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Original Research

Overweight Not Associated with Q-Angle in the Elderly

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ABSTRACT

Background: *Overweight can affect the quadriceps angle (Q-angle), which plays an important role in knee balance and stability, especially in the elderly. Q-angle imbalance has the potential to cause musculoskeletal disorders. This study aims to determine the relationship between overweight and Q-angle in the elderly.*

Methods: *This study used a cross-sectional design and was conducted on December 1 and 5, 2022, at the Dr. Soetomo Surabaya Hospital Retirees Association. The sampling technique used purposive sampling with a sample size of 54 elderly people (14 men and 40 women) aged 60–75 years. Data were collected using observation sheets and measurements of height, weight, and Q-angle in the supine position. Data analysis used Spearman's correlation test because the data were not normally distributed.*

Results: *The average age of respondents was 64.41±3.77 years with a body mass index (BMI) of 27.41±1.22 kg/m² and an average Q-angle of 17.78±3.42°. The correlation test results showed a p-value >0.05 (r=0.196), indicating no significant relationship between overweight and Q-angle in the elderly.*

Conclusion: *There is no relationship between overweight and Q-angle in the elderly. These results indicate that the measurement position, activities prior to measurement, and physical characteristics of the elderly can affect Q-angle values. The researchers suggest that Q-angle examinations in the elderly be performed in a functional position (standing) and with relaxed muscles.*

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INTRODUCTION

Health is an important aspect of human life because a healthy body allows individuals to function optimally in their daily lives. Improvements in the quality of health services and public awareness have led to an increase in life expectancy in Indonesia. Data from the Indonesian Ministry of Health shows that the number of elderly people increased from 18 million in 2010 to 25.9 million in 2019 and is estimated to reach 48.2 million in 2035. Healthy and high-quality elderly people are in line with the concept of active aging, which is healthy aging physically, socially, and mentally so that they remain productive in old age (Manuaba et al., 2021; Kiik, Sahar, & Permatasari, 2018).

Weight tends to increase in adulthood due to changes in metabolism and decreased physical activity patterns. Overweight is a condition of excess body weight due to excessive body fat accumulation, which occurs due to an imbalance between energy intake and energy expenditure (Lubis & Lestari, 2020). The World Health Organization (WHO) classifies a body mass index (BMI) of 25–29.9 kg/m² as overweight and ≥30 kg/m² as obese. This condition is a global health problem because it increases the risk of degenerative diseases such as diabetes, hypertension, and musculoskeletal disorders (Strømmen et al., 2015).

Overweight contributes to increased load on the knee joint, which can trigger pain and changes in the mechanical structure of the knee. Weight gain increases the compressive force on the lateral side of the knee, triggering complaints such as anterior knee pain and the risk of osteoarthritis (Mambodiyanto, 2016; Juriansari, Naufal, & Widodo, 2020). One biomechanical indicator related to knee function is the quadriceps angle or Q-angle. The Q-angle indicates the relationship between the pulling force of the quadriceps muscle and the patellar tendon and is used to assess knee joint stability (De Oliveira Silva et al., 2015).

The Q-angle has dynamic variations due to changes in knee position and muscle activity. An increase in the Q-angle can occur due to femoral anteversion, external tibial rotation, or excessive hamstring muscle tension. These conditions can alter the direction of patellar pull and increase the risk of disorders such as patellofemoral pain syndrome (Songur & Demirdel, 2020). Research by Soheilipour et al., (2020) shows a significant relationship between BMI and genu varum and genu valgum deformities, where groups with high BMI have a larger Q-angle. This reinforces the assumption that being overweight can affect the size of the Q-angle.

Based on this description, the phenomenon of the relationship between overweight and Q-angle in the elderly is still rarely studied in Indonesia, especially in the post-retirement population who regularly engage in physical activities such as elderly gymnastics. The novelty of this study lies in the context of measuring the Q-angle in the supine position after exercise in overweight elderly people. Therefore, this study aims to determine the relationship between overweight and the Q-angle in elderly people at the Dr. Soetomo Surabaya Hospital Retirees Association.

MATERIALS AND METHOD

This type of research is analytical observational research with a cross-sectional approach. This design was chosen because the researchers wanted to determine the relationship between overweight and quadriceps angle (Q-angle) in elderly people at a single measurement point without intervening in the research subjects. A cross-sectional design is considered appropriate for describing the relationship between variables and facilitating researchers in collecting data efficiently from a predetermined population.

