CORRELATIONS BETWEEN ANTHROPOMETRIC AND BIOCHEMICAL INDICATORS AND THE PREVALENCE OF CHRONIC DISEASES IN THE ADULT POPULATION OF TÎRGU-MUREŞ

DANIELA-EDITH CEANĂ¹, MONICA TARCEA², FLORINA BOARIU RUȚA³, GEANINA MOLDOVAN⁴, SEPTIMIU VOIDĂZAN⁵

^{1,2,4,5}University of Medicine and Pharmacy Tirgu-Mures, ³Romanian Association of Nutrition and Dietetics (ARoND)

Keywords: obesity, nutrition, anthropometric measurements Abstract: Currently, cardiovascular diseases, followed by cancer diseases are major causes of death worldwide. Epidemiological studies have found a progressive increase in the prevalence of cardiovascular risk factors (dyslipidemia, hypertension, impaired glucose control) due to lifestyle in general and to nutrition in particular. Regarding the genesis of chronic cardiovascular or malignant diseases, it seems that diet is a key issue. The aim of the study was to emphasize the relationship between anthropometric and biochemical indicators and the emergence of some chronic diseases in an adult population, under the condition of a predominantly omnivorous diet. We conducted a cross-sectional study based on the survey of 2045 systematically sampled people from Tirgu Mures. We were interested in the assessment of demographic data, anthropometric indicators (height, weight, waist circumference), biochemical parameters (glucose, cholesterol), presence of chronic diseases, dietary habits and the evaluation of health status. Approximately 27% of the total surveyed people admitted that they suffer from one or more chronic cardiovascular or malignant diseases. We found statistically significant differences (p < 0.05) with much higher values for the followed parameters in people who admitted suffering from ischemic heart disease, obesity, diabetes or hypertension, however we did not find significant differences in case of malignant conditions.

Cuvinte cheie: obezitate, nutriție, indicatori antropometrici **Rezumat:** La ora actuală, bolile cardiovasculare, urmate de bolile canceroase reprezintă cauze importante de deces la nivel mondial. Studiile epidemiologice au găsit o creștere progresivă a prevalenței factorilor de risc cardiovasculari (dislipidemie, hipertensiune arterială, tulburări ale controlului glicemic) datorită în general stilului de viață și în mod particular alimentației. În cadrul procesului de geneză a bolilor cronice cardiovasculare sau maligne, se pare că dieta joacă un rol central. Scopul studiului a fost de a evidenția relația dintre indicatorii antropometrici sau biochimici și apariția unor boli cronice într-o populație adultă, în condițiile unui regim alimentar predominant omnivor. S-a efectuat un studiu cross-secțional bazat pe chestionarea a 2045 de persoane eșantionate sistematic din orașul Tîrgu-Mureș. S-au urmărit datele demografice, indicatori antropometrici (înălțime, greutate, circumferința abdominală), parametrii biochimici (glicemie, colesterol), prezența bolilor cronice, tipul de regim alimentar și aprecierea stării de sănătate. Aproximativ 27% dintre respondenți au relatat că suferă de una sau mai multe boli cronice cardiovasculare sau maligne. S-au obținut diferențe semnificative statistic (p<0.05), cu valori ale parametrilor urmăriți mult mai mari la persoanele care au relatat că suferă de cardiopatie ischemică, obezitate, diabet zaharat sau hipertensiune arterială, în schimb nu am identificat diferențe semnificative în cazul afecțiunilor maligne.

INTRODUCTION

The World Health Organization estimated that in 2008 approximately 3 million people died because of cardiovascular diseases which represent 30% of all death cases on a global scale.(1) Epidemiological studies have discovered a progressive increase in the prevalence of cardiovascular risk factors (dyslipidemia, hypertension, impaired glycemia control) generally due to lifestyle and particularly to nutrition.

