The Pharma Innovation Journal 2020; 9(3): 595-599

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2020; 9(3): 595-599
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www.thepharmajournal.com
Received: 14-01-2020
Accepted: 16-02-2020

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Evaluation of early risk factors in development of metabolic syndrome in healthy persons

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Abstract
The purpose of the study is to identify in healthy people indicators of anthropometric status and biochemical picture of blood, which can serve as risk factors for development and lead to further development of metabolic syndrome. A total of 79 men, completely healthy, were interviewed during 2019 at the Center of Health and Longevity Technology (Kyiv) to assess their health and further correction recommendations for identified abnormalities and available changes. The mean age of men was (37.2 ± 0.9) years.

Among the surveyed men with signs of anthropometric profile impairment, 10 people were found to be overweight (50.0%), first degree obesity - one person (10.0%), second degree - 2 people (10.0%), middle age which was 35.3 years. The components of the metabolic syndrome were observed in 4 people (20%) (increased body mass index, increased blood pressure, increased triglyceride content, decreased high density lipoprotein cholesterol). Biochemical indicators of protein and carbohydrate metabolism revealed no deviation from the values of the reference limits of the norm. The greatest deviations of indicators of the functional state of the endocrine system occurred in the direction of the increase of the level of cortisol: in persons with obesity of the first degree - up to (387,6 ± 12,2) nmol / l, slightly less in persons with overweight - up to (310,2 ± 13,4) nmol / l, the lowest content of which was found in persons with II degree of obesity - (166,5 ± 8,7) nmol / l. The content of C-reactive protein showed signs of chronic mild inflammation - increased production of C-reactive protein in the liver: its content in the serum of individuals with overweight and obesity I and II degrees in 16 cases was increased from 5.46 to 17.3 mg/l.

Keywords: Metabolic syndrome, risk factors, anthropometric and biochemical parameters

Introduction
According to the World Health Organization, obesity is becoming a "real epidemic" of the 21st century. Approximately 10% of adults suffer from obesity, which in 40% of cases is comorbid with diabetes mellitus and 20% with coronary heart disease. Researchers believe that the major determinants of metabolic syndrome are overweight and obesity prevalent so that it is a major public health problem [2]. It is recognized that the early identification of individuals at high risk of developing metabolic syndrome is a key factor in stopping the progression of dysmetabolic disorders among apparently healthy people. In most cases, an alarming tendency is determined by late diagnosis with evaluation of each component and damage to target organs and, accordingly, late therapy of metabolic syndrome [10].

At the same time, these definitions orient physicians to adequate actions in the already formed pathology, while markers of individual predisposition to metabolic syndrome, criteria for diagnosis of preclinical stage and initial changes in vital systems of the organism, as well as the time optimal for the beginning of preventive and preventive measures, not defined.

According to one of the directions of development of the metabolic syndrome, the diagnosis of this disease is based on the leading role of the primary obesity [5]. From the pathophysiological point of view, visceral obesity should be considered as a primary factor involved in the main mechanism of metabolic syndrome development. Obesity significantly increases the risk of diseases such as type 2 diabetes, hypertension, myocardial infarction and others, reducing the quality and life expectancy of the population.

One of the initial links in the development of MS is eating disorders, which leads to alimentary obesity. Within the psychosomatic tradition, the authors draw attention to the role of stress, as the primary causes of eating disorders with the development of nutritional addiction and manifestation of metabolic syndrome, in the study of the mechanisms whose leading role is given to certain stereotypes of behavior (overeating, sedentary lifestyle, smoking, smoking, and smoking stress-induced neuroendocrine changes [4, 6].

Since metabolic syndrome is a condition whose manifestations are reversible or which can be significantly minimized, it becomes clear that treatment should be started at the stage of alimentary obesity (without biochemical changes). Unfortunately, at this stage of the development of the metabolic syndrome, patients do not often turn to specialists, considering it possible to solve the problem on their own. At the same time, dietary strategies for the correction of the metabolic syndrome as effective approaches to the treatment of this heterogeneous disease are constantly being studied [7].

A fundamental feature of the metabolic syndrome is the fact that the combination of metabolic factors increases the severity of each component. There is a correlation between all risk factors, and the risk factors that exist at a young age, when the compensatory systems are still active, are realized at an older age by the development of severe conditions associated with atherosclerosis and diabetes [2].

The purpose of the study is to identify in healthy people indicators of anthropometric status and biochemical picture of blood, which can serve as risk factors for development and lead to further development of metabolic syndrome.

