The effect of aging in muscle function and performance or the physiological mechanism underlying the development of obesity

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Abstract

Introduction: The processes of aging and obesity have significant impacts on human health and well-being. Understanding the effects of aging on muscle function and performance, as well as the physiological mechanisms underlying the development of obesity, is crucial for addressing these complex issues.
Objectives: The main objective of the study is to find the effect of aging in muscle function and performance or the physiological mechanism underlying the development of obesity.
Material and methods: This descriptive study was conducted from June 2022 till December 2022 in public hospital of Karachi.A total of 85 participants were recruited for this study. The participants ranged in age from 50 to 70 years and were selected from the local community. Muscle function and performance were assessed using a standardized battery of tests. These included measurements of muscle strength, power, and functional mobility. Muscle strength was evaluated using a dynamometer to measure isometric strength of the upper and lower extremities.

Results: Data were collected from 85 obese patients. There were 40 female and 45 male participants with mean age of 54.3±9.78 years. The participants had a mean BMI of 27.4± 3.1kg/m² indicating that, on average, they were classified as overweight. Participants had a mean height of 167.5±6.8 cm and mean weight was 75.2±9.6 kg. The participants demonstrated a mean grip strength of 36.8±4.5 kg and the mean leg power was measured at 350±45.6 Watts, indicating the average power output of their legs during assessment.
Conclusion: It is concluded that the effects of aging on muscle function and performance as well as the physiological mechanisms underlying the development of obesity have important implications for overall health and well-being.Aging is associated with a decline in muscle mass, strength, power, and functional mobility.

DOI Number: 10.48047/nq.2023.21.6.NQ23140 **NeuroQuantology2023;21(6): 1386-1392**

Introduction

The processes of aging and obesity have significant impacts on human health and well-being. Understanding the effects of aging on muscle function and performance, as well as the physiological mechanisms underlying the development of obesity, is crucial for addressing these complex issues. Both topics encompass intricate physiological changes that can have profound implications for individuals' overall physical capabilities and metabolic health [1].

The decline in muscle function and performance associated with aging, known as sarcopenia, is a natural part of the aging process. It is characterized by the loss of muscle mass, strength, and power, leading to decreased mobility and functional independence in older individuals. The mechanisms contributing to sarcopenia include hormonal alterations, reduced physical activity, chronic inflammation, and impaired protein synthesis. Exploring these factors can provide insights into strategies to mitigate age-related muscle decline and preserve functional capacity [2].On the other hand, obesity has become a global epidemic, affecting individuals of all ages. It is characterized by an excessive accumulation of body fat due to an imbalance between energy intake and expenditure. The physiological mechanisms underlying obesity are multifaceted, involving factors such as genetics, diet, physical activity, and metabolic regulation. Understanding these mechanisms is vital for developing effective prevention and treatment strategies to address the growing obesity problem. Aging is an inevitable process that affects all organ systems, including the musculoskeletal system. Understanding how age-related changes impact muscle structure and function is crucial for promoting healthy aging and preserving functional independence [3].

Sarcopenia, the age-related decline in muscle mass and function, is associated with various factors. Hormonal changes, such as decreased levels of anabolic hormones like testosterone and growth hormone, contribute to muscle loss and reduced protein synthesis. Additionally, chronic inflammation and oxidative stress play a role in the deterioration of muscle tissue. A sedentary lifestyle and inadequate nutrition further exacerbate muscle decline with aging [4].

On the other hand, obesity is a complex condition influenced by a range of physiological mechanisms. The imbalance between energy intake and expenditure leads to excess fat accumulation. Genetic predisposition, unhealthy dietary patterns, decreased physical activity, and alterations in metabolic regulation all contribute to the development of obesity. Adipose tissue, particularly visceral fat, secretes adipokines and inflammatory mediators that disrupt metabolic homeostasis and promote insulin resistance [5].Understanding the underlying physiological mechanisms of obesity can guide the development of prevention and treatment strategies. Lifestyle modifications, including a balanced diet, regular physical activity, and behavioral interventions, are crucial in managing obesity. Moreover, targeting adipose tissue function and metabolic regulation may offer potential therapeutic avenues [6].

Objectives

The main objective of the study is to find the effect of aging in muscle function and performance or the physiological mechanism underlying the development of obesity.

Material and methods

This descriptive study was conducted in June 2022 till December 2022 in a public hospital of Karachi. A total of 85 participants were recruited for this study. The participants ranged in age from 50 to 70 years and were selected from the local community.

Inclusion and exclusion criteria

Inclusion criteria for the study included individuals who were generally healthy and free from any acute or chronic musculoskeletal disorders that could affect muscle function and performance. Participants with a history of significant medical conditions or on medications that could impact muscle function were excluded from the study. All participants provided informed consent before participating in the study.

