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Association of Selected Biochemical Markers and Body Mass Index in Women with Endocrine Disorders

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***Abstract*—**Obesity is frequent attendant phenomenon of patients with endocrinological disease. Between BMI and endocrinological diseases is close correlation. In thesis we focused on the allocation of hormone concentration – PTH and TSH, CHOL a mineral element Ca in a blood serum. The examined group was formed by 100 respondents (women) aged 36 – 83 years, who were divided into two groups – control group (CG), group with diagnosed endocrine disease (DED). The concentration of PTH and TSH, Ca and CHOL was measured through the medium of analyzers Cobas e411 (Japan); Cobas Integra 400 (Switzerland). At individuals was measured body weight as well as stature and thereupon from those data we enumerated BMI. On the basis of Student T-test in biochemical parameter of PTH and Ca we found out significantly meaningful difference ($p<0,05$) between CG and DED. In CG we made a founding the association between BMI and PTH by means of correlation analysis.

***Keywords*—**Biochemical markers, hormones, obesity, women.

I. Introduction

TAKING into account that the majority of hormones directly or indirectly influences various organs and tissues, endocrinopathies are characterized by the set of symptoms and abnormalities which are often considered to be very complex. Except the clinical picture of dysfunction of peripheral glandules regulated by this system, there are present also disorders of thermoregulation, electrolytic and aquatic management, food intake, sleeping, behaviour and mental problems [1]. Reference [2] presents following the most frequent clinical marks warning of the presence of endocrinopathy: changes of body weight, faintness and increased tiredness, dermal as well as psychical changes. Endocrine diseases, mainly the diseases of thyroid gland, belong among the disorders of cumulative occurence with prevalence (5% of population) which is comparable with *diabetes mellitus* [3].

Obesity is frequent attendant phenomenon of patients with endocrinological disease. It is influenced by levels of hormones but also by patient´s treatment. Between BMI and endocrinological diseases is close correlation which intensifies if BMI>29 [4]. Biochemical markers reflect the response of organism on signals of external as well as internal environment. They provide the information about metabolic balance and physiological processes of organism of environment [5]. Reference [6] in their studies point out on the association of value of BMI with the concentration of parathyroid hormone (PTH), thyroid-stimulating hormone (TSH), calcium (Ca) and phosporus (P).

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II. Materials and Methods

A. Subject

The study included 100 individuals – women, who were divided into two groups based on the clinical screening. The first was a control group (CG) with a number of 50 individuals, the second group was formed by women (n=50) with diagnosed endocrine disease (DED). The study was conducted after obtaining a written informed agreement from all individuals and implemented in accordance with the ethical principles based on the Helsinki Declaration.

B. Anthropometric Measurements

In the observed groups of women we measured body weight (kg), body height (cm), waist circumference (cm) hip circumference (cm). Body weight was measured on a digital personal scale DM - 117 Dimarson with accuracy 100 g, body height was measured barefoot in light clothing by digital height (DIN 862 with a precision of 0.01 mm) as an average of two consecutive measurements. Subsequently, data were taken from weight and height and we calculated body mass index - BMI (kg/m2). Waist circumference was measured periumbilical and hip circumference pertrochanteric, while we used the textile belt rate. From the measured data - waist circumference and hip circumference, we calculated index WHR - *Waist Hip Ratio* (waist circumference - cm / hip circumference - cm).

C. Biochemical Measurements

Venous blood samples were collected from all individuals from *vena mediana cubital* into tubes without anticoagulant content. By centrifugation, Selecta R, Spain (1500 rpm/15min.) of blood samples we separated blood serum, in which selected biochemical markers (PTH and TSH) were subsequently measured using a fully-automated immunochemical analyzer Cobas e411 (Roche Diagnostic, Japan), based on the principle of electrochemiluminescence. Other biochemical markers CHOL – total cholesterol and mineral element Ca - calcium, were measured by a biochemical analyzer Cobas Integra400 plus (Roche Diagnostics, Switzerland).

D. Statistical Analysis

The measured data were processed by Excel 2010 and Statistica ver. 10. The particular parameters were evaluated by using the statistical characteristics of the position - (average, minimum, maximum) and variability (standard deviation and variation range). For detection of the significance of differences between groups in each parameter we used parametric methods Student's T-test (to detect significant differences between the averages of the two sets). We considered the significance level of $p < 0.05$. To determine a statistically significant dependence between two parameters we used the Spearman correlation coefficient.