This study was conducted at the Dr. Soetomo General Hospital Retirees Association, Surabaya, East Java, which is a place for regular activities for the elderly, such as gymnastics and social gatherings. This location was chosen based on its ease of access, the active involvement of the elderly in physical activities, and the support of the community management. The study was conducted on December 1 and 5, 2022, coinciding with the schedule of regular exercise activities for the elderly, which are held twice a week, so that the physical condition of the respondents was active but measurable.

The population in this study consisted of all elderly members of the Dr. Soetomo Hospital Retirees Association aged 60–75 years, with a total population of 74 people. The sampling technique used purposive sampling based on criteria determined by the researcher. Based on the selection results, 54 elderly people who met the inclusion criteria were obtained, consisting of 14 men and 40 women. The inclusion criteria included elderly people who were willing to be respondents by signing informed consent, were overweight, aged 60–75 years, and were able to communicate well. Meanwhile, the exclusion criteria included elderly people with severe knee osteoarthritis, a history of femur or tibia fractures in the last 6 months, knee ligament injuries, and cardiovascular, respiratory, or neurological diseases.

The independent variable in this study was overweight, while the dependent variable was the quadriceps angle or Q-angle. Overweight was determined based on Body Mass Index (BMI) measurements using the formula of weight (kg) divided by height squared (m^2). The Q-angle was measured using a goniometer from the line between the anterior superior iliac spine (ASIS) to the center of the patella and from the center of the patella to the tibial tuberosity. Other instruments used were a weighing scale, a height measuring tape, and an observation sheet. All instruments were calibrated in advance to ensure the accuracy of the measurements.

The validity and reliability of the measuring instruments referred to physiotherapy standards, in which goniometers have a high level of reliability for measuring knee joint angles (Weiss et al., 2013). The data collection procedure was carried out in several stages. The first stage was preparation, which included obtaining research permission and coordinating with the head of the retiree association. The second stage was subject selection based on inclusion and exclusion criteria.

After the participants were selected, the researchers explained the purpose and procedure of the study to the respondents and requested their written consent. Measurements were taken after participants completed their routine exercise and rested for 10–15 minutes. Each respondent's height, weight, and Q-angle were measured in a supine position to reduce the risk of injury. The measurement data were then systematically recorded in the research observation sheet.

Data analysis was performed using SPSS software version 26.0. The first stage was to test the normality of the data using the Kolmogorov–Smirnov method to determine the data distribution. As the results showed a non-normal distribution, the analysis of the relationship between overweight and Q-angle was performed using Spearman's correlation test. Significance values ($p>0.05$) were used as the basis for determining whether there was a meaningful relationship between variables. This study underwent an ethical review process by the Ethics Committee of the Surakarta Ministry of Health Polytechnic, and all respondents signed an informed consent form as a form of agreement to participate in the study, taking into account the principles of respect for person, beneficence, and justice.

RESULTS

Table 1. Frequency Distribution of Respondents Based on Gender (n = 54)

Gender	Number (n)	Percentage
Male	14	25.9
Female	40	74.1
Total	**54**	**100**

Table 1 shows that most respondents in this study were female, totaling 40 people (74.1%), while males numbered 14 people (25.9%). This indicates that female participation in elderly exercise activities is higher than that of males. This composition also reflects the tendency for there to be more elderly women in the community of retirees at Dr. Soetomo General Hospital in Surabaya.

Table 2. Distribution of Average Age, Body Mass Index, and Q-Angle Values of Respondents (n = 54)

Variable	Minimum Value	Maximum Value	Mean ± SD
Age (years)	60	74	64.41 ± 3.77
Body Mass Index (kg/m²)	25	30	27.41 ± 1.22
Q-Angle (°)	15	30	17.78 ± 3.42

Table 2 shows that the average age of respondents was 64.41 ± 3.77 years with an age range of 60–74 years. The average body mass index value of 27.41 ± 1.22 kg/m² indicates that all respondents were classified as overweight. These findings indicate that most elderly people in the Dr. Soetomo Hospital retiree community are overweight, which could potentially affect knee biomechanics. The average Q-angle value in the elderly studied was 17.78 ± 3.42°, with a range of 15° to 30°. This value is still within the normal physiological range for the adult population, but shows variation between individuals. This Q-angle variation can be influenced by differences in pelvic anatomy, quadriceps muscle strength, and body position during measurement (supine).

