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THE RELATIONSHIP BETWEEN OBESITY AND ARTERIAL BLOOD PRESSURE

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ABSTRACT

This article is devoted to a comprehensive study of the relationship between obesity and arterial blood pressure. The paper analyzes the impact of overweight and obesity on blood pressure, the mechanisms underlying the development of obesity, various factors contributing to hypertension, and the biological mechanisms involved (including changes occurring in the heart and blood vessels in obesity.In addition, methods for identifying and assessing obesity and overweight, diagnostic approaches, prevention strategies, and modern treatment methods are also examined.To further investigate the relationship between obesity and arterial blood pressure, a cross-sectional observational study was conducted involving 100 patients. Their blood pressure, body mass index (BMI), and other relevant indicators were measured and compared.

Relevance of the Topic

It is well known that obesity and overweight are considered global health problems worldwide. According to the World Health Organization (WHO), as of 2022, one out of every eight people globally lives with obesity. Since 1990, the prevalence of overweight among adults has doubled, and among adolescents and children, it has increased fourfold.

Cardiovascular diseases, including elevated arterial blood pressure (hypertension), are among the leading risk factors for sudden death worldwide. Approximately 1.4 billion adults (aged 30–79 years) are living with hypertension globally, representing about 33% of the adult population in this age group.Approximately 600 million people (44%) are unaware that they have hypertension. Hypertension has been diagnosed in approximately 630 million individuals and have started treatment. Only 320 million people have been able to control their hypertension. These two chronic conditions are closely interconnected.

Introduction

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Obesity and overweight are among the most pressing problems of the 21st century. Obesity is the excessive accumulation of fat in the body. Statistics show that:

In 2022, 2.5 billion adults (aged 18 and older) were overweight, of whom 890 million were living with obesity.

In 2022, more than 390 million children and adolescents aged 5–19 were overweight, of whom 160 million were diagnosed with obesity.

In 2024, 35 million children under the age of 5 were overweight.

The results show that obesity and overweight are increasing year by year not only among adults, but also among children and adolescents. Obesity is not only an aesthetic problem, but also causes significant negative changes in internal organs. Including:

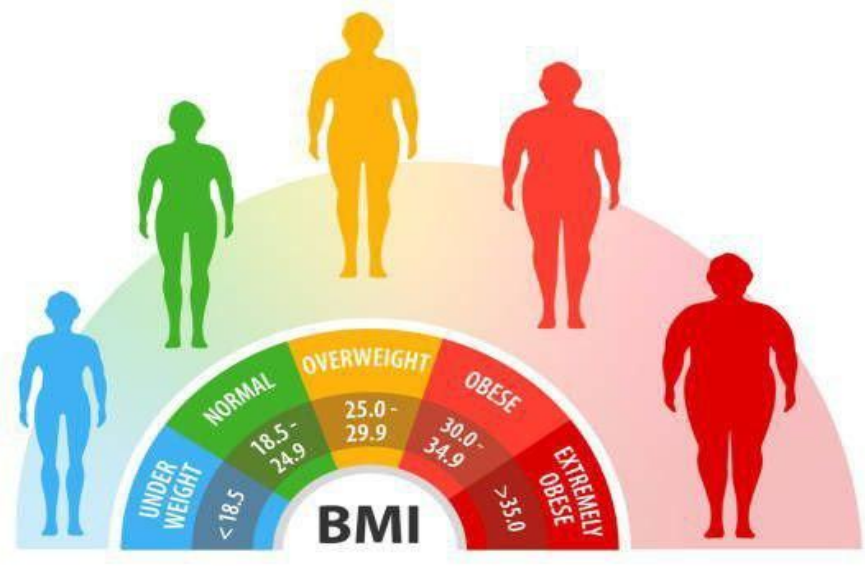
- Cardiovascular diseases
- Diabetes mellitus
-Oncological diseases and other conditions

Various classifications of obesity have been proposed, but the most commonly used is the body mass index (BMI).

To determine overweight or obesity, a person's weight and height are measured and BMI is calculated:

Weight (kg) / height^2 (m^2)

After determining BMI using the above formula, individuals are categorized based on the results into underweight, normal weight, or obesity, as shown below:



-Underweight: BMI < 18.5
-Normal: BMI 18.5–24.9
- Overweight: BMI 25.0–29.9
-Obesity: BMI 30.0–34.9
- Severe obesity: BMI > 35.0

How do overweight and obesity develop?

Obesity mainly develops as a result of an imbalance between energy intake and energy expenditure (physical activity). Consuming high-calorie foods and engaging in low levels of physical activity leads to the accumulation of unused energy in the body; that is, this

energy begins to be stored in the form of fat.

According to the distribution of fat, obesity is divided into two types:

Gynoid (female type, pear-shaped)

Android or visceral (male type, apple-shaped)

That is, in women, fat is more commonly accumulated in the thigh region, whereas in men it is predominantly accumulated in the abdominal region.

An increase in arterial blood pressure (hypertension) is considered one of the main risk factors for cardiovascular diseases. Worldwide, hypertension is regarded as one of the leading causes of sudden death.

Hypertension is defined as elevated blood pressure within the blood vessels (>140/90 mmHg). Hypertension does not develop spontaneously; there are several risk factors that contribute to its development. These are divided into two groups: modifiable and non-modifiable factors.

