МЕДИЦИНА

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Olena HAIDAI
Candidate of Medical Science, Associate Professor at the Department of Descriptive and Clinical Anatomy, Bogomolets National Medical University, lenaustimenko23@gmail.com
ORCID: 0000-0002-1567-7482

ASSESSMENT OF RENAL FUNCTION IN OVERWEIGHT ADULTS IN THE CONTEXT OF ANTHROPOMETRIC PARAMETERS

The study of kidney function in overweight individuals is one of the most important issues for modern medicine, as an increase in obesity can lead to an increase in the risk of kidney disease. The main factors that can affect the development of renal dysfunction are anthropometric data: body mass index (BMI), waist circumference (WC), and waist-to-hip ratio (WHR).

Materials and Methods. *This study evaluated the association between the determinants and renal function. The study involved 150 adults of different sexes. Renal function was analyzed by determining creatinine clearance and standardizing data in the «RenNorm» computer program.*

Results and Discussion. *Anthropometric parameters were measured using standard methods, and the results showed that an increase in BMI correlated with a significant decrease in creatinine clearance, indicating renal dysfunction. Waist circumference has been shown to be most strongly associated with renal function, and the role of visceral fat has been shown to be a major risk factor in the development of chronic kidney disease. The waist-to-hip ratio also showed a negative relationship with creatinine clearance.*

Conclusions. *All the results confirm the importance of more detailed studies of anthropometric parameters in the future for the preventive identification of individuals with a predisposition to develop renal failure. Monitoring of anthropometric parameters can be used as one of the tools for the prevention of kidney disease in individuals with increased body weight.*

Key words: *body mass index, waist circumference, waist-to-hip ratio, creatinine clearance, renal function, obesity, chronic kidney disease.*

Олена Гайдай. ОЦІНКА НИРКОВОЇ ФУНКЦІЇ У ДОРОСЛИХ ОСІБ ІЗ НАДМІРНОЮ МАСОЮ ТІЛА В КОНТЕКСТІ АНТРОПОМЕТРИЧНИХ ПАРАМЕТРІВ

Дослідження функції нирок у осіб з надлишковою вагою є одним з найважливіших питань для сучасної медицини, адже збільшення ступеня ожиріння може призводити до збільшення ризику виникнення патологій нирок. Основними факторами, що можуть вплинути на розвиток ниркової дисфункції є антропометричні дані: індекс маси тіла (ІМТ), окружність талії (ОТ) та співвідношення талії до стегон (WHR).

Матаріали та методи. *У цьому дослідженні проведено оцінку зв'язку між визначальними параметрами та функціональним станом нирок. У дослідженні брало участь 150 дорослих осіб різної статі. Аналіз ниркової функції був здійснений за допомогою визначення кліренсу креатиніну та стандартизації даних у комп'ютерній програмі «RenNorm».*

Результати та обговорення. *Антропометричні показники було виміряно за стандартними методами, а результати продемонстрували, що збільшення ІМТ співвідноситься зі значним зменшенням кліренсу креатиніну, що говорить про ниркову дисфункцію. Доведено, що окружність талії має найбільший зв'язок з нирковою функціональністю, а роль вісцерального жиру, основним фактором ризику у розвитку хронічних захворювань нирок. Співвідношення талії до стегон також продемонструвало негативну залежність з кліренсом креатиніну.*

Висновки. *Всі результати підтверджують важливість у майбутньому більш детальних досліджень антропометричних параметрів задля превентивного виявлення осіб, що мають схильність до розвитку ниркової недостатності. Моніторинг антропометричних показників можна використовувати, як один з інструментів профілактики захворювань нирок у осіб зі збільшеною масою тіла.*

Ключові слова: *індекс маси тіла, окружність талії, співвідношення талії до стегон, кліренс креатині, функція нирок, ожиріння, хронічна хвороба нирок.*

Introduction. The issue of overweight and obesity can be considered one of the most pressing and important for modern medicine and the world. According to the WHO [7], more than 1.9 billion people in the world are overweight, of which 650 million people suffer from obesity of varying degrees. Such conditions are accompanied by an increased risk of developing chronic diseases, one of which is chronic kidney disease. Functional renal disorders can be almost asymptomatic in the early stages, but if diagnosed late, the risk of renal failure develops. Somatometric indicators, including body mass index, waist circumference, waist-to-hip ratio, are used to assess the degree of obesity, but their relationship with the functional state of the kidneys remains poorly understood, especially in terms of taking into account somatotype and individual morphological and functional characteristics. An integrated approach to assessing the state of renal function, especially using

anthropometric parameters, allows us to understand in detail the pathological mechanisms of chronic kidney disease in the context of overweight. The study of these patterns is important in practical use for identifying individuals at risk, creating individualized preventive recommendations and effective monitoring of overweight patients.