III. Results and Discussion

From anthropometric parameters we found out biologic age, we measured body weight, body height, waist and hip circumference. On the basis of the obtained parameters we calculated BMI and WHR index. In Table I we present the values of anthropometric parameters in both groups of women (CG and DED).

TABLE I
AVERAGE VALUES OF SELECTED ANTHROPOMETRIC PARAMETERS IN OBSERVED GROUPS OF WOMEN

group	parameter	min	max	average value	±SD
group of women with diagnosed endocrine disease (DED=50 women)	biological age (years)	44	83	60,48	7,96
	body height (cm)	150	174	161,98	5,71
	body weight (kg)	54	121	75,18	12,64
	waist circumference (cm)	74	128	96,32	12,19
	hip circumference (cm)	91	139	108,48	9,07
	BMI (kg/m^2)	21,09	43,91	28,81	4,53
	WHR (cm)	0,74	1,07	0,89	0,07
control group (CG=50 women)	biological age (years)	39	76	55	7,68
	body height (cm)	150	175	162,42	5,64
	body weight (kg)	50	103	68,34	11,12
	waist circumference (cm)	72	121	88,82	9,81
	hip circumference (cm)	86	126	103,44	7,71
	BMI (kg/m^2)	19,2	37,95	25,89	3,75
	WHR (cm)	0,74	1,07	0,86	0,06

min–minimum value, max–maximum value, ±SD-standard deviation

Using comparison of average anthropometric measurements between women with endocrine disease and control group of women, it was confirmed that obesity is a frequent symptomatologic attribute of the most of endocrinological diseases. Average body weight of women with endocrinological disorder was 75,12±12,64 kg, while in control group of women it was 68,34±11,12 kg. In women waist circumference larger than 88 cm is considered to be abdominal obesity, from which results that average value of waist circumference in DED (108,48±9,07 cm) exceeds physiological value. In our set of women the average value of BMI index was higher in women with endocrine disease (28,81±4,53 kg/m^2) which belongs to the category of excess weight. Average value of BMI index of control group was in the category of the excess weight (25,89±3,75 kg/m^2). On the basis of the measurements as well as calculation we found out that based on BMI index 14 women with endocrine disease have the obesity of I. grade, 5 women have the obesity of II. grade and in one case there was ascertained the obesity of III. grade, which means heavy obesity. Average value of WHR index in DED was 0,87±0,07 cm, CG= 0,86±0,06 cm. The increase of values over 0,85 cm is considered to be a risk for the creation of obesity and diseases of civilization. The group of women with endocrine disease in respect to WHR index belonged to risky category of distribution of fat in body.

According to the results of the study, which was accomplished by [7], every second inhabitant of Slovakia is the occupier of increasing intraabdominal fat. Nowadays, metabolic syndrome affects approximately 30 % of adult population in productive age. On the other hand, in women we observe the most often frequency of broader waist circumference. The prevalence of metabolic syndrome significantly grows simultaneously with age. More than 40 % of people are afflicted at the age 60+ years. Patients with diagnosed metabolic syndrome have 3,7-times higher risk of the development of ischemic heart disease and also 24,5-times higher risk of the development of diabetes mellitus of II. type [8].

Tables II, III provide measured values of biochemical parameters according to BMI category.

TABLE II
AVERAGE VALUES OF BIOCHEMICAL MARKERS IN CONTROL GROUP BY CATEGORY OF BMI INDEX

Categories of BMI (kg/m^2)	**n**	**PTH (pg/ml)**	**TSH (mIU/l)**	**CHOL (mmol/l)**	**Ca (mmol/l)**
Normal weight (18,5 - 24,9)	20	34,29±12,92	2,29±1,89	5,55±1,32	2,28±0,64
Excess weight (25 - 29,9)	25	28,65±8,23	2,16±1,49	6,48±2,05	2,51±0,18
Obesity of I. grade (30 - 34,9)	3	33,43±7,84	1,60±0,30	5,28±0,82	2,47±0,10
Obesity of II. grade (35 - 39,9)	2	15,63±6,69	5,81±0,78	5,04±0,08	2,50±0,09