Modifiable risk factors include:

-Obesity

-Low level of physical activity

-Consumption of foods high in salt

- Smoking

- Alcohol consumption

Non-modifiable risk factors:

- Age (over 65 years)

-Family predisposition

- Diabetes

- Kidney diseases

The mechanisms linking obesity and arterial blood pressure are multi-systemic and occur through a chain of processes:

Increase in visceral fat:

In obesity, adipose tissue increases, especially accumulating around the abdomen (abdominal fat). Visceral fat is metabolically highly active and produces adipokines and cytokines.Adipokines are biologically active substances produced by adipose tissue (adipocytes) that regulate metabolism and the cardiovascular system by sending signals to the central nervous system.

Among adipokines, leptin, adiponectin, resistin, and angiotensinogen are produced, each having a specific function:

After leptin is produced, it sends signals to the hypothalamus, activating the sympathetic nervous system. Once the sympathetic nervous system is activated, heart rate increases, which leads to an increase in blood pressure.

Angiotensinogen is a plasma globulin produced by the liver and adipose tissue that activates the RAAS (Renin–Angiotensin–Aldosterone System). This process occurs as follows:

The produced angiotensinogen is converted into angiotensin I by renin. Angiotensin I is then converted into angiotensin II in the lungs and vascular endothelium with the participation of the ACE enzyme. Angiotensin II causes constriction of vascular smooth muscles and stimulates aldosterone production. Aldosterone increases sodium reabsorption in the renal tubules. When sodium is retained in the body, it also retains water, resulting in increased blood volume and elevated blood pressure.

Cytokines are inflammatory mediators, including CRP (C-reactive

protein), Interleukin-6 (IL-6), and TNF-alpha (Tumor Necrosis Factor-alpha).

CRP is considered an indicator of endothelial damage, while interleukin-6 stimulates inflammation and increases CRP production.

TNF-alpha causes endothelial dysfunction and reduces insulin sensitivity. All of these factors damage the endothelial layer of blood vessels, and because this process is persistent in obesity, it increases peripheral resistance.

Adipokines produced by visceral fat activate the RAAS and sympathetic system, while cytokines promote endothelial dysfunction and intensify this process, resulting in persistent arterial hypertension.In addition, adipokines and cytokines also affect nitric oxide (NO) in the endothelial layer. Under normal conditions, this oxide relaxes vascular smooth muscles, providing vasodilation. It also reduces the risk of thrombosis and provides anti-inflammatory protection to the endothelium.Superoxide radicals react with NO to form peroxynitrite, which reduces the biological activity of NO. As a result, vessels cannot relax, the risk of microvascular thrombosis increases, and vasodilation decreases.Through these processes, obesity and overweight lead to elevated arterial blood pressure. It has been observed that in overweight individuals, cholesterol levels increase by 20 mg for each excess kilogram of body weight. For every 4.5 kg increase in body weight, systolic arterial pressure increases by 4.5 mmHg.

Materials and Methods

To further study the relationship between obesity and arterial blood pressure, a cross-sectional observational study was conducted. A total of 100 patients were included in the study.

Objective of the study: To determine the relationship between obesity and arterial blood pressure.Body mass index (BMI) was measured for each participant based on their height and weight. Weight was measured in kilograms and height in meters, and BMI was calculated using the following formula:

BMI = Weight (kg) / height^2 (m^2)

Each participant's height and weight were measured and applied to the formula. Measurements were conducted according to standard rules:

- Weight was measured in the morning on an empty stomach, with participants wearing light clothing or without heavy clothing.

-An electronic scale was used.

-The scale was placed on a flat surface, and participants' proper standing position was monitored.

Height measurement rules:

- During height measurement, participants removed shoes and headwear, and it was ensured that the shoulder blades and buttocks were in contact with the stadiometer.

-The head position was directed forward and aligned according to the Frankfurt plane.

Based on the obtained results, participants were categorized into normal weight, overweight, and obesity groups. Among the 100 participants, 32 had results within the normal range (18.5–24.9). In 45 participants, the body mass index (BMI) was within the range of 25–29.9 and they were classified as overweight. The remaining 23

participants had a BMI greater than 30.Arterial blood pressure of each participant was measured using a sphygmomanometer. Participants were instructed to remain at rest for at least 5 minutes before measurement, and it was explained that this could influence the results. The observed parameters were systolic and diastolic blood pressure. Measurements were taken using the Nikolai Korotkov method.

Results

Participants:	**100**	**100%**
Normal weight	**32**	**32%**
Overweight	**45**	**45%**
Obesity	**23**	**23%**
BMI Group	**Systolic BP (mmHg)**	**Diastolic BP (mmHg) |**
Normal weight	**118 ± 8**	**76 ± 4**
Overweight	**132 ± 10**	**85 ± 5**
Obesity	**145 ± 10**	**90 ± 10**

Statistical Analysis

Data were analyzed using SPSS 23.0 software. Results were expressed as M ± SD.

ANOVA test was applied to compare BMI groups.Student's t-test was used for pairwise comparisons.

The analysis showed that systolic arterial blood pressure significantly increased with rising BMI. Diastolic pressure increased in a similar manner.

Prevalence of Hypertension

BMI Group	Hypertension present (n) | %	
Normal weight	**5**	**15.6%**
Overweight	**18**	**40%**
Obesity	**16**	**69.5%**

The chi-square (χ^2) test was used to compare categorical variables.

Result: The prevalence of hypertension in the obesity group was significantly higher compared to the normal weight group.

Scientific Conclusion

The obtained results demonstrated that arterial blood pressure increases with rising body weight. Participants in the obesity group had higher systolic and diastolic blood pressure, and the risk of developing hypertension increased accordingly. These findings confirm that obesity is a significant risk factor for cardiovascular diseases.

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