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# Will Carrying Angle Have an Impact on Different Types of Obesity and Dominance? A Correlational Study

**Charchika Mohanty[1], Roopa Desai[2]**

[1]Intern, Dr. D. Y. Patil College of Physiotherapy, Dr. D. Y. Patil Vidyapeeth, Pune, India
[2]Professor, Dr. D. Y. Patil College of Physiotherapy, Dr. D. Y. Patil Vidyapeeth, Pune, India

Corresponding Author: Charchika Mohanty

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## ABSTRACT

The carrying angle represents the angle developed when the forearm is fully extended and supinated in between lateral obliquity and the median axis of both the arms, and shoulder externally rotated. The carrying angle measurement is conducted on genders having android and gynoid obesity in the age category of 20–45 years. In this research we evaluated carrying angle and analyzed its prevalence in both genders with different types of obesity. A total of 100 obese participants, consisting 26 obese men and 74 obese women took part in the study. Simultaneously, their dominant and non-dominant hands were used to measure the carrying angle using a goniometer and body mass index was measured using a stadiometer, an electronic weight machine including a measuring tape for the waist to hip ratio. The statistical analysis was done using Microsoft Excel and the statistical package for social sciences (SPSS) version 21 software. The average carrying angle in the right hand of an obese android is 19.87 ± 2.72, whereas that of a gynoid is 19.83 ± 2.41. The carrying angle of an android's left hand is 17.67 ± 2.67. on average, compared to 17.60 ± 2.50 are obese gynoid individuals. It has been discovered that gynoid obesity is more common in women than android obesity in men. The study concluded that increase in body mass index and waist hip ratio can affect the carrying angle in both male and female obese individuals, but gynoid and android obesity has no effect on the carrying angle. Hence, there is no significant correlation between carrying angle with android and gynoid obesity in both genders.

***Keywords:*** Android, Carrying Angle, Gynoid, Obesity, Waist to hip ratio

## INTRODUCTION

The prevalence of carrying angle varies significantly among genders 78.88% female and 75% male students around adolescence, a phase when changes in bone growth and maturation occurs. Flexion and extension movements at the joint can prominently differ the carrying angle [1,2]. As compared to men, women have a greater carrying angle due to larger hips and narrower shoulders which permit them to walk without their forearms brushing against their hips and reducing the friction between the forearm and the area around the pelvis[3,4]. Females have a higher level of joint laxity, which allows them to have more extension, it changes from childhood till adulthood [5]. Further it has been determined that normal carrying angle in males is 5°-10° where else in females is 10°-15°. This angle is known as cubitus valgus if it is > 15°, and cubitus varus if it is < 5°[6]. Moreover, it was

discovered by Paraskevas et al. in their study that the carrying angle is higher on the dominant limb than on the non-dominant limb in both males and females; this occurs because of the longer forearm, which is based on changes in morphometric factors. It's also inversely correlated to the inter trochanteric diameter [7].

Due to urbanization, sedentary lifestyle changes, bad dietary habits, and a lack of physical activity, obesity incidence has rapidly increased. It has doubled over the past three decades, leading to 39% of men and 40% of women being obese confining it as a non-communicable disease [8]. Body size is primarily determined by anthropometric parameters like body weight and body Mass Index (BMI=kg/m2). As per the ASIAN BMI classification, those who had a body mass index > 25 kg/m2 were considered obese [9]. According to Marie E. Thoma et al discussed that regional fat distribution are essential for determining different types of body shapes: android (upper body fat, including visceral deposits at the level of the waist and subcutaneous deposits on the back), intermediate, and gynoid (lower body fat, including on the thighs and buttocks, wider pelvis) in women [10]. Thus, researchers have discovered a connection between carrying angle and many measurements in adolescence, including BMI and the waist-hip ratio. In contrast, a radiographic investigation of a large series of 422 patients analyzed revealed no variation in carrying angle between men and women [11].

Evidence from the literature indicates that patients with elbow deformities may experience an increase in carrying angle that may result in conditions like lateral epicondylitis, non-traumatic ulnar neuropathy, elbow instability and pain during exercise, entrapment neuropathy of the ulnar nerve at the elbow, and other conditions that, if untreated, may impair the ability to flex the elbow. Since many studies have proven that with obesity there is variation in carrying angle, thus there is a need to find out association of carrying angle among population with types of obesity namely android and gynoid along with its dominance.

## MATERIALS & METHODS

It is a correlational study with 100 participants, including both male and female obese people with both android and gynoid obesity. Participants in the current study were obese males (n = 26) and females (n = 74), aged 20 to 45 years, with normal elbow range of motion and BMI index > 25 (according to ASIAN Classification). However, participants with neurological disorders were not included in our study as were those with congenital abnormalities of the extremities, fractures, or surgeries near the elbow joint.