PTH-parathyroid hormone, TSH- thyroid-stimulating hormone, CHOL – cholesterol, Ca – calcium, n-number

TABLE III
AVERAGE VALUES OF BIOCHEMICAL MARKERS IN GROUP OF WOMEN WITH DIAGNOSED ENDOCRINE DISEASE BY CATEGORY OF BMI INDEX

Categories of BMI (kg/m^2)	n	PTH (pg/ml)	TSH (mIU/l)	CHOL (mmol/l)	Ca (mmol/l)
Normal weight 18,5 - 24,9)	13	31,75±15,21	1,95±0,88	5,86±0,93	2,49±0,20
Excess weight (25 - 29,9)	17	45,26±24,99	2,23±1,92	6,30±1,76	2,50±0,24
Obesity of I. grade (30 - 34,9)	14	32,01±12,98	1,61±1,17	5,96±1,70	2,58±0,33
Obesity of II. grade (35 - 39,9)	5	26,59±13,91	2,60±1,50	6,90±1,46	2,65±0,21
Obesity of III. grade (40 and more)	1	43,91±0,00	4,03±0,00	6,45±0,00	2,56±0,00

PTH-parathyroid hormone, TSH- thyroid-stimulating hormone, CHOL – cholesterol, Ca – calcium, n-number

Taking into account the observation of biochemical markers, we found out that average values of PTH in both groups of women in all categories of BMI were in keeping with reference values. Average values of TSH and CHOL were apart from border line of reference values in the category of obesity of II. grade in control group of women.

On the basis of Student´s T-test in biochemical parameter of PTH and Ca we found out significantly important difference ($p<0,05$) between CG and DED. Average values of biochemical parameters are mentioned in Table IV.

TABLE IV
AVERAGE VALUES OF BIOCHEMICAL MARKERS AND STATISTICAL SIGNIFICANCE

biochemical parameter	CG	DED	p
PTH (pg/ml)	30,67±10,88	36,04±19,22	0,044*
TSH (mIU/l)	2,32±1,74	2,06±1,46	0,096
CHOL (mmol/l)	5,98±1,74	6,15±1,51	0,298
Ca (mmol/l)	2,41±0,43	2,54±0,25	0,041*

CG – control group, DED – group of women with diagnosed endocrine disease, * – statistical significance ($p<0,05$), PTH-parathyroid hormone, TSH-thyroid-stimulating hormone, CHOL – cholesterol, Ca - calcium

Reference [9] in the study which was realized among Slovak individuals with average biological age 47,3 years, found out that average concentration of cholesterol was 5,25±1,10 mmol/l. Our both groups of women (CG and DED) had a higher level of cholesterol, and simultaneously their average biological age was higher. The levels of cholesterol in blood increase with biological age [10]; and about to this factor can influence also higher level of cholesterol in our groups of individuals.

Through the correlation analysis we found out association between BMI and PTH in control group, which means that increasing value of BMI index results in a decreasing level of PTH in blood. Correlated relationship between PTH and BMI in control group of individuals was confirmed by [11]. Reference [12] in their study also affirmed connection between value of BMI and concentration of PTH in blood. The value of PTH increased in connection with growing level of BMI index. Other associations between TSH and BMI, CHOL and BMI, Ca and BMI were not confirmed in any of observed groups of our study.

Reference [13] in his scholar study affirmed the significant relation between TSH and BMI index. Our measured average values of TSH in particular categories are comparable with results provided by [13]; however, in our set of women there was not statistically confirmed association of this parameter with BMI. Association between TSH and BMI was confirmed by [14] who were monitoring men and women from the USA without any kind of disrupted function of endocrine system. Mutual relation between TSH and BMI also was not affirmed by [15] in population of Teheran, and also [16] did not affirm relation between TSH and BMI in the exploration of Greek population. The reason of endocrine disorders has a multifarious origin and biological mechanism is not completely known. The next factor, which influenced that our correlated relations were not affirmed, can be inadequately numerous group of individuals who were observed – Slovak population, i.e. individuals of female gender – women.

IV. CONCLUSION

Hormones fulfill essential and inseparable function in the keeping of homeostasis of organism; they also affect wide range of physiological processes. The function of endocrine glands is mainly primary while the changes of body weight are secondary. They are above as a consequence of acting of various factors of external as well as internal background of organism.

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