse oximetry, were completed.[10]

Predicted 6MWD

For the purpose of this study, the predicted 6MWT was calculated using the Enright and Sherrill equation.[11] The predicted distance was then compared to the actual 6MWT for each group.

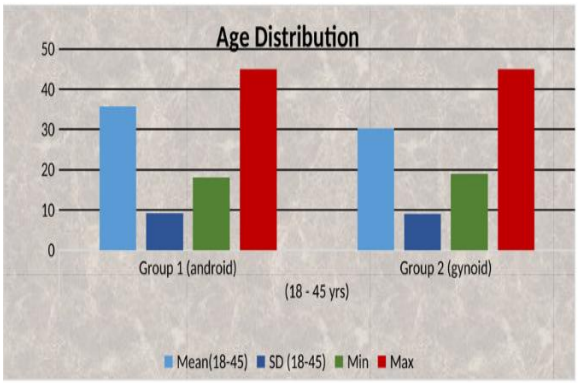
Statistical analysis

The normality of the data was tested using the Shapiro-Wilk test. Actual 6MWD for the android and gynoid groups were compared using Welch's independent samples t-test. For each group, paired samples t-test was done to compare actual and predicted 6MWD. A p value of less than 0.05 was considered to be statistically significant.

RESULTS

Mean and SD of age in android and gynoid group

The mean age was 35.70±9.17 years in the android group and 30.23±9.06 years in the gynoid group (Table 1) (Figure 1).



Gender wise distribution

This table shows the gender distribution of study participants in the android and gynoid groups. The android group comprised 23 males (76.67%) and 7 females (23.33%), whereas the gynoid group comprised 4 males (13.33%) and 26 females (86.67%). Consequently, the android group had more males, while the gynoid group had more females (Table 2 and Figure 2).

Descriptive statistics of study variables

Table 3 presents the mean and standard deviation of the study variables in the android and gynoid groups.

Within-group comparison of actual and predicted 6MWD

For the android group, the average actual 6MWD was substantially less than the estimated value. The average difference was approximately 272.56 m. The paired sample t-test (t=−14.44) indicated that this was a statistically significant result. The gynoid group also had a similar situation, whereby the average actual 6MWD was approximately 289.76 m less than the estimate. The paired sample t-test (t=−21.52) also indicated that this was a statistically significant result (Table 4 and Figure 3).

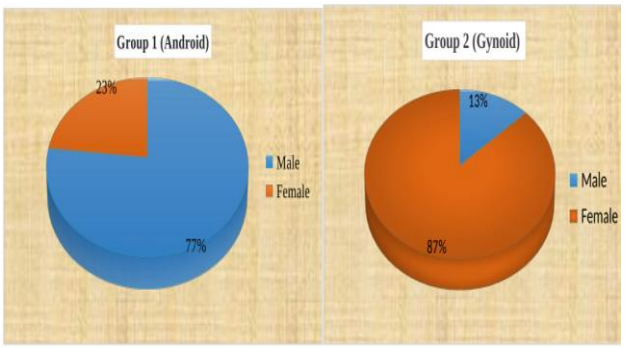


Figure 2: Gender-wise distribution.

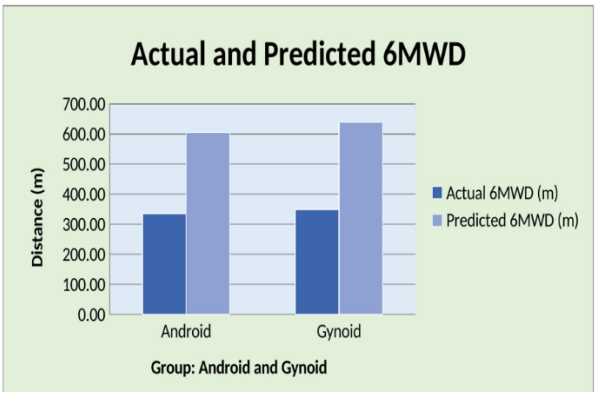


Figure 3: Within-group comparison of actual and predicted 6-minute walk distance (6MWD).

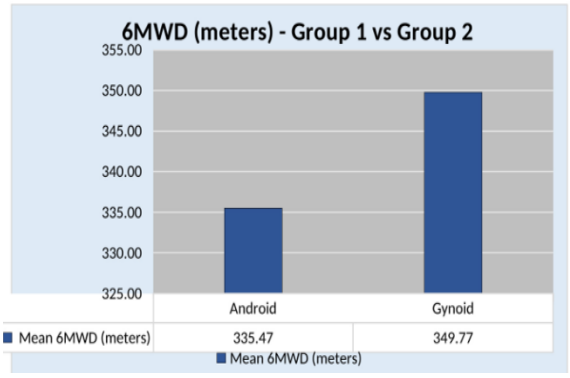


Figure 4: Between-group comparison of actual 6-minute walk distance (6MWD).

Between-group comparison of actual 6MWD

The mean 6MWD was 335.47±78.53 m in the Android group and 349.77±69.07 m in the Gynoid group. Although the Gynoid group walked a greater mean distance, the difference between the two groups was not statistically significant (t = −0.749, p=0.457) (Table 5 and Figure 4).

Table 1: Mean and SD of age in android and gynoid group.

Age in years	Groups	Mean age	SD	Min	Max
18-45	Group1 (android)	35.7	9.17	18	45
	Group2 (gynoid)	30.23	9.06	18	45

Table 2: Gender-wise distribution.