In recent decades, many prospective and crosssectional studies have been conducted by using anthropometric measurements and biochemical parameters, in order to understand the relationship between obesity and cardiovascular risk factors.(2,3,4) Cancer also appears on the palette of chronic diseases, with a continuously rising prevalence due to certain cancer-causing habits, such as smoking, obesity, nutrition etc.(5) Statistics show that in our country every 10 minutes a person dies because of a cardiovascular disease and of its complications, or that every 11 minutes a person dies of cancer. In 2010, the standard mortality in Romania according to cardiovascular diseases was estimated as being 188 - 540 cases/ 100,000 people compared to 82.4 - 225 cases/ 100,000 people, the average value recorded in other countries of the European Union. Standard cancer mortality was also estimated at 180 cases/ 100,000 people compared to the European average of 170 cases/ 100,000 people.(6,7) Regarding the genesis of chronic cardiovascular or malignant disease, dietary habits play a key role.

PURPOSE

The purpose of the study was to emphasize the relationship between biochemical and anthropometric indicators and the presence of chronic diseases (ischemic heart disease,

¹Corresponding author: Daniela-Edith Ceană, Str. Surianu, Nr. 4, Ap. 20, Tîrgu-Mures, E-mail: daniela_edith@yahoo.com, Tel: +40745 582865 Article received on 03.02.2013 and accepted for publication on 02.04.2013 ACTA MEDICA TRANSILVANICA June 2013;2(2):205-209

obesity, diabetes, hypertension and cancer) in an adult population in correlation with dietary habits.

METHODS

We conducted a cross-sectional study based on a questionnaire meant to evaluate the life-style and health status of 2045 people. Data were collected during 01.07.2012 - 28.02.2013. The subjects of the survey were informed about the objective of this study. The total number of participants represented a sample of the adult population from Tirgu Mures. We applied a systematic sampling method (sampling step k = 5) in order to respect the condition of qualitative order and to be representative of the target population.

The questionnaire targeted to find out about demographic data (gender, age), anthropometric indicators (height, weight, waist circumference), biochemical parameters (glucose, cholesterol) as evaluated by the family physician, specialist or by a routine check-up. The presence of chronic diseases and dietary habits were also assessed. Regarding diagnosed chronic diseases, we looked for the presence of ischemic heart disease, obesity, diabetes mellitus, hypertension or malignant diseases. Weight, height, and waist circumference were measured by using standard procedures. Waist circumference was measured using a measuring tape, midway between the bottom of the rib cage and the iliac crest. The provided values of height and weight helped us calculate the body mass index (BMI) by using the formula weight/height². According to the definitions of the World Health Organization (WHO), [1] we could classify the participants of this survey as underweight, normal weight, overweight or obese.

Statistical analysis: Data obtained from the questionnaires were centralized in an Excel database, and the statistical analysis was performed by using GraphPad Prisma Software (San Diego, California, USA). We identified the heterogeneity of data collected from a large group of people with a high biological variation. We used the Mann-Whitney U test to assess differences between nonparametric variables (expressed by median, range) and the Kruskal Wallis test, while the Chi square test (χ 2) test was used for categorical variables expressed by numbers (%). All tests were interpreted compared to the threshold level of significance p = 0.05 and statistical significance.

RESULTS

There were 2045 adult people evaluated, the rate of females being of 54.2%.

In the first period we studied the relationship between anthropometric (BMI, waist circumference) and biochemical indicators (blood glucose and cholesterol) respectively age groups. The median age was 41 (range: 18-92 years of age). The largest surveyed population group comprised population aged 21-30 years (26.1%) and the smallest group comprised people in their eighties (0.6%). Almost half of the respondents (46.4%) were characterized by a normal BMI and 4.4% were overweight. There was a rather high frequency of people, almost half of the studied group, who belonged to the overweight and obese category: 31.8% were overweight, 13.3% presented first-degree obesity, 3.7% second-degree obesity and 0.5% third-degree obesity.

We used the Kruskall Wallis non-parametric test, studying the maximum and minimum values in the descriptive statistics (table no. 1) and the medians (figures no. 1 and 2). Statistically significant differences (p<0.0001) were especially identified between declared indicator values of younger people

(up to 40) and values obtained from individuals aged between 41 - 80 years old.