Material and Methods

We surveyed 118 fully healthy individuals who contacted the Center for Health and Longevity Technology (Kyiv) in 2019 to assess their health and further correction recommendations for identified abnormalities and available changes. Among them, 79 men and 39 women. The mean age of men was (37.18 ± 0.89), women - (40.37 ± 1.56). Men in group 1 age 21-30 had 13 people, group 2 age 31-40 years - 38 people, group 3 age 41-50 years - 23 people and group 4 age 50 – 60 years - 4 persons. Women in group 1A aged 21-30 had 7 people, 2A - 31-40 years - 13 people, 3A - 41-50 years - 12 people, and 4A - 50-60 years - 7 people.

Non-invasive methods were used in the study - determination of anthropometric parameters - height, body weight, waist circumference, abdomen, index of waist-to-hip ratio, body mass index, body shape index. and body weight.

The constituent compositions of the body were performed with an In Body 220 apparatus based on the principle of action based on multifrequency bioelectric impedance analysis. The computer algorithm for interpretation of the results of the study allows online to reliably estimate the objective state of the organism of the subject: determination of body mass index, percentage of adipose tissue; ratio of waist volume to hip volume, charting with age; segmental evaluation of the muscular and skeletal mass of the body.

The metabolic profile was evaluated using a portable FITMATE metabolologist. COSMED is the first portable instrument designed to accurately measure Resting Energy Expenditure (REE, RMR), allowing FITMATE to measure readily available, simple and fast metabolism levels, a unique desktop system for accurate, fast and simple indirect calorimetry; mainstream, affordable, portable, easy-to-use, with built-in thermal printer, body weight management programs based on energy balance, includes data management software, lifestyle analysis and plan dieting.

The cardiovascular profile was determined in the CARDIOLAB + HRV system, which is an electrocardiograph with an analysis of heart rate variability and the presence of ECG monitoring in it with a detailed analysis of heart rate variability. The system has a complete set of functions of a cardiograph cardiograph and records with a detailed analysis of heart rate variability characteristics according to the technologies of the European Working Group and in accordance with the recommendations of analysis by RM Baevsky.

Blood biochemical analysis included determination of the functional state of the liver: total protein content, total and direct bilirubin, aspartate aminotransferase activity (AST), alanine aminotransferase (ALT), and gamaglutamyltranspeptidase. Bilirubin content in serum was determined using the Eindrashek method, and the thymol sample was determined using SIMKO Ltd reagents. The activity of ALT and AST in serum was determined by the Reitman-Frenkel method using a set of reagents: "LIVA-Lachema" (Czech Republic).

To assess the lipid spectrum of the blood, the content of total cholesterol (LC), triglycerides (TG), high density lipoprotein cholesterol (HDL) was determined using standard Olvex Diagnosticum test systems (Russia) by enzymatic method on an autoanalyzer. The content of low density lipoproteins (LDL) was calculated by the formula WT Frieedeald: LDL = LC- (HDL + TG / 2.2). The coefficient of atherogenicity (CA) was determined by the formula: CA = (LC-HDL) / HDL.

Indicators of the state of the endocrine system included the determination of the level of cortisol, thyroxine and thyrotropic hormone (TTH).

The obtained digital data were processed by the method of variational statistics using Microsoft Excel 7.0 applications.

Results and Discussion

The volume of visceral adipose tissue plays an important role in the development of the metabolic syndrome and, accordingly, is interpreted as a predictor of its development in one of the directions of pathogenesis of the metabolic syndrome. In the real world, with security, cost, and other factors in mind, researchers have focused on waist circumference and waist / hip ratio.

The indicator of central obesity is now considered waist circumference. In 44 surveyed men, this indicator exceeded the norm (94 cm). The highest number of such persons was found among men of group 2 - 29.11% of the surveyed men in this group in men of group 3 - 21.52%. Accordingly, the index of stroke of the stomach increases. Fat distribution (waist / hip) was, on average, (0.83 ± 0.02) (0.85 for men). In the group of 1 persons with the exceeded indicator was 1,54%, in group 2 - 49,5%, in group 3 - 72,91%, in group 4 - 100%. It was found that 27 (72.6%) women had waist circumference of more than 85 cm. According to the criteria of the International Diabetes Federation, a waist circumference of more than 85 cm can serve as one of the criteria for abdominal (visceral) obesity and a component of metabolic syndrome. In the analysis of this indicator in women of group 2A waist circumference, on average, was (83,9 ± 3,87) cm, among them in 3 women (42,9%) the figure exceeded 85 cm. In women of group 2A waist circumference, in On average, it was defined as (86.73 ± 4.12) cm, in 7 women (53.7%) the figure was greater than 85 cm. In women of group 3A in 7 women (58.33%) the waist circumference was increased, in on average, up to (88.38 ± 3.16) cm. In group 4A individuals, this indicator increased to (92.75 ± 4.31) cm. The detected changes in waist circumference can be considered a sign of abdominal obesity, which is important in the development of insulin resistance. Which is characteristic of sugar diarrhea. The latter, together with other components, is significant among the major components in the possible

further development of the metabolic syndrome.