Objective. To determine the peculiarities of the functional state of the kidneys in overweight adults, focusing on anthropometric parameters, in order to determine the potential risks of renal dysfunction.

Materials and methods of the study. The study involved 150 adults of different sexes who were overweight, which was determined by calculating a body mass index (BMI) that exceeded 25 kg/m^2. All study participants were divided into obesity levels according to the WHO classification: I degree (BMI 25-29.9 kg/m^2), II degree (BMI 30-34.9 kg/m^2) and III degree (BMI >35 kg/m^2). To assess the somatic parameters of the participants, we calculated their body mass index (BMI), measured their waist circumference, waist-to-hip ratio, hip circumference, and adipose tissue volume. All these indicators were used to determine the type and degree of obesity and to assess the distribution of adipose tissue in the body. To assess the functional state of the kidneys, the results of laboratory tests were also taken into account, such as creatinine clearance, which is an indicator of glomerular filtration, and urine analysis for the presence of protein, red blood cells, white blood cells and other indicators that may indicate possible impaired kidney function. Statistical analysis consisted of calculating the correlation between anthropometric parameters and renal function. In order to assess the relationship between anthropometric parameters (BMI, waist circumference, waist-to-hip ratio) and renal function (creatinine clearance), Pearson's correlation coefficient was used to determine the tendency of one parameter to change with another. To process the results and evaluate the role of anthropometric parameters in the process of renal functioning, the RenNorm program [1] was used to normalize the data and help build models that take into account all the morphological characteristics of the participants. Scatter plots were used to visualize the relationships. This helped to demonstrate the correlation between variables and identify patterns that are characteristic of renal dysfunction in overweight.

Results and discussion. The study involved 150 adults aged 18 to 65 years (mean age 42.6 ± 11.3 years), of whom 87 were women (58%) and 63 men (42%). The main criterion for inclusion in this sample was the presence of overweight (BMI >25 kg/m^2). According to the degree of obesity, participants were divided into three main groups:

I degree of obesity (BMI 25-29.9 kg/m^2) - 67 people (44.7%)

II degree of obesity (BMI 30-34.9 kg/m^2) - 52 people (34.7%) III degree of obesity (BMI ≥35 kg/m^2) - 31 people (20.6%)

All participants were measured: body mass index (BMI), waist and hip circumference, waist-to-hip ratio (WHR). The overall average values were: average BMI: 31.4 ± 3.2 kg/m^2; average waist circumference: 98.2 ± 9.5 cm; average hip circumference: 112.4 ± 8.1 cm; mean WHR: 0,86 ± 0,05. (Table 1)

Table 1

Anthropometric data of study participants depending on the degree of obesity

Indicator	I degree of obesity	II degree	III degree
BMI (kg/m^2)	27,8 ± 1,4	32,3 ± 1,3	38,3 ± 2,1
Waist circumference (cm)	91,2 ± 5,2	98,1 ± 6,1	108,4 ± 6,5
WHR	0,83 ± 0,03	0,86 ± 0,04	0,91 ± 0,02

The difference between the groups is statistically significant ($p < 0.01$). In the group with the third degree of obesity, there was a clear predominance of abdominal obesity, which can be considered the most harmful for metabolism and kidney function [9]. The main measurements for the study of renal function were: creatinine clearance (calculated by the Cockcroft-Gault formula), general urine analysis: the presence of protein, red blood cells, leukocytes. (Table2)

Table 2

Indicators of kidney function in overweight adults depending on the degree of obesity

Indicator	I degree	II degree	III degree
Creatinine clearance (ml/min)	89,3 ± 8,6	83,7 ± 7,4	76,2 ± 7,1
Proteinuria (% of participants)	7%	14%	32%
Appearance of white blood cells in the urine	3%	6%	15%
Appearance of red blood cells in the urine	2%	4%	12%

The decrease in creatinine clearance is linear with increasing BMI. Proteinuria and microhematuria are more common in individuals with grade III obesity, which may be a marker of the initial manifestations of glomerulopathy [11]. Pearson's correlation coefficient was also used to assess the relationship between anthropometric parameters and renal function. (Table 3)

The strongest relationship can be observed between waist circumference and creatinine clearance, which in turn emphasizes the role of visceral fat as a risk factor for renal dysfunction [2,5,9]. (Figure 1) shows the

scatterplot of values showing a negative trend between WHR and creatinine clearance. Despite the fact that the relationship is less pronounced compared to BMI and waist circumference, a general pattern of increasing WHR can be observed, which demonstrates a significant predominance of visceral obesity, and a decrease in renal function, which may confirm the harmful effects of abdominal fat on glomerular filtration [5, 10, 11].