Table no. 1. Descriptive statistics (minimum and maximum) of anthropometric and biochemical indicators according to age groups

| Variables/ age | Indicators | < 20 | 21-30 | 31-40 | 41-50 | 51-60 | 61-70 | 71-80 | >80 |
|--------------------------|------------|-------|--------|--------|--------|--------|--------|-------|-------|
| groups: years | | years | years | years | years | years | years | years | years |
| (%) | | old | old | old | old | old | old | old | old |
| | | (3.8) | (26.1) | (18.7) | (19.2) | (16.2) | (10.8) | (4.6) | (0.6) |
| BMI (kg/m ²) | Minimum | 16,90 | 16,33 | 15,37 | 18,21 | 18,21 | 19,53 | 13,84 | 19,56 |
| | Maximum | 32,15 | 38,57 | 42,52 | 41,52 | 44,69 | 39,06 | 36,79 | 28,73 |
| Abdominal | Minimum | 50,0 | 50,0 | 55,0 | 52,0 | 49,0 | 54,0 | 54,0 | 67,0 |
| waist (cm) | Maximum | 121,0 | 134,0 | 138,0 | 143,0 | 160,0 | 153,0 | 130,0 | 115,0 |
| Glycemia | Minimum | 76,0 | 70,0 | 69,0 | 65,0 | 69,0 | 75,0 | 70,0 | 110,0 |
| (mg/dl) | Maximum | 120,0 | 140,0 | 193,0 | 220,0 | 371,0 | 300,0 | 233,0 | 120,0 |
| Cholesterol | Minimum | 100,0 | 50,00 | 80,00 | 70,00 | 118,0 | 120,0 | 69,00 | 180,0 |
| (mg/dl) | Maximum | 120,0 | 320,0 | 330,0 | 375,0 | 400,0 | 352,0 | 300,0 | 250,0 |

Figure no. 1. Significant differences of anthropometric indices according to age groups in the studied sample



Figure no. 2. Significant differences of biochemical indices according to age groups in the studied sample



Another objective of the questionnaire was to identify the presence of diagnosed chronic diseases. Responses were targeted to acquire information about cases of ischemic heart disease, obesity, diabetes, hypertension and malignant diseases. About 27% of the respondents reported that they suffer from one or more of these diseases. Ischemic heart disease was diagnosed in 6.3% of the patients, obesity in 9.0%, diabetes mellitus in 6.9%, hypertension in 19.1% and cancerous diseases in 0.5% of the cases. We would like to mention the fact that some people suffer from multiple chronic diseases, so that there are associations among these diseases. Thus we have frequently identified people with coronary heart disease and hypertension (4.8% of all chronic disease), obesity and hypertension (5.4%), diabetes mellitus and hypertension (5.6%), and persons suffering from three or four of these chronic diseases.

We applied nonparametric Mann Whitney tests so that we could see if there were any differences among the obtained age, BMI, waist circumference, blood sugar or cholesterol values, according to the presence or absence of the five monitored diseases (table no. 2). We acquired statistically significant differences (p < 0.05) with much higher values for the tracked parameters in respondents who admitted suffering from coronary heart disease, obesity, diabetes or hypertension, however we found no significant differences in case of malignant conditions.

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| Tuble no. 2. Interential statistics of parameters depending on the presence of absence of enrolle diseases | | | | | | | | | | |
|--|-------------------|-------------|-----------------------|---------------|---------------|----------------|--|--|--|--|
| | % | Age | BMI | Waist | Glucose | Cholesterol | | | | |
| | | (years) | (kg/cm ²) | circumference | (mg/dl) | (mg/dl) | | | | |
| Ischemic | Yes (6.3) | 62 (21-83)* | 29.4 (18.2-44.7)* | 102 (63-160)* | 116 (76-300)* | 230 (115-400)* | | | | |
| cardiopathies (n=128) | No (93.7) | 40 (18-92) | 24.7 (13.8-44) | 88 (49-153) | 92 (65-371) | 200 (50-375) | | | | |
| Obesity (n=184) | Yes (9.0) | 53 (19-80)* | 32.5 (17.9-44.7)* | 112 (65-160)* | 107 (75-371)* | 219 (115-375)* | | | | |
| | No (91.0) | 40 (18-92) | 24.5 (13.8-42.4) | 86 (49-150) | 93 (65-300) | 200 (50-400) | | | | |
| Diabetes mellitus | Yes (6.9) | 61 (21-83)* | 29.4 (17.6-44)* | 104 (54-150)* | 134 (73-300)* | 220 (115-375)* | | | | |
| (n=141) | No (93.1) | 40 (18-92) | 24.7 (13.8-44.7) | 88 (49-160) | 90 (65-371) | 200 (50-400) | | | | |
| Hypertension | Yes (19.1) | 62 (21-92)* | 29.3 (13.8-44.7)* | 102 (59-160)* | 110 (70-300)* | 223 (69-375)* | | | | |
| (n=390) | No (80.9) | 40 (18-85) | 24.2 (15.4-42.5) | 85 (49-153) | 90 (65-371) | 200 (50-400) | | | | |
| Malignant diseases | Yes (0.5) | 54 (20-92) | 23.8 (19.3-28.7) | 84 (75-108) | 83 (80-110) | 184 (168-200) | | | | |
| (n=11) | No (99.5) | 41 (18-85) | 24.9 (13.8-44.7) | 90 (49-160) | 95 (65-371) | 202 (50-400) | | | | |