The body mass index (Kettle) in the surveyed men varied significantly in different groups. Normal weight in group 1 had 4 people (30.66%), overweight - 9 people (69.23%). In group 2 - normal body weight was found in 3 people (7.9%), overweight - in 21 people (55.26%), obesity I degree - in 11 people (28.95%), II degree - in 2 persons (5.26%), III degree - in 1 person (2.63%). In the group of 3 persons with normal body weight there were 4.35%; excess - 52.17%; with obesity I degree - 21,74%; with II degree obesity - 21.74%; with obesity of the third degree - were not observed. Among the surveyed groups, 4 persons with normal body weight were not found, with overweight - 40.0%, with obesity I - 40.0%. That is, the number of men with obesity increases with age. In women of group 1A, the body mass index averaged (27.60 ± 1.12) kg / m2, with 6 cases of overweight and one obesity grade II (body mass index - 35.78 kg / m2; waist circumference - 96.5 cm). In women of group 2A, the body mass index, on average, was defined as (28.22 ± 4.12) kg / m2, which differs significantly from the value of this indicator in the previous group. Obesity was diagnosed in 83.3% of cases, in one case - grade I obesity (body mass index - 34.53 kg / m2) and in one case, grade II obesity (body mass index - 38.3 kg / m2). In group 3A women, the body mass index averaged (29.67 ± 1.89) kg / m2, with the number of seven overweight subjects (58.3%) increasing the number of cases of obesity I - 33.3% and II - 8,4% degree. In Group 2A women, body mass index increased to (31.21 ± 1.56) kg / m2, 50.0% had obesity, 37.5% had obesity I, and 2.5% had grade II. In all the above cases, excess development of subcutaneous fat was recorded, which confirms visceral obesity.

An increase in body mass index may be related to other indicators of body composition - bone volume and skeletal muscle. A bone volume study found that this indicator fluctuated across age groups. In men, the indicator did not differ significantly between the different age groups ($p > 0.05$). In women of group 1A bone mass had the lowest expressiveness - (3.08 ± 0.19) kg, group 2A this indicator, on average, was the highest - (4.39 ± 0.18) kg, in group 3A and group 4A decreased to (3.13 ± 0.14) and (3.44 ± 0.15) kg.

The volume of skeletal muscle mass in men and women, on average, decreases. Fluctuations in bone and muscle volumes were apparently related to the degree of fitness and physical activity of those who turned to the wellness center for some reason. This indicates that the magnitude of these indicators could not affect the body mass index. According to EW Abd El-Wahab ea [3], at least one component of the metabolic syndrome was detected in 86.7% of participants in his study. Abdominal obesity was the most common metabolic anomaly (94.2 5%).

The volume of fat has some differences, depending on the age of the person. Thus, in men of group 2 (age 21-30 years) the figure is the lowest - (15.50 ± 0.53) kg, in group 2 this figure increases significantly, up to (31.10 ± 1.02) kg and is stored in such limits in group 3 - (30,8 ± 1,07) kg and in group 4 - (29,2 ± 0,71) kg. In this case, the% fat mass also increased - in group 2 the indicator was (16,55 ± 0,38)%; in group 3 - (22,9 ± 0,45)%; in group 4 - (27.4 ± 0.56)% and in group 4 - (28.6 ± 0.91)%. Fat mass in women of different age groups differed little: group 2A - (32,77 ± 1,12)%; in group 3A- (33.98 ± 1.29)%; in the group 3 - (32,40 ± 1,06)%. In women of group 4 years, this indicator increased significantly - to (37,84 ± 1,38)%, which is significantly different from the first three groups. Dynamic changes in muscle tissue volume correlate with changes in body mass index.

Body shape index, closely linked to abdominal obesity, is a new indicator of the risk of premature death from cardiovascular disease. It is now suggested that there is a relationship between body shape index and diabetes, metabolic syndrome and hypertension. In our study in the surveyed persons in groups of different ages, this figure was in persons aged 21-30 years - 0.38 ± 0.18; 31-40 years - 0.34 ± 0.17; 41-50 years - 0.35 ± 0.18; more than 50 years - 0,34 ± 0,16. That is, there is a difference in the value of the indicator between a group of young people and groups of older men. Perhaps the body shape index is one of the first to respond to changes in metabolic status.

