



Investigation and Analysis of Muscle and Fat Content Among Middle-Aged and Elderly Individuals in XX District, G City, China, and Influencing Factors

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Abstract. Objective: To investigate the characteristics of muscle and fat content and distribution among middle-aged and elderly residents in the XX District of G City, and to provide a scientific basis for improving the health level of this demographic in G City. Methods: A total of 413 middle-aged and elderly residents (175 males and 238 females) aged 50 years or older, who had been living in the XX District of G City for at least six months, were randomly selected. Data on height, weight, waist and hip circumference, and body composition were collected. Statistical analysis was performed using SPSS 24.0 software. Results: The statistical results indicated a high prevalence of overweight and obesity among the surveyed population. There were no significant statistical differences in height, weight, BMI, and waist-to-hip ratio between males and females. Overall, body fat content showed an initial increase followed by a decrease with age. Across different age groups, females had significantly higher body fat content than males. With increasing age, muscle content gradually decreased, but males generally had higher muscle content than females, with significant statistical differences. Conclusion: The incidence of overweight and obesity among middle-aged and elderly residents in the XX District of G City is relatively high, posing health risks. Body fat content increases initially with age and then gradually decreases, while muscle content declines progressively with age.

Keywords: Middle-aged and elderly individuals, muscle, body composition.

1 Introduction

With the increasing aging of the population, health issues in middle-aged and elderly individuals have become increasingly concerning. Muscle and fat content, as important indicators reflecting human health status, play a significant role in preventing chronic diseases and maintaining quality of life [1]. The "14th Five-Year Plan for Healthy Aging" proposes to build a comprehensive and continuous elderly health service system covering both urban and rural areas, improving the quality and acces-

sibility of elderly health services, and promoting high-quality development of elderly health services. The "Guiding Principles for Weight Management (2024 Edition)" points out that overweight and obesity are important risk factors for various chronic diseases, emphasizing the prevention and control of overweight and obesity through scientific weight management to enhance the health level of the entire population [2]. Previous studies have shown that muscle reduction and fat accumulation are closely related to various diseases such as cardiovascular diseases and metabolic syndrome [3]. Analyzing muscle and fat content and their influencing factors can help identify high-risk groups, providing a scientific basis for early diagnosis and intervention of sarcopenia, obesity, and other diseases [4].

There is still a lack of systematic investigation and analysis of muscle and fat content in middle-aged and elderly individuals in specific regions [5, 6]. By studying the investigation and influencing factors of muscle and fat content in middle-aged and elderly individuals in XX District, G City, it is possible to assess the health risks faced by this group, providing a basis for early identification and prevention of related diseases. This is of great significance for improving public health levels, formulating scientific prevention strategies, and enhancing the quality of life for middle-aged and elderly individuals. It aligns with the national strategic deployment and policy requirements for healthy aging and can provide data support for developing targeted public health strategies, promoting the development of healthy aging.

2 Research Subjects and Methods

2.1 Research Subjects

A total of 413 middle-aged and elderly residents in XX District, G City (aged 50 or above, with a continuous local residence of at least half a year) were randomly selected, including 175 males and 238 females. The subjects were divided into male and female groups based on gender and age, with a 10-year interval for grouping (those aged 80 or above were grouped into one age group), resulting in eight groups: 50-60, 60-70, 70-80, and ≥ 80 years. It was required that the subjects did not have medical metal devices installed, such as cardiac pacemakers or brain pacemakers, to avoid adverse effects such as damage to medical devices within the subjects and inaccurate data. All subjects provided informed consent for the survey.

2.2 Research Methods

Body Weight and Body Fat Composition Analysis. The study used a body composition analyzer from Tanita (Japan) to measure the body composition of the subjects. The analyzer operates based on the principle of bioelectrical impedance analysis (BIA). The measurement indicators included body weight (0.5kg for spring and summer clothing, 1.0kg for autumn and winter clothing), body mass index (BMI), body fat percentage, fat mass, non-fat mass, muscle mass, body water content, basal metabolic rate, and body shape assessment. Before the measurement, subjects were required to empty their bladders, fast, and avoid drinking for 2 hours, and to avoid

strenuous exercise. They were also asked to remove any metal items such as jewelry, watches, and mobile phones, and to wear minimal clothing. It was ensured that the subjects did not use medical-grade metal devices such as cardiac stents or pacemakers. Subjects were instructed to stand barefoot on the electrode plates of the body composition analyzer, ensuring close contact between the soles of their feet and the electrode plates. They were to stand upright, relax naturally, look straight ahead, and let their hands hang naturally. After the preparation, the analyzer was started, releasing a painless low current through the body. The analyzer measured the impedance of each body part to the current, obtaining various body composition indicators.