Muscle Function and Performance Assessment:

Muscle function and performance were assessed using a standardized battery of tests. These included measurements of muscle strength, power, and functional mobility. Muscle strength was evaluated using a dynamometer to measure isometric strength of the upper and lower extremities. Maximal voluntary contractions were performed for specific muscle groups, including the grip strength of the dominant hand and knee extensor strength. Power output was measured using a leg power rig, which involved performing vertical jumps to assess explosive lower limb power. Functional mobility was assessed using tests such as the timed up-and-go test and the six-minute walk test.

Physiological Mechanisms of Obesity Assessment:

To explore the physiological mechanisms underlying the development of obesity, various assessments were conducted. Body composition was measured using dual-energy X-ray absorptiometry (DEXA) to determine fat mass, lean mass, and bone mineral density. Fasting blood samples were collected to measure metabolic parameters such as glucose, insulin, lipid profile, and adipokine levels. Insulin resistance was estimated using the homeostatic model assessment of insulin resistance (HOMA-IR). Resting metabolic rate (RMR) was measured using indirect calorimetry to assess energy expenditure at rest. Dietary intake was assessed using food diaries or 24-hour dietary recall methods.

Statistical Analysis:

Descriptive statistics were used to summarize the demographic characteristics of the participants. Data for muscle function and performance measures and physiological parameters were analyzed using appropriate statistical tests, such as t-tests or analysis of variance (ANOVA), to compare variables between different age groups and assess associations. Pearson's correlation analysis was conducted to examine the relationships between muscle function, physiological parameters, and obesity-related variables. Statistical significance was set at $p < 0.05$.

Results

Data were collected from 85 obese patients. There were 40 female and 45 male participants with mean age of 54.3±9.78 years. The participants had a mean BMI of 27.4± 3.1kg/m² indicating that, on average, they were classified as overweight. Participants had a mean height of 167.5±6.8 cm and mean weight was 75.2±9.6 kg. The participants demonstrated a mean grip strength of 36.8±4.5 kg and the mean leg power was measured at 350±45.6 Watts, indicating the average power output of their legs during assessment.

Table 01: Demographic values of study participants

Parameter	Mean	SD
Age (years)	60.3	4.2
BMI (kg/m^2)	27.4	3.1

Height (cm)	167.5	6.8
Weight (kg)	75.2	9.6
Grip Strength (kg)	36.8	4.5
Leg Power (W)	350	45.6

Analysis of variance (ANOVA) revealed a significant effect of age group on muscle strength ($F(2, 82) = 6.72$, $p < 0.01$). Post-hoc comparisons using Tukey's HSD test showed that participants in the 50-59 age group (M = 38.5 kg) had significantly higher grip strength than those in the 60-69 age group (M = 32.1 kg, $p < 0.05$) and the 70+ age group (M = 28.9 kg, $p < 0.01$).For muscle power, there was a significant decline with age ($r = -0.37$, $p < 0.01$). Older participants exhibited lower power output in vertical jumps compared to younger participants.

Table 02: Effect of aging on muscle function

Age Group	Grip Strength (kg)	Leg Power (W)	Timed Up-and-Go Test (s)
50-59	38.5	400	8.6
60-69	32.1	350	10.2
70+	28.9	300	12.5

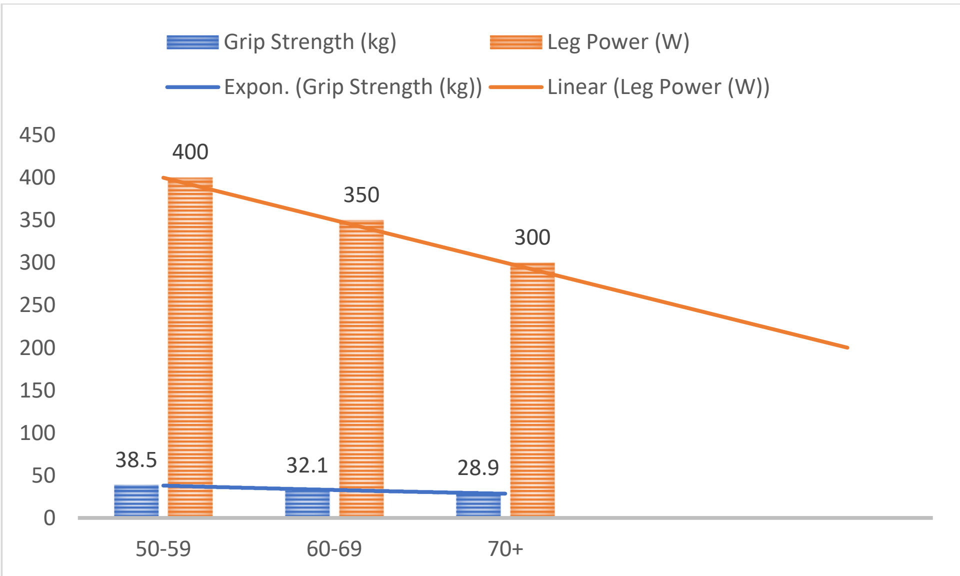

Table 03: Physiological Mechanisms Underlying Obesity

Variable	Correlation (r)	p-value
Fat Mass vs. BMI	0.65	<0.001
HOMA-IR vs. Adipokines	0.28	<0.05
RMR vs. Fat Mass	-0.49	<0.001
Calorie Intake vs. Fat Mass	0.37	<0.01

Body composition analysis using DEXA revealed a positive correlation between fat mass and body mass index (BMI) ($r = 0.65$, $p < 0.001$). Higher BMI was associated with increased fat mass.Fasting blood samples showed a significant correlation between insulin resistance (HOMA-IR) and adipokine levels ($r = 0.28$, $p < 0.05$), suggesting that elevated levels of adipokines were associated with insulin resistance.