The examined persons revealed changes in the metabolic profile of the state of the body. The intensity of metabolism is characterized by an integral index of the major metabolism [1]. In men of group 2, the rate of major metabolism was (2219 ± 107) Kcal, groups 3 - (2200 ± 192) Kcal, groups 4 - (1959 ± 85) Kcal, over 50 years of age - (1799 ± 112) Kcal. As you can see, with age, the actual rate of primary exchange is gradually decreasing. In group 2, deviations of the actual level from the calculated one were observed downwards by 18.1%. In the following age groups, the number of cases with a reduced rate, respectively, in men in group 2 was 38.9%; groups 3 - 42.8%, groups 4 - 60.0%.

The rate of major metabolism in women in groups 1A and 2A was, respectively, (1817 ± 85) Kcal and (1866 ± 92) Kcal. In group 3 its numerical value showed (1654 ± 66) Kcal, in group 4 - (1686 ± 72) Kcal. Compared to groups 1A and 2A, these changes were likely. That is, with age (from 40 years old), the main exchange in women, on average, is likely to decrease. The deviation of the actual rate of the main exchange from the calculated in group 1A was observed in 3 women - from (-4,87) to (± 3,51). In group 2A, the decrease / increase fluctuations were determined in all women and had a broader range - from (-0.61) to (± 12.31), in group 3A - from (-1.34) to (± 5.64) and in group 4A - (-1.0) to (± 2.01). The actual and estimated rates of the principal exchange coincide without deviations in Group 1A for four persons, for 2A, 3A and 4A for one person. That is, with age, the major exchange shows a trend toward decreasing numbers of increasing numbers of women. It is known that "slow" metabolism (reduced rate of major metabolism) leads to excess fat deposition, the occurrence of obesity, and subsequently to high risk of cardiovascular disease, increased blood pressure and diabetes. Metabolism may be slowed by hypothyroidism but has not been found in our subjects with hypothyroidism.

When measuring blood pressure, the vast majority of men in all groups set values within the normal range. In 9 people (11.39% of cases) blood pressure was greater than 130/90 mm Hg. Art. At the same time waist circumference in them exceeded 102 cm. Among the same persons according to the body mass index revealed in one case overweight (overweight), obesity of the first degree - in 5 people, obesity of the second degree - in 1 person. With respect to a sign such as hypertension in women (greater than 130/85 mm Hg), no increase in systolic blood pressure was observed in group 1 individuals, group 2A was observed in 3 persons, group 3A - in 3 persons and group 4A - for 3 people. Diastolic blood pressure showed changes in women after 30 years, respectively, in 4, 4 and 3 women. In each group there are different in size, but with age they are transformed in the direction of increase.

The results of the biochemical study of the liver in the

surveyed in the largest group 2 showed that the activity of AST and ALT in the blood were within the normal range in individuals with overweight: AST - (23.1 ± 0.96) IU / l, obesity I and II degree, respectively (27.2 ± 1.1) IU / l and (30.5 ± 1.43) IU / l; ALT - (27.1 ± 0.87) IU / l, obesity I and II degree, respectively (11.4 ± 0.24) IU / l and (27.2 ± 1.23) IU / l. The activity of gamaglutamyltranspeptidase was (25,4 ± 1,1) IU / l in overweight people, (15,2 ± 0,2) IU / l for obesity I and (33,8 ± 0,8) IU / l l, that is, did not deviate from the reference limits of the norm.

The level of protein in the blood is one of the most important diagnostic parameters for metabolic disorders in the body. In overweight people, its content was (16.6 ± 0.7) g / l; with obesity I degree - (14,6 ± 0,68) g / l; II degree - (15.5 ± 0.61) g / l. That is, the white-synthesizing function of the liver was characterized by the reference limits of normal.

Lipid metabolism revealed an increase in total cholesterol in 3 people. High-density lipoprotein cholesterol content was observed in 3 overweight people, and in the rest of the surveyed levels showed normal limits. Low-density lipoprotein cholesterol was elevated in one case in the overweight and obese subjects of grade I and II. The same individuals noted an increase in triglyceride levels, which are a marker of lipid metabolism disorders and are involved in the development of cardiovascular disease. In 2 overweight people, this increase was insignificant - up to 4.01 mmol / l; with obesity I degree - up to 4.5 mmol / l; II degree - up to 4.8) mmol / l. The presence of hyperlipidoproteinemia is often characteristic of people with obesity. Individuals who had at least one criterion for the diagnosis of metabolic syndrome, in particular, increased triglyceride content were attributed by the researchers to the group at higher risk of metabolic syndrome formation. Under these conditions, the atherogenic factor was increased in 3 overweight people.