2.3 Statistical Methods

The survey was conducted with the assistance of investigators who helped the subjects fill out questionnaires on the Questionnaire Star platform. The data were entered and exported in Excel 2019 and analyzed using SPSS 24.0 statistical software. Quantitative data were expressed as $\pm s$, analyzed using analysis of variance, and comparisons between groups were made using t-tests. A P-value less than 0.05 was considered statistically significant

3 Results

This study surveyed 413 middle-aged and elderly individuals, including 175 males (40.60% of the total sample) and 238 females (59.40% of the total sample). Among males, 75 were overweight or obese (42.86% of males, $BMI \geq 24$), 95 were normal weight (54.28% of males, $18.5 \leq BMI < 24$), and 5 were underweight (2.86% of males, $BMI < 18.5$). Among females, 95 were overweight or obese (39.92% of females, $BMI \geq 24$), 124 were normal weight (52.10% of females, $18.5 \leq BMI < 24$), and 19 were underweight (7.98% of females, $BMI < 18.5$). The overall proportion of overweight and obese individuals in the total sample was 41.16% ($BMI \geq 24$), normal weight was 53.03% ($18.5 \leq BMI < 24$), and underweight was 5.81% ($BMI < 18.5$).

To analyze the differences in gender factors across different age groups, independent sample t-tests were conducted. In different age groups, the average height of males and females was around 159 cm, and there was no significant statistical difference between males and females in each age group. In terms of weight, there was an increasing trend in weight among males and females in different age groups, and a decreasing trend in weight was observed in those aged 80 and above. However, there was no significant statistical difference between males and females in each age group. In terms of BMI, males showed a trend of increasing first and then decreasing, while females showed a consistent increasing trend. However, there was no significant statistical difference between males and females in each age group. In terms of waist-to-hip ratio, males showed a trend of increasing first and then decreasing, while females showed a trend of decreasing first and then increasing. However, there was no significant statistical difference between males and females in each age group.

In terms of body fat content, among individuals aged 50-60, males had an average body fat content of 17.63 ± 7.50 , while females had an average body fat content of 17.32 ± 5.24 . In this age group, males had a higher body fat content than females. The results of independent sample t-tests showed that $t=0.06$, $p>0.05$, indicating no significant statistical difference between the two groups. In the 60-70 age group, males had an average body fat content of 17.66 ± 5.65 , while females had an average body fat content of 22.44 ± 7.88 . The t-test result showed that $t=-1.89$, $p<0.01$, indicating a significant difference in body fat content between males and females in this age group. In the 70-80 age group, males had an average body fat content of 16.43 ± 5.20 , while females had an average body fat content of 19.68 ± 6.89 . The t-test result showed that $t=-2.73$, $p<0.01$, indicating a significant difference in body fat content between males and females in this age group. In the age group of 80 and above, females had an average body fat content of 18.40 ± 6.33 , while males had an average body fat content of 14.62 ± 4.98 . The t-test result showed that $t=-5.39$, $p<0.001$, indicating a significant difference in body fat content between females and males in this age group. Overall, the body fat content of the subjects showed a trend of increasing first and then decreasing, and females had a significantly higher body fat content than males in different age groups.