Table 3

Interdependence of renal function on anthropometric parameters in overweight adults

Parameters	The coefficient r	Direction of communication	Significance
BMI vs creatinine clearance	-0.62	negative	$p < 0.01$
Waistline vs creatinine clearance	-0.68	negative	$p < 0.01$
WHR vs creatinine clearance	-0.54	negative	$p < 0.01$

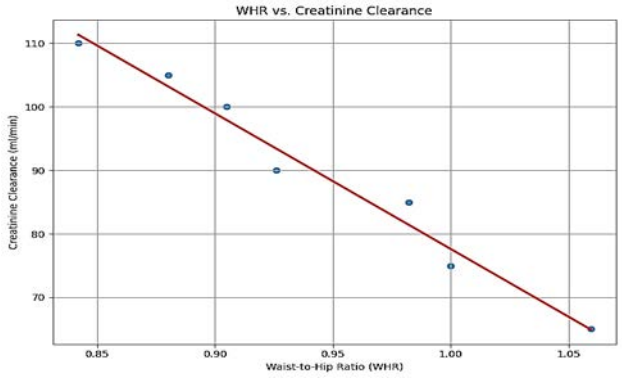

Fig. 1. Relationship between Waist-to-Hip Ratio (WHR) and Creatinine Clearance

(Figure 2) shows a consistent negative relationship between waist circumference and creatinine clearance. With an increase in waist circumference, which indicates the accumulation of visceral fat, a gradual decrease in glomerular filtration rate can be observed, confirming the important role of abdominal obesity as one of the independent risk factors for renal dysfunction. This relationship is observed regardless of gender and age, which makes waist circumference one of the markers of risk assessment [3, 4, 8].

(Figure 3) shows a significant linear negative relationship between BMI and creatinine clearance. An increase in BMI, which indicates increased body weight and obesity, simultaneously demonstrates a gradual decrease in glomerular filtration rate and confirms that

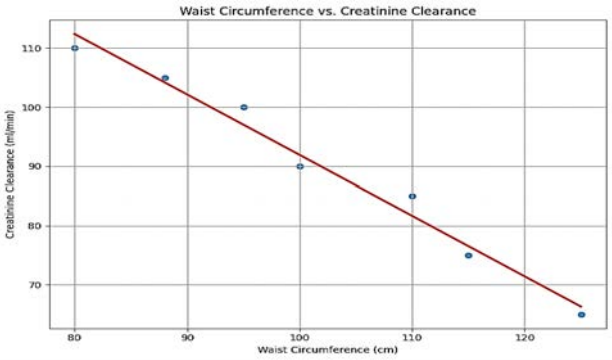

Fig. 2. Relationship between Waist Circumference and Creatinine Clearance

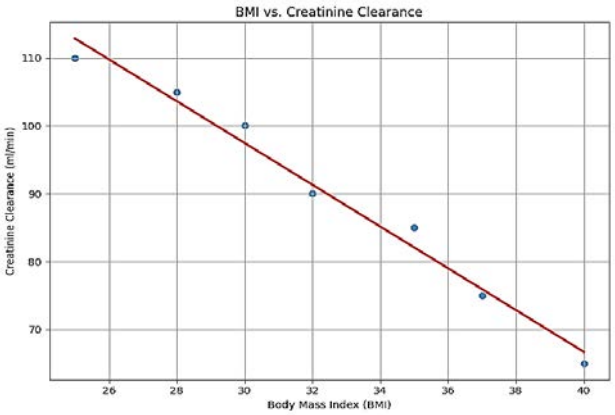

Fig. 3. Relationship between Body Mass Index (BMI) and Creatinine Clearance

increased BMI may form a risk factor for deterioration of renal function, which is important in the early detection of individuals at risk of developing chronic kidney disease [6, 7, 8].

The results of the study demonstrated that body mass index (BMI) is one of the most important markers of renal dysfunction, as shown by the linear negative correlation between BMI and creatinine clearance. Also, an increase in BMI correlates with a decrease in glomerular filtration rate. Increased BMI is typical for obese individuals, which also contributes to the development of renal pathologies. The correlation between waist circumference and creatinine clearance proves the role of visceral fat as a risk factor for renal dysfunction. The waist-to-hip ratio (WHR) and creatinine clearance are less affected, indicating the need to control not only total weight but also certain distributions of adipose tissue.