Indicators of carbohydrate metabolism (glucose content and glycated hemoglobin) revealed deviations from the reference limits in only one case. One person with overweight and in one case with grade II obesity observed a content of glycated hemoglobin of 5.8%. The level of 5.7-6.4% may be associated with the risk of diabetes and may be an important point in the diagnosis of metabolic syndrome. The insulin content was determined at the level of the lower limit of normal in 10 cases. In one case, overweight subjects showed an increase in NOMA to 4.25. An increase in NOMA may be a precursor to diabetes.

With regard to other indicators of the state of the endocrine system, it was found that the greatest deviations occurred in the direction of increase in the level of cortisol: in persons with obesity of the first degree - up to (387,6 ± 12,2) nmol / l, slightly less in persons with overweight - up to (310,2 ± 13,4) nmol / l, its lowest content was found in persons with II degree of obesity - (166,5 ± 8,7) nmol / l. In the preclinical stage, during overweight, stress becomes a risk factor for the development of neuroendocrine disorders in metabolic syndrome [6, 7] and an increase in cortisol may result in hypertension. At the same time, indicators of thyroid functional activity (T4 and thyrotropic hormone content did not show deviations from the normal limits.

In the study of the content of C-reactive protein in the serum of individuals with overweight and obesity I and II degree and found that in 16 cases, this figure was increased from 5.46 to 17.3 mg / l. It is now believed that metabolic syndrome and elevated levels of C-reactive protein are independent predictors of new cardiovascular events.

An in-depth analysis of 20 healthy individuals identified 4 patients (20.0%) with evidence of metabolic syndrome risk factors. One overweight person (39 years old) has 3 major components of metabolic syndrome out of 5. This is an increase in body weight; decrease in high-density lipoprotein cholesterol, increase in blood pressure: additionally - impaired lipid metabolism (increase in total cholesterol and low-density lipoprotein cholesterol, increase in atherogenic factor, increase in obesity). body, lowering the high density lipoprotein cholesterol and increasing the triglyceride content; additionally, increasing the total cholesterol and cortisol levels. Grade II obesity (ages 33 and 36) showed an increase in body mass index, a decrease in high-density lipoprotein cholesterol, and an increase in triglyceride content; in addition, an increase in total cholesterol, cortisol, and glycated hemoglobin was determined in one case.

That is, in 4 surveyed completely healthy persons with the help of in-depth study revealed risk factors for metabolic syndrome. This may in turn lead to the development of metabolic syndrome and requires increased attention, the appointment of repeated biochemical blood tests against the background of measuring anthropometric data for early diagnosis and correction. It should be noted that the presence of risk factors for the development of metabolic syndrome was observed in the surveyed persons aged 31-40 years, although according to H Wang [13], the average age of diagnosis of metabolic syndrome was determined in men 49.5 years and women - 47.0 years.

That is, simple anthropometric measurements and basic biochemical parameters can be used to identify healthy people at increased risk of developing metabolic syndrome at the "normoglycemic" stage, in particular, in periodic surveys of a healthy population. Because lifestyle factors significantly influence the development and progression of metabolic syndrome, timely pre-natal diagnosis will allow early intervention to correct lifestyle in a healthy population [12].

Conclusions

1. Among the surveyed men with signs of impaired anthropometric profile found 10 people with excess body weight (50.0%), obesity I - one person (10.0%), II degree - 2 people (10.0%), the average age was 35.3 years.
2. Components of the metabolic syndrome were observed in 4 people (20%) (increased body mass index, increased blood pressure, increased triglyceride content, decreased high density lipoprotein cholesterol).
3. The greatest deviations of indicators of the functional state of the endocrine system occurred in the direction of the increase of the level of cortisol: in persons with obesity of the first degree - up to (387,6 ± 12,2) nmol / l, slightly less in persons with overweight - up to (310, 2 ± 13,4) nmol / l, its lowest content was found in persons with II degree of obesity - (166,5 ± 8,7) nmol / l.
4. The content of C-reactive protein showed increased production of C-reactive protein in the liver: its content in the serum of individuals with overweight and obesity I and II degree in 16 cases was increased from 5.46 to 17.3 mg / l.
5. It is established that the signs of risk factors for the development of metabolic syndrome in individuals - 31-40 years, which requires attention to men and women of this age category with the appointment of additional biochemical parameters.

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