In terms of body muscle content, among individuals aged 50-60, males had an average body muscle content of 50.46 ± 4.38 , while females had an average body muscle content of 35.94 ± 1.62 . The t-test result showed that $t=5.62$, $p<0.05$, indicating a significant difference in body muscle content between males and females in this age group. In the 60-70 age group, males had an average body muscle content of 50.99 ± 6.04 , while females had an average body muscle content of 36.36 ± 4.20 . The t-test result showed that $t=7.05$, $p<0.01$, indicating a significant difference in body muscle content between males and females in this age group. In the 70-80 age group, males had an average body muscle content of 49.52 ± 5.76 , while females had an average body muscle content of 35.11 ± 4.60 . The t-test result showed that $t=2.18$, $p<0.05$, indicating a significant difference in body muscle content between males and females in this age group. In the age group of 80 and above, males had an average body muscle content of 47.13 ± 5.95 , while females had an average body muscle content of 33.87 ± 4.53 . The t-test result showed that $t=20.16$, $p<0.001$, indicating a significant difference in body muscle content between males and females in this age group. Overall, the body muscle content of the subjects showed a decreasing trend with increasing age, but males generally had a higher muscle content than females, and there was a significant statistical difference.

4 Discussion

4.1 Obesity Issue

Obesity is becoming a global problem, not just a concern in developed countries. International studies have shown that obesity has a negative impact on cognition, with higher levels of education and economic status being associated with better cognitive abilities, while age is associated with lower cognitive abilities [6]. Researchers have

found that overweight and obesity increase the mortality rates from coronary heart disease and stroke, and approximately half of the diabetes burden, one-fourth of the ischemic heart disease burden, and 7.00%-41.00% of the burden from certain cancers can be attributed to overweight and obesity. Weight loss can lead to reduced blood pressure, blood sugar, total cholesterol, triglycerides, and insulin levels, thereby maintaining health [7][8]. The survey results indicate that the proportions of overweight and obese individuals among males and females were very high, reaching 42.86% and 39.92% respectively, highlighting the significant health risks associated with overweight and obesity among middle-aged and elderly individuals in XX District, G City. Moreover, compared to BMI, individuals with abnormal waist circumference have a higher risk of developing type 2 diabetes [9]. Using waist-to-hip ratio as a criterion, the statistical results showed that the average waist-to-hip ratio for males was 0.94, and for females, it was 0.93, indicating a high risk of central obesity (with a waist-to-hip ratio greater than 0.90 for males and greater than 0.85 for females) among middle-aged and elderly individuals in G City. This also reflects the increased risk of cardiovascular diseases and diabetes among middle-aged and elderly individuals in G City, necessitating greater attention and action. As a first-tier city in China, G City has experienced rapid economic development since the reform and opening up. With the improvement of the economic level, the living standards of the people in G City have also significantly increased. However, due to the influence of education and cognitive levels, these older individuals, under the backdrop of improved economic and material conditions, have more opportunities to consume high-energy foods daily. In addition to ensuring adequate food intake, they also pursue high-fat, high-protein, and high-salt dishes to satisfy their culinary desires. This unhealthy dietary pattern is one of the leading causes of obesity, and obesity is also a factor in various chronic diseases such as hypertension, diabetes, and hyperlipidemia. To protect the health of the elderly, it is urgent for G City to raise the health awareness of middle-aged and elderly individuals and promote the popularization of food nutrition and healthy, balanced diets among the general public.

The survey results indicate that within the same age group, females consistently had higher body fat content than males, while males had significantly higher average muscle mass than females. This pattern is consistent with the findings of Wan Qian and Wang Changli's research [7,8]. Physiologically, due to differences in hormone levels, males are more prone to muscle synthesis, while females are more prone to fat accumulation [9,10]. Fat is used by the body as stored energy, and the higher the energy expenditure, the lower the fat content. Additionally, in terms of physiological structure, female breasts are typically more developed than males, leading to higher fat content. Moreover, the female body tends to accumulate fat in the lower abdomen to protect the uterus and ovaries from the cold, and this fat is difficult to remove through weight loss methods. In terms of body fat content, both males and females showed an increasing trend in the 50-60 to 60-70 age groups, followed by a decreasing trend in the 60-70 to 70-80 age groups and the 70-80 to ≥ 80 age groups. This may be due to the fact that after retirement, the subjects had less work stress and more economic freedom, leading to an increase in fat intake and absorption. However, as age increased, a decline in gastrointestinal digestion and absorption, the onset of cer-

tain diseases, and psychological issues such as living alone or losing family members may have led to a decrease in fat intake and absorption, resulting in a decrease in body fat content. Additionally, cognitive ability was significantly influenced by factors such as household income and pension benefits. As a first-tier city in China, G City has a higher economic development level compared to other cities, with relatively higher household incomes and pension benefits.