Table no. 2. Inferential statistics of parameters depending on the presence or absence of chronic diseases

Note. Data are expressed via median and range,

*- is the significant difference (p-0.0001) among the values of the following parameters: age, BMI, waist circumference, glycemia and cholesterol depending on the presence or absence of the disease

Type of alimentary regimen: Most surveyed respondents were on an omnivorous diet (90.2%), vegetarian diet being favoured only by 1.8% of the individuals (table 3). If we analyze separately data for patients suffering from chronic diseases one can see that the percentage for omnivorous regime (81.3%) is lower than for the general one, and that is because more than 13% of people suffering from this disease prefer a lacto - ovo vegetarian diet or more than 2% who are strictly on a vegetarian diet (p = 0.006).

The same is true of people with diabetes, the percentage of vegetarians reaching 4.3% (p = 0.02).

Table no. 3. Type of diet according to the presence or absence of chronic diseases

| | % | Omnivore | Lacto-ovo | Vegetarian | Another | P value |
|--------------|--------|----------|------------|------------|---------|---------|
| | | | vegetarian | | dietary | |
| | | | | | regimen | |
| Ischemic | Yes | 81.3 | 13.3 | 2.3 | 3.1 | 0.006 |
| cardiopathy | (6.3) | | | | | |
| | Nu | 90.8 | 5.3 | 1.8 | 2.1 | |
| | (93.7) | | | | | |
| Obesity | Yes | 87.0 | 8.2 | 1.6 | 3.3 | 0.34 |
| | (9.0) | | | | | |
| | Nu | 90.5 | 5.6 | 1.8 | 2.0 | |
| | (91.0) | | | | | |
| Diabetes | Yes | 83.7 | 9.9 | 4.3 | 2.1 | 0.02 |
| mellitus | (6.9) | | | | | |
| | Nu | 90.7 | 5.5 | 1.6 | 2.2 | |
| | (93.1) | | | | | |
| Hypertension | Yes | 89.2 | 6.7 | 1.8 | 2.3 | 0.87 |
| | (19.1) | | | | | |
| | Nu | 90.5 | 5.6 | 1.8 | 2.1 | |
| | (80.9) | | | | | |
| Malignant | Yes | 100 | 0 | 0 | 0 | 0.77 |
| diseases | (0.5) | | | | | |
| | No | 90.2 | 5.9 | 1.8 | 2.2 | |
| | (99.5) | | | | | |
| Total | 100 | 90.2 | 5.8 | 1.8 | 2.2 | |

To what extent are you interested in having a healthy diet?

Concerning this inquiry, about 45% of the respondents are concerned and 20.6% are *very much* concerned about eating healthier. Data analysis regarding Table 4 showed that many people suffering from malignant disorders (18.2%, p = 0.01) and 14.9% (p = 0.03) of those suffering from diabetes mellitus are *very little* concerned about proper dietary habits. For the rest of the investigated chronic diseases, the results for responses like "*very little* or *not at all*" were about 2.8% and 8.6%.