Ethical approval was obtained from the Institutional Ethical Committee. Participants have been recruited from Dr. D. Y. Patil Vidyapeeth for this study. Subjects with normal elbow range of motion and with BMI index > 25 (according to ASIAN Classification) were provided consent forms to give acceptance. Using an electronic scale to measure weight and a stadiometer or measuring tape, depending on the feasibility, the BMI was calculated, and the measurements were documented. According to the ASIAN Classification of BMI, the subjects were classified into groups in order to evaluate the waist and hip circumferences in the horizontal plane, a measuring tape was wrapped around the narrowest region of the trunk and along the buttocks' greatest protrusion. In the horizontal plane, subjects were each assigned an erect Stand position, and waist hip ratio were calculated.

The subjects were instructed to stand with their arms outstretched and their elbows extended in the standard anatomical position. With the fulcrum placed at the anterior aspect of the medial epicondyle, a universal goniometer was used to measure the carrying angle with a

stationary arm along the long axis of the arm and a moving arm along the long axis of the forearm.

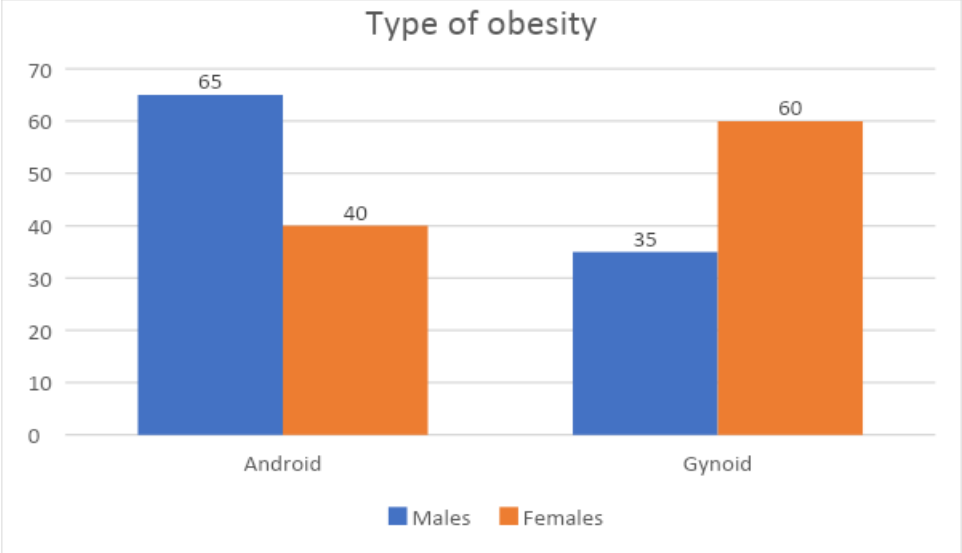
**Fig 1. To measure carrying angle one arm of the goniometer was placed along the long axis of the arm and the other arm along the long axis of the forearm, fulcrum is placed on the anterior aspect of medial epicondyle.**

## STATISTICAL ANALYSIS

It was recorded using Microsoft Excel and the Statistical Package for Social Sciences (SPSS) version 21 software was done and data was prepared accordingly.

## RESULT

This study contains 100 participants, it was observed that both android and gynoid obese people had higher carrying angles on their dominant hand than their non-dominant hand. The participants in the current study were obese male -26 and female - 74 adults aged 20-45 years. According to the study, 60% of gynoid obesity are women and 65% android obesity are men. The average carrying angle in the right hand of android obesity is 19.87 ± 2.72, while that of gynoid is 19.83 ± 2.41. The average carrying angle in the left hand of android is 17.67 ± 2.67, while that of gynoid obesity is 17.60 ± 2.50. It has been shown that gynoid obesity is more prevalent in females than android obesity is in men.



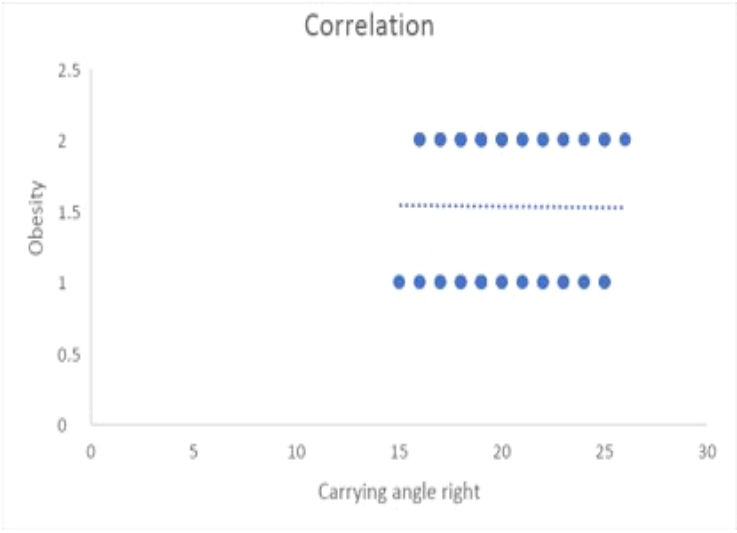

**Graph 1. In male's android obesity was high and in females gynoid obesity was high**

| Characterstics | Mean+/-SD | Mean+/-SD |
|---|---|---|
| Gender | Males | Females |
| Age(years) | 26.88+/-7.96 | 28.40+/-8.66 |