Variable	Group	Group 1 (Android)		Group 2 (Gynoid)	
		Frequency	Percentage	Frequency	Percentage
Gender	Male	23	76.67%	4	13.33%
	Female	7	23.33%	26	86.67%

Table 3: Descriptive statistics of study variables in the android and gynoid groups.

Variables	Android Mean±SD	Gynoid Mean±SD
Age (years)	35.70±9.17	30.23±9.06
Height (cm)	163.43±9.57	158.53±4.36
Weight (kg)	89.90±12.25	81.81±6.62
BMI (kg/m²)	33.35±2.36	32.55±2.30
Waist circumference (cm)	104.57±15.08	87.17±8.10
Hip circumference (cm)	99.27±11.93	107.99±10.80
Waist-hip ratio	1.05±0.08	0.81±0.04
6-minute walk distance (m)	335.47±78.53	349.77±69.07
Predicted 6-minute walk distance (m)	608.03±61.12	639.53±53.85

Table 4: Within-group comparison of actual and predicted 6MWD.

Group	Actual 6MWD (m) [Mean±SD]	Predicted 6MWD (m) [Mean±SD]	Paired t	p value
Android	335.47±78.53	608.03±61.12	-14.44	<0.001
Gynoid	349.77±69.07	639.53±53.85	-21.52	<0.001

Table 5: Between-group comparison of actual 6MWD.

Group	N	Mean±SD	Statistical test	p value	Welch's t-value
Android	30	335.47±78.53	Welch's Independent-Sample t-test	0.457	-0.749
Gynoid	30	349.77±69.07	Welch's Independent Sample t-test		

DISCUSSION

This study assessed the functional capacity of android and gynoid obesities through the 6MWT. The study included 60 participants, 30 in each group. The mean 6MWD for the android group was 335.47±78.53 m and the mean 6MWD for the gynoid group was 349.77±69.07 m. In both groups, the walk test yielded results less than the expected results. Although the gynoid group mean 6MWD was higher than that of the android group, the difference was not statistically significant.

Lower than expected 6MWDs in the android group could be due to the effects of abdominal fat on the breathing and movement required to perform the test. Increased abdominal fat may restrict movement of the diaphragm and alter breathing. Increased demand on breathing may affect walking endurance. Central adiposity is also associated with insulin resistance, ectopic fat and

inflammation. It is thought that central adiposity may contribute to alterations in metabolism and energy regulation that may reduce the body's ability to perform and tolerate exercise.

These findings are in line with Udomittipong et al who reported that abdominal obesity measures, particularly waist-circumference-to-height ratio, were negatively associated with six-minute walk distance. They also reported poorer pulmonary function in obese participants, suggesting that greater abdominal adiposity may be related to reduced respiratory function and lower exercise-related functional capacity.[12]

Lim et al also reported an association between intermuscular adipose tissue, adipose-tissue inflammation and poorer functional performance in people with central adiposity. Greater intermuscular adipose tissue was associated with poorer muscle strength and gait performance. This suggests that changes in muscle quality and inflammatory processes may be additional factors through which central adiposity affects physical performance.[13]

Participants in the gynoid group also demonstrated a mean 6MWD below the predicted distance. With increasing adipose tissue of the hips and lower extremities (Gynoid type), regular repetitive movement of the lower extremities during ambulation requires increased muscular effort and energy expenditure. This may also affect control of movement in a lateral direction (steps with lateral excursion) and increase the muscular effort required to walk and maintain an upright position, resulting in loss of endurance for walking and increasing the feeling of fatigue.

The findings can be considered alongside the study by Santarém et al which found an association between body composition and walking capacity in individuals with severe obesity. Greater fat-free mass was related to better 6MWD, while excessive adipose accumulation and mechanical factors were considered relevant to walking performance.[14]

Maktouf et al further reported that gynoid obesity was associated with a wider step width and shorter step length during walking. A wider step width was accompanied by greater mediolateral centre-of-pressure displacement and increased external mechanical work. The study also found greater ankle muscle coactivation during propulsion, indicating increased muscular effort and energy demand during gait. These changes may increase the energy cost of walking and contribute to earlier fatigue, which could affect functional performance.[15]

Despite these differences in the possible mechanisms affecting walking, the present study did not find a statistically significant difference in functional capacity between the android and gynoid groups. Both groups had lower actual 6MWD than their predicted values, suggesting that obesity was associated with reduced walking performance in both patterns. However, the location of excess fat alone may not have been sufficient to produce a measurable difference in 6MWD between the two groups.

One possible explanation is that functional capacity is influenced by several factors in addition to regional fat distribution. The total amount of fat mass, fat-free mass, muscle strength and level of physical activity may all contribute to walking performance. These factors were not directly assessed in the present study. Therefore, although android and gynoid obesity may affect walking through different physiological or biomechanical pathways, their overall effect on 6MWD may be similar when other important determinants of functional capacity are not accounted for. The present findings should therefore be interpreted as showing no statistically significant difference between the two groups rather than proving that fat distribution has no effect on functional capacity.

Limitations

Functional capacity was assessed using only the 6-minute walk test and other functional measures were not included. To check fat distribution region-wise, skinfold calliper was not considered. WHR was used to classify fat distribution; however, it may not accurately represent the actual regional or visceral fat distribution. Study have not considered the exact amount of fat mass, fat free mass, level of physical activity etc. which affects functional capacity.

CONCLUSION

No, statistically significant difference in actual functional capacity, as assessed by 6MWD, was observed between the android and gynoid groups. Both groups walked significantly shorter distances than their predicted values.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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