| Table no. 4. | То | what | extent | are | you | interested | in | having | a |
|---------------|----|------|--------|-----|-----|------------|----|--------|---|
| healthy diet? | | | | | | | | | |

| | % | Not at | Very | Little | Much | Very | P value |
|-----------------|-----------|--------|--------|--------|---------|--------|---------|
| | | all | little | | | much | |
| Ischemic | Da (6.3) | 1.6 | 7.8 | 21.9 | 43.0 | 25.8 | 0.58 |
| cardiopathy | Nu (93.7) | 2.9 | 8.6 | 23.1 | 45.1 | 20.2 | |
| Obesity | Da (9.0) | 3.3 | 9.8 | 26.1 | 44.6 | 16.3 | 0.54 |
| | Nu (91.0) | 2.8 | 8.4 | 22.7 | 45.0 | 21.0 | |
| iabetes melliti | Da (6.9) | 2.8 | 14.9 | 19.1 | 39.0 | 24.1 | 0.03 |
| | Nu (93.1) | 2.8 | 8.1 | 23.3 | 45.4 | 20.3 | |
| Hypertension | Da (19.1) | 1.6 | 7.8 | 21.9 | 43.0 | 25.8 | 0.01 |
| | Nu (80.9) | 2.9 | 8.6 | 23.1 | 45.1 | 20.2 | |
| Malignant | Da (0.5) | 0.0 | 18.2 | 9.1 | 45.5 | 27.3 | 0.59 |
| diseases | Nu (99.5) | 2.9 | 8.5 | 23.1 | 45.0 | 20.6 |] |
| Total | 100 | 2.8 | 8.6 | 23.0 | 45.0 | 20.6 | |
| Which wor | d would | be f | he hes | t to d | lescrib | e vour | health |

status?

This self-evaluation revealed a *good* health condition in 41.2% of the respondents, or *acceptable* in 32.1% (Table 5). Statistically significant differences derive from the fact that between 14.1% and 27.3% of those with chronic illnesses considered that they have a *poor* health status, while 17.4% -20.4% of the population who do not suffer from chronic diseases considered that they are in a *very good* health condition. *Excellent* health status was particularly declared by healthy people (approximately 4.6%).

| Table no. 5. | Which | word | would | be the | best to | describe yo | ur |
|---------------|-------|------|-------|--------|---------|-------------|----|
| health status | 5? | | | | | | |

| | % | Precarious | Acceptable | Fine | Very | Excellent | Р |
|--------------|--------|------------|------------|------|------|-----------|--------|
| | | | | | good | | value |
| Ischemic | Da | 19.5 | 63.3 | 15.6 | 1.6 | 0.0 | 0.0001 |
| cardiopathy | (6.3) | | | | | | |
| | Nu | 3.7 | 30.1 | 42.9 | 18.4 | 4.9 | |
| | (93.7) | | | | | | |
| Obesity | Da | 18.5 | 51.6 | 23.9 | 4.3 | 1.6 | 0.0001 |
| | (9.0) | | | | | | |
| | Nu | 3.3 | 30.2 | 42.9 | 18.7 | 4.9 | |
| | (91.0) | | | | | | |
| Diabetes | Da | 19.9 | 53.9 | 24.1 | 1.4 | 0.7 | 0.0001 |
| mellitus | (6.9) | | | | | | |
| | Nu | 3.6 | 30.5 | 42.5 | 18.5 | 4.9 | |
| | (93.1) | | | | | | |
| Hypertension | Da | 14.1 | 54.0 | 27.0 | 4.4 | 0.5 | 0.0001 |
| | (19.1) | | | | | | |
| | Nu | 2.5 | 27.0 | 44.5 | 20.4 | 5.6 | |
| | (80.9) | | | | | | |
| Malignant | Da | 27.3 | 36.4 | 27.3 | 9.1 | 0.0 | 0.02 |
| diseases | (0.5) | | | | | | |
| | Nu | 4.6 | 32.1 | 41.3 | 17.4 | 4.6 | |
| | (99.5) | | | | | | |
| Total | 100 | 4.7 | 32.1 | 41.2 | 17.4 | 4.6 | |

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DISCUSSIONS

The risk of developing a disease in people with high cholesterol is 2-4 times higher than in those with normal levels. There are enough evidence collected in the past 40 years to prove the causal relationship between dietary habits and serum total cholesterol levels.(8) High blood pressure also plays an important role because of modifications induced in the heart muscle and blood vessels, by increasing 2-5 times susceptibility to cardiovascular diseases.(9)