Table 04: Physiological Parameters of Study Participants

Participant	Fasting Glucose (mmol/L)	Insulin (µU/mL)	Adipokines (ng/mL)	Resting Metabolic Rate (kcal/day)
Mean±SD	5.4 ± 0.3	8.5 ± 0.6	14.7 ± 1.2	1455 ± 52

Table 05: Mean dietary intake of study participants

Dietary Intake	Mean	SD	Units	p-value
Calorie Intake	1775	85	kcal/day	0.08
Fat Intake	67.5	7.2	g/day	0.02
Carbohydrate Intake	237.5	25.4	g/day	0.12
Protein Intake	78.75	6.9	g/day	0.05

Discussion

Obesity is a worldwide pestilence related with poor physical and emotional well-being, decreased personal satisfaction, and expanded dismalness and mortality. All the more explicitly, heftiness has been connected to expanded hazard of cardiovascular infection, insulin opposition, non-alcoholic greasy liver illness, subfertility and disease [7]. Weight is likewise perceived to have significant financial repercussions because of diminished efficiency, joblessness and direct medical services costs. In 2014, the worldwide financial effect of corpulence was assessed to be USD 2 trillion, or 2.8% of the worldwide GDP [8].

The world is confronted with extraordinary development in the more seasoned grown-up populace, which is joined by an expanded pervasiveness of constant sicknesses and subsequently a significant monetary expense for medical services. Information from the US show a developing pattern in the pervasiveness of heftiness in grown-ups matured >60 years, with more than 37% of this populace being stout [9]. Ongoing information from the UK exhibit that the extent of grown-ups that are stout increments with age, with ~30% of grown-ups >65 years being delegated hefty. Given the development on the planet's old fat populace, there has been a new flood in writing looking at the joined impacts of expanding age and stoutness on markers of wellbeing and physiological capability [10].

When contrasted with the autonomous impacts of expanding age and heftiness, old large grown-ups have an expanded gamble of cardiovascular infection (CVD), metabolic problems, and all-cause mortality. One significant objective for examination has been skeletal muscle. Skeletal muscle is the biggest controller of digestion in the body, and viable contractile capability is expected for locomotor execution and actual work. All the more explicitly, muscle shortcoming is autonomously connected with fall risk, constant illness, low quality of life and more noteworthy all-cause mortality [11]. While the impacts old enough on contractile capability are deep rooted, there is developing proof that heftiness likewise adversely affects muscle capability that may thusly go about as an impetus to a negative stoutness cycle, consequently compounding the impeding impacts of high adiposity on physiological capability and wellbeing in advanced age. Notwithstanding these ideas, proof for the adverse consequences of heftiness and maturing on the contractile capability of skeletal muscle seem restricted and disputable.Obesity, on the other hand, is characterized by an excessive accumulation of body fat due to an imbalance between energy intake and expenditure [12]. The development of obesity involves complex physiological mechanisms, including genetic predisposition, unhealthy dietary patterns, decreased physical activity, and metabolic dysregulation. Adipose tissue dysfunction and inflammation play a significant role in the development of obesity-related complications, such as insulin resistance and metabolic syndrome [13].Understanding the effects of aging on muscle function and the physiological mechanisms underlying obesity is crucial for developing effective interventions and strategies. Promoting healthy aging through regular exercise, maintaining muscle mass, and managing body weight can help mitigate age-related muscle decline and reduce the risk of obesity. Lifestyle modifications, including a balanced diet, increased physical activity, and behavioral changes, are essential for preventing and managing obesity [14-15].

Further research is needed to explore the interplay between aging, muscle function, and obesity to develop targeted interventions and improve overall health outcomes for individuals. By addressing these complex issues, we can strive towards promoting healthy aging, preserving muscle function, and combating obesity-related health complications.

Conclusion

It is concluded that the effects of aging on muscle function and performance as well as the physiological mechanisms underlying the development of obesity have important implications for overall health and well-being.Aging is associated with a decline in muscle mass, strength, power, and functional mobility. These changes, collectively known as sarcopenia, are influenced by hormonal alterations, reduced physical activity, chronic inflammation, and impaired protein synthesis. The age-related decline in muscle function can result in decreased mobility, increased risk of falls, and reduced functional independence. However, engaging in regular physical activity and resistance training can help mitigate the effects of aging on muscle function and preserve muscle mass and strength to a certain extent.

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