**Table 1. The mean age of the population among males and females respectively**

| Evaluations | Males | Females |
|---|---|---|
| Values | Mean+/-SD | Mean+/-SD |
| WHR | 0.91+/-0.07 | 0.84+/-0.11 |
| BMI | 31.50+/-4.32 | 32.24+/-3.81 |
| Carrying angle left | 16.38+/-2.84 | 18.04+/-2.34 |
| Carrying angle right | 18.80+/-3.14 | 20.21+/-2.21 |

**Table 2: The mean values of males and females obese individuals with waist hip ratio, body mass index, carrying angle of left and right upper limb.**




**Graph 2a. Correlation of right Carrying angle with obesity.**


**Graph 2b. Correlation of left Carrying angle with obesity.**

| Evaluations | n | Rt (η) | Lt (η) |
|---|---|---|---|
| Carrying angle with gynoid obesity | 100 | 0.008 | 0.003 |
| Carrying angle with android obesity | 100 | 0.008 | 0.003 |

**Table 3. n= sample size, η= eta coefficient**

## DISCUSSION

The main objective of this study was to examine the relationships between carrying angle with android and gynoid, along with dominance in obese male and female subjects. Rapid globalization has led to an increase in obesity, which affects both men and women globally and raises the risk of many diseases. According to a contrary study by Chinweife K. C et al, men have a stronger correlation between the waist hip ratio and the carrying angles (both left and right) than women do. Since men have a relatively more central distribution of fat in the abdomen region and women have more in the pelvic region as a result of secondary sexual characteristics[12].The present study also demonstrated that males have a greater waist-hip ratio of (0.91+/-0.07) and females a greater waist-hip ratio of (0.84+/-0.11). Furthermore, according to WHR research, obesity in both the male and female populations has been classified as android and gynoid.

Carrying angle research has primarily focused on its secondary nature. A study by Manandhar B et al. found that carrying angle is greater in the dominant hand than in

the non-dominant hand in both males and females. The prevalence of the carrying angle in female students had a higher mean value (12.58±1.60) and the value was a little lower (11.22±1.25) in the right-hand of male students[2]. However, our study shows that females had considerably greater values of carrying angles for both the right and left (Right 20.21+/-2.21, Left 18.04+/-2.34) than did males (Right 18.80+/-3.14, Left 18.80+/-3.14).Researchers have discovered that secondary sexual traits in both the male and female population reflect variations in carrying angles. One aspect of the body, where there are apparent changes between the genders in the general population is the pelvic area. The pelvic girdles of women are generally lighter, thinner, and wider than those of men.

Comparatively, the front of the female pelvis flares out more laterally than the male. The sacroiliac joint, a robust synovial joint with fibrocartilage and potent ligamentous support, connects the pelvis to the trunk. Males don't have mobile sacroiliac joints because of their thicker, stronger sacroiliac ligaments, but females do because of their greater laxity in the ligaments that support the joint, which aids in parturition, acts as an energy absorber during gait, and induces positional differences in the center of gravity while standing in each gender. While it is located in the same plane as the sacrum in females, the center of gravity is more anterior in males. Additionally, females have wider pelvis and smaller shoulders than males, which results in a greater carrying angle[13].

Generally, it has been observed that men are more likely to have android obesity, whereas women are more likely to have gynoid obesity. However, Camilleri G et al. have shown, android distribution can be found in women and gynoid distribution can be found in men. A variety of genetic and environmental factors interplay to regulate the accumulation of adipose tissue[14]. In our prospective analysis, 35% of men are gynoid and 40% of women are android. Increased androgens were reported to play a role in the pathophysiology of abdominal obesity in women in a prior study by Hirschberg A[15].

## CONCLUSION

This study revealed that carrying angle with android and gynoid obesity did not significantly correlate in either gender. Based on this study, increase in BMI and WHR can affect the carrying angle in both male and female obese individuals, but gynoid and android obesity has no effect on the carrying angle.

### *Declaration by Authors*

**Ethical Approval:** Approved

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**Conflict of Interest:** The authors declare no conflict of interest.

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