Conclusions. The results of the study showed that there are clear and reliable relationships between somatic parameters and indicators of the functional state of the kidneys among overweight individuals. Namely, it was found that body mass index (BMI) has an inverse relationship with glomerular filtration rate

(GFR), which proves the potentially harmful effect of overweight on kidney function. With an increase in BMI, a gradual decrease in GFR is also characterized, which makes it possible to consider BMI not only as a diagnostic marker of obesity, but also as a predictor of the risk of developing renal dysfunction. It is also worth mentioning waist circumference and waist-to-hip ratio (WHR). A statistically significant negative relationship was found between waist circumference and creatinine clearance, indicating a key role of visceral fat in the development of renal dysfunction. A similar relationship was observed for hip circumference, although it was less pronounced, which is associated with differences in the metabolic activity of different types of adipose tissue. The results suggest that an increase in abdominal fat is an independent risk factor for a decrease in renal filtration capacity, even in the absence of severe chronic kidney disease. This proves the importance of regular monitoring of anthropometric data as part of screening programs for early detection of the risk of renal dysfunction among overweight individuals. The novelty of the study is a comprehensive analysis of the relationship between anthropometric indices (BMI, waist circumference, hip circumference, WHR) and renal function (GFR, creatinine clearance) in individuals with different degrees of obesity. The identified correlations expand the possibilities of the diagnostic value of markers in renal dysfunction and can be used in clinical practice as affordable and non-invasive prognostic tools. It can be concluded that the inclusion of BMI, waist circumference, and WHR in risk assessment algorithms for overweight patients is an important and necessary step in the primary prevention of chronic kidney disease and can be used to optimize screening programs, create recommendations for weight control, and reduce abdominal obesity.

Bibliography:

1. Program for determination of sonographic kidney size "RenNorm" : patent 85223 Ukraine. No. 86786 ; published on 26.04.2025, Bulletin no. 52
2. Anthropometric measurements as a key diagnostic tool for familial partial lipodystrophy in women. V. R. Veras et al. *Diabetology & Metabolic Syndrome*. 2024. Vol. 16, no. 1. URL: https://doi.org/10.1186/s13098-024-01413-w
3. Augmented clearance of nivolumab is associated with renal functions in chronic renal disease model rats. K. Taguchi et al. *Drug Metabolism and Disposition*. 2021. P. DMD–AR–2021–000520. URL: https://doi.org/10.1124/dmd.121.000520
4. Bilchenko O. V. Results of the DAPA-CKD trial and their impact on clinical practice. *INTERNATIONAL JOURNAL OF ENDOCRINOLOGY (Ukraine)*. 2023. Vol. 19, no. 4. P. 300–305. URL: https://doi.org/10.22141/2224-0721.19.4.2023.1290
5. Dairy consumption and its association with anthropometric measurements, blood glucose status, insulin levels, and testosterone levels in women with polycystic ovary syndrome: a comprehensive systematic review and meta-analysis. H. Rastad et al. *Frontiers in Endocrinology*. 2024. Vol. 15. URL: https://doi.org/10.3389/fendo.2024.1334496
6. Fat tissue quantity, waist circumference or waist-to-hip ratio in patients with chronic kidney disease: A systematic review and meta-analysis / S. Zimmermann et al. *Obesity Research & Clinical Practice*. 2024. URL: https://doi.org/10.1016/j.orcp.2024.03.007
7. Obesity and overweight. *World Health Organization (WHO)*. URL: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight
8. Sweatt K., Garvey W. T., Martins C. Correction: Strengths and Limitations of BMI in the Diagnosis of Obesity: What is the Path Forward? *Current Obesity Reports*. 2024. URL: https://doi.org/10.1007/s13679-024-00584-x
9. The association between visceral adiposity index and decreased renal function: A population-based study. Z. Qin et al. *Frontiers in Nutrition*. 2023. Vol. 10. URL: https://doi.org/10.3389/fnut.2023.1076301
10. Waist–hip ratio measured by bioelectrical impedance analysis as a valuable predictor of chronic kidney disease development. Y. Song et al. *BMC Nephrology*. 2022. Vol. 23, no. 1. URL: https://doi.org/10.1186/s12882-022-02981-7
11. Yu L., Câmara N. O. S. The Impact of Obesity on Glomerular Diseases Remains to be Determined. *American Journal of Kidney Diseases*. 2024. URL: https://doi.org/10.1053/j.ajkd.2024.06.004