The normality test results showed that the significance value (p-value = 0.001) was less than 0.05, which means that the data was not normally distributed. Therefore, the analysis of the relationship between variables was performed using a nonparametric correlation test, namely the Spearman Correlation Test. This test was chosen because it is suitable for ordinal scale data and does not meet the assumption of normality.

Table 4. Results of the Spearman Correlation Test between Overweight and Q-Angle (n = 54)

Variable	Correlation Coefficient (r)	p-value	Description
BMI vs Q-Angle	0.196	1.000	No significant relationship

Table 4. Shows the results of Spearman's correlation analysis, indicating a correlation coefficient of 0.196 with a p-value of 1.000 ($p > 0.05$). These results indicate that there is no significant relationship between overweight (based on BMI) and Q-angle in the elderly. The very weak positive correlation value shows that an increase in BMI is not always followed by a significant change in the Q-angle. This condition is likely due to measurement position factors, muscle fatigue after exercise, and anatomical differences among elderly individuals.

DISCUSSION

The results of this study indicate that there is no significant relationship between overweight and the quadriceps angle (Q-angle) in elderly people at the Dr. Soetomo Surabaya Hospital Retirees Association. These findings show that an increase in body mass index (BMI) is not always followed by a significant change in the Q-angle. The measurement position, which was performed in a supine position, may have influenced the results because there was no body weight pressure on the knee joint. In this position, the quadriceps muscle pull does not work optimally, so the Q-angle appears relatively stable even with excess weight.

These results are in line with the study by Songur and Demirdel (2020), which showed that Q-angle measurements in the supine position tend to yield smaller results compared to the standing position because there is no axial load on the lower limbs. Similarly, research by Ghait et al. (2020) reported that body position and quadriceps muscle activity can affect the size of the Q-angle. This shows that biomechanical factors, such as measurement position and muscle activity, play an important role in Q-angle measurement results, not just body weight alone.

The difference between the results of this study and previous studies can be explained by the physiological conditions of the elderly and the physical activity performed before measurement. The elderly in this study had performed routine exercises before the examination, which could cause the quadriceps muscles to be tired or less relaxed. This condition affected knee stability and the measured Q-angle (De Oliveira Silva et al., 2015). Research by Juriansari, Naufal, and Widodo (2020) also confirms that uncontrolled muscle tension can reduce the accuracy of Q-angle measurements, especially in elderly individuals with high physical activity levels.

The implications of this study indicate that overweight in the elderly does not always have a direct impact on changes in knee biomechanics if the position and condition of the muscles during measurement are not appropriate. Factors such as anatomical position, muscle flexibility, and pelvic structure can affect the size of the Q-angle (Kurniawan, Husni, & KSL, 2019). This emphasizes the importance of standardizing measurement positions and controlling confounding variables to ensure more valid research results. Clinically, these results indicate that in overweight elderly individuals, assessing knee joint function is not sufficient using only the Q-angle parameter; it must be accompanied by a comprehensive evaluation of muscle and pelvic structure.

The limitations of this study lie in the relatively small sample size and the fact that measurements were only taken once after physical activity. Factors such as muscle fatigue, differences in flexibility levels, and the absence of measurements of other biomechanical variables such as muscle strength or hip angle may have influenced the results. This study also did not compare Q-angle measurements in standing and supine positions, so it cannot fully describe the differences in angle values due to changes in body position. This condition could be a source of bias in interpreting the relationship between BMI and Q-angle.

Based on these findings, the researchers recommend that future studies use a design with repeated measurements in functional positions, such as standing, to assess the relationship between overweight and Q-angle more accurately. In addition, it is recommended to add biomechanical variables such as quadriceps muscle strength, joint flexibility, and knee pain to obtain a more comprehensive picture. Exercise-based interventions, such as leg muscle strengthening exercises and weight control, also need to be developed to maintain knee joint stability and prevent musculoskeletal disorders in overweight older adults (Manuaba et al., 2021; Kiik, Sahar, & Permatasari, 2018).

CONCLUSION

The results of this study indicate that there is no relationship between overweight and the quadriceps angle (Q-angle) in elderly individuals at the Dr. Soetomo General

Hospital Retirees Association in Surabaya. These findings confirm that an increase in body mass index is not always accompanied by significant changes in the Q-angle, especially when measurements are taken in a supine position without weight bearing. Biomechanical factors such as body position, muscle condition, and pelvic anatomical structure can affect Q-angle measurement results. Therefore, further research is recommended to measure the Q-angle in a functional position (standing), add other biomechanical variables such as muscle strength and joint flexibility, and use more accurate measuring instruments such as radiological or digital analysis.

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