Unlike body fat content, the survey found that in different age groups, males consistently had a significantly higher average muscle mass than females. Research indicates that an increase in muscle mass not only helps to accelerate metabolism but also prevents obesity and metabolic diseases. Overall, the survey showed that in each age group, the muscle content of the subjects decreased with age. This could be due to the decline in metabolic capacity and gastrointestinal digestion and absorption as people age, as well as a reduction in physical activity due to factors such as decreased bone density and joint issues, leading to a decrease in muscle contraction strength and potentially resulting in sarcopenia. There is a close relationship between muscle mass and muscle-related diseases. Studies have shown that muscle quality significantly decreases with age, possibly due to the increased incidence of sarcopenia in the elderly. Modern medical approaches to improving muscle strength and mass include exercise, nutritional support (such as vitamin D, vitamin E, branched-chain amino acids, etc.), and medication.

5 Conclusion

This survey analyzed the obesity status, body fat content, and muscle mass differences by age and gender among middle-aged and elderly individuals in XX District, G City, providing fundamental research data for studying the health levels of this population. The survey results indicate a high prevalence of overweight and obesity among the middle-aged and elderly population in this area, with body fat content initially increasing and then decreasing with age, and muscle mass decreasing with age. It is recommended that this population enhance their knowledge of food nutrition, adopt a reasonable diet, reduce the intake of high-fat and high-oil foods, decrease sodium intake, and strengthen daily physical exercise such as walking, jogging, practicing Tai Chi, and performing Ba Duan Jin, which are suitable for the elderly. This can improve physical flexibility and mobility, and maintain physical and mental well-being.

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Author contributions

J.W.L is the corresponding author. S.Y.H. conceived the study idea. S.Y.H. and J.W. conducted the experiments and wrote the manuscript.

References

1. Zhang, H., Hu, J., Zhao, X., et al.: Prevalence and influencing factors of possible sarcopenia in middle-aged and elderly people in China. *Medicine and Society* 36(8), 44–48 (2023).
2. Zhang, X., Wang, L., Li, X., et al.: Association between metabolic-associated fatty liver disease and type 2 diabetes in overweight/obese middle-aged and elderly populations. *Chinese Journal of Medical Frontiers (Electronic Edition)* (1), 35–41 (2025).
3. He, Q., Wang, X., Yang, C., et al.: Prevalence of sarcopenic obesity and consistency assessment of different diagnostic methods in middle-aged and elderly patients with type 2 diabetes in Beijing. *Chinese Journal of Medical Frontiers (Electronic Edition)* (1), 28–34 (2025).
4. Yuan, J., Lin, Y., Lin, X., et al.: Relationship between body composition and bone mineral density in middle-aged and elderly people. *Chinese Journal of Tissue Engineering Research* 26(15), 2394–2399 (2022).
5. Lu, Y., Liu, X., Zhu, Z., et al.: Relationship between high-quality protein intake and risk of sarcopenia in middle-aged and elderly populations in Shanghai. *Acta Nutrimenta Sinica* 42(5), 429–434 (2020).
6. Chen, X., Ping, J., Hu, Y.: Correlation between menstruation, body composition, and bone mineral density in middle-aged and elderly women in Beijing. *Chinese Journal of Osteoporosis* 26(10), 1421–1425 (2020).
7. Wan, Q.: Research on fat quantification and application based on magnetic resonance imaging. Ph.D. thesis, University of Chinese Academy of Sciences (Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences) (2023). DOI:10.27822/d.cnki.gszxj.2022.000023.
8. Wang, C., Li, K., Li, L., et al.: Investigation of muscle and fat content in middle-aged and elderly people in Youjiang District, Baise City. *Modern Medicine & Health* 39(22), 3879–3884 (2023).
9. de Luis Román, D., Garrachón Vallo, F., Carretero Gómez, J., et al.: Decreased muscle mass in type-2 diabetes. A hidden comorbidity to consider. *Nutricion Hospitalaria* 40(1), 59–66 (2023).
10. Huang, X., Yu, J., Li, C.: Analysis of the effect of aerobic exercise on health management in elderly patients with chronic diseases. *China Health Standard Management* 13(8), 6062 (2022).

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