Another modifiable risk factor is diabetes mellitus that is a fasting blood sugar> 120mg/dl or any other blood sugar> 200mg/dl associated with specific symptoms.(10) Obesity increases the risk of some diseases, particularly heart disease, type 2 diabetes, certain types of cancer. In most cases, obesity is caused by the combination of excessive consumption of calories, lack of physical activity and genetic predisposition.(11,12)

Obesity is one of the leading causes of death, which can be prevented on a global scale, with increasing prevalence in adults and children. It is considered by the authorities as one of the most serious public health problems of the twenty first century.(14) Data analysis shows that less than 50% of our respondents have normal BMI, the rest of them being underweight, overweight or obese. We found that almost 32% of them are overweight and 17.5% obese of varying degrees.

Maximum values of BMI or waist circumference were observed in persons aged between 51-60, respectively in individuals aged 61-70 years old. We identified obesity in people with median BMI of 32.5 kg/m2 and median waist circumference of 112 cm, where biochemical parameters had the tendency to increase toward the maximum values of the normal limits.

At the opposite side of maximum values for BMI and waist circumference were young people, particularly who were younger than 20 years old and elderly people above 80 years old. Perhaps young people are more vigorous, more active and elderly people do not base their dietary habits on excessive consumption of calories, whereas people in their fifth - seventh decades of age are affected by inactivity, excessive food intake, genetic or hormonal factors. There is little evidence supporting the fact that some obese people eat less but gain weight due to slow metabolism, but on average, obese people consume more energy than slim people, given the fact that they need energy to support increased load.(13) Our study showed that obese people adopt predominantly an omnivorous diet. Only a small number of obese people (16.3%) are greatly preoccupied by proper diet and only 18.5% are assessed as having poor health. Poor nutrition can have impact on health and occurrence of cardiovascular diseases (ischemic heart disease, hypertension) or diabetes mellitus.(15,16)We insisted on the maximum values of cholesterol and glycemia, except for those under 20 years old, values that exceed the upper limit of normal values, especially in persons aged 50 - 70 years old.

These cardiovascular diseases and diabetes mellitus occur according to our data base at the age of 60, in overweight people, as evidenced by median BMI of 29.4 kg/m2 or waist circumference of 102-104 cm.

Statistically significant differences are visible when comparing values in people without these diseases. The situation is clear as well in case of biochemical parameters, where after our statistical processing we found the following results: median blood glucose levels at 134 mg/ dl in diabetics or median cholesterol of 230 mg/ dl in patients with ischemic heart diseases compared to healthy population._We identified the highest percentage of people on lacto-ovo vegetarian diet those suffering from ischemic heart diseases (13.3%) and the highest percentage of vegetarians in case of diabetics (4.3%). However 14.9% of diabetics are very little concerned about healthy diet.

Nevertheless few people suffering from the mentioned diseases consider their health very good or excellent, they consider it rather poor.

Although, clinical trials in general (17,18) specify that among various risk factors, uncontrolled diet represents an important role in the etiology of malignant diseases, which can lead to diabetes and obesity, our data presented in Table 2 do not underline these assumptions. We noticed that malignancies occur mainly in the fifth decade of life, although according to the calculated range, they may occur in the 20th and 90th year of life, the values of anthropometric and biochemical parameters are normal or lower than in the population who denied suffering from these diseases. Perhaps there are other causes that cause malignant tumors.

In our study we could not prove clearly the link between the causes of cancer versus improper diet because of the few patients who declared that they suffer from oncological illnesses. However, we could observe that these few people were all on a omnivorous diet, that 18.2% were very little concerned about a proper diet and 27.3% consider their health condition to be poor.

CONCLUSIONS

Statistical approach for the identification of anthropometric and biochemical indicators is relevant for revealing the prevalence of chronic diseases in a community.

We obtained statistically significant differences (p <0.05) with the studied parameter values much higher in people suffering from heart disease, obesity, diabetes or hypertension, however we found no significant differences for malignant diseases.

Results show that particularly the age group of 50 - 70 years old people should correct their dietary habits, because this is an age group that is more prone to the emergence of chronic diseases.

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