

THE ROLE OF NUTRITION IN ACHIEVING HORMONAL BALANCE IN WOMEN¹

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ABSTRACT

Proper nutrition of a complete daily meal contains 50% whole foods, 25% protein, 25% complex carbohydrates, probiotics, 20-30g of fiber, moderate physical activity, and proper sleep and relaxation, with the addition of natural stimulants for optimal hormone function, the basis for a happy and long life is the hormonal balance. Hormones are substances that are released into the bloodstream from glands or organs and affect cell activity elsewhere, so the goal of this paper is to prove that a woman are particularly sensitive to hormonal changes and their body weight tends to vary. For researching is use a questionnaire "Women's awareness of the relationship between diet and hormonal status" who is created with the aim of collecting data on women's understanding of the impact of hormones on the body, eating habits and attitudes about the dietary impact on the appropriate work of hormones.

KEY WORDS: nutrition, diet, hormonal balance, hormones, women

¹ original research paper

INTRODUCTION

Hormones are substances that are released into the bloodstream from glands or organs and affect cell activity elsewhere. Hormone binding to the receptor accelerates, slows down or otherwise alters the cellular function. There are hormones that are important in a woman's life. **Cortisol**- it is a product of the adrenal gland that controls hunger, digestion, blood pressure, sleep pattern, physical activity and capacity to cope with stress; to prevent an increase in its level from the diet it is necessary to eliminate stimulants in food such as sugar. (Guyton & Hall, 2006) **Serotonin**- it has the function of transmitting messages between nerve cells, participates in the thickening of smooth muscles and contributes to the feeling of happiness; it is obtained by a chemical reaction involving the amino acid tryptophan, found in turkey, eggs and cheese; (Hart, 2009) **Melatonin**-it is a hormone produced by the pineal gland, along with serotonin they participate in the regulation of sleep and wakefulness cycles, and its deficiency causes skin ageing, obesity, high blood pressure, type 2 diabetes, glaucoma, infertility, depression, migraine and malignancies; fish, turkey, pumpkin seeds contain the amino acid tryptophan which further increases melatonin levels, but also citrus fruits, carrots, tomatoes, broccoli, kale. (Toljan, 2018) **Progesterone** hormone, which is primarily secreted in the ovaries, and its low levels can lead to endometriosis, precancerous or endometrial cancer, anxiety, and sleep disorders, while its increase can be stimulated by foods rich in zinc, magnesium, vitamin E, B6, C. (Toljan, 2018) **Estrogen**-it is produced in the ovaries (80%) whose balance is related to the progesterone balance that can be affected by diet; a diet based on too much artificial fat leads to too much estrogen, and if the diet is too much fibrous, the expulsion of excess estrogen from the body is encouraged. (Toljan, 2015 & Gottfried, 2014) **Leptin** - this hormone is responsible for regulating appetite whose levels change during the menstrual cycle, while in postmenopausal women and men it is always stable. (Toljan, 2015) **Insulin**-hormone produced by the pancreas; the consequences of its imbalance are type 1 diabetes (congenital absence of insulin production) and type 2 diabetes (insulin is produced but not recognized by cells); occurs insulin resistance (excess sugar) with the consequence of creating a basis for inflammation, clogged arteries, overweight, dementia, Alzheimer's disease, stroke, accelerated ageing, hormonal imbalance, the poor working capacity of the body; it also underlies the development of metabolic syndrome (excess fat in the abdomen) which causes liver resistance to insulin, hyperinsulinemia, dyslipidemia,

hypertension, and ultimately diabetes and coronary heart disease; its control is based on proper nutrition. (Živković, 2000)

Proper nutrition of a complete daily meal contains 50% whole foods, 25% protein, 25% complex carbohydrates, probiotics, 20-30g of fiber, moderate physical activity, and proper sleep and relaxation, with the addition of natural stimulants for optimal hormone function, the basis for a happy and long life is the hormonal balance. (Varanešić&Alebić, 2006)

Objectives

To gain insight into women's eating habits, their knowledge about the work of hormones, and the impact of proper nutrition on hormonal balance and examine whether there are differences in knowledge about hormones depending on some characteristics of respondents (age and eating habits).

Hypotheses:

1. **H1** Respondents are not sufficiently informed about the action of hormone
2. **H2** There are differences in hormone awareness among respondents depending on age and eating habits:
 - 2.1. **H2a** There is no statistically significant difference in hormone awareness between older and younger respondents, all showing the same level of knowledge
 - 2.2. **H2b** There is a statistically significant difference in hormone awareness among respondents depending on their eating habits, those respondents who choose healthier breakfasts and snacks have greater knowledge about hormones
3. **H3** Most participants are aware that proper nutrition is the best way to restore hormonal balance

MATERIALS AND METHODS OF WORK

For the purpose of the research, we used our own questionnaire "*Women's information on the relationship between diet and hormonal status*" with questions related to the sociodemographic characteristics of participants (age, area of work, height/cm, weight/kg), hormone awareness (6 multiple choice questions with one correct answer), questions related to hormones and diet and questions of various aspects (health status, habits of respondents, personal pleasures and the use of hormones for contraception or therapy).

The research was conducted in the period from February 22 to March 10 via the Internet and Google Forms (distributed via social networks) with both anonymous and voluntary participation of 308 women (participants). The results were processed in the statistical IBM program SPSS 23. Quantitative descriptive analysis included response frequencies and percentages, arithmetic means with standard deviations, and the range of results (minimum to maximum). Hypotheses were tested by analysis of variance.

RESULTS AND DISCUSSION

Out of a total of 308 participants, 37.7% are less than 25 years old, while 2.6% are > 55 years old, with an average height of 166.91% $\pm$ 6.51cm and a weight of 66.02kg $\pm$ 14, 28kg. The highest percentage of 40.6% work as a health, nature or biotechnical expert.

When asked what they think about the way hormones work in the body, 85.1% believe that hormones work on all functions that take place within the body, while 43.2% of the "conductor of the hormonal system" opt for cortisol. Also, 63.3% of them believe that cortisol is a hormone that is activated during increased stress. In stressful situations, the body activates physiological mechanisms that increase the secretion of the hormone cortisol, to help the body overcome some obstacles. However, when cortisol levels are elevated for a long time, negative effects on the body, health and cognitive functioning occur, as evidenced by a study by renowned emergency physicians on a sample of 2231 people. The conclusion states that higher serum cortisol was associated with lower brain volume and memory disorders in asymptomatic younger people, up to middle-aged and elderly people, and this connection was more visible in women. (Echouffo - Tcheugui et al., 2018)

The result of which hormone is considered to be the strongest antioxidant in the body, 47.4% of them answered that it is oxytocin, and 27.3% believe that it is melatonin. Data from the results of a study of the treatment of breast cancer cells with melatonin show that melatonin reduced the expression of genes and proteins responsible for the survival and invasion and migration of breast tumor cells. (Lacerda et al., 2019)

Participants' awareness of hormones is shown by the results, which show that 56.5% of respondents believe that the building blocks of sex hormones are proteins, although they are known to be healthy fats and cholesterol, to which 23.7% answered. When asked about the lack of which hormone causes the intensified symptoms of PMS, 60.1% of them answered that they think it is estrogen and 36.7% that it is progesterone. The study Measured levels of female sex hormones from day 9 before the onset of menstruation

to the first day of menstruation in 15 women with PMS symptoms and 17 women in the control group. Estrogen in women with premenstrual symptoms was significantly higher 5 days before menstruation than in women in the control group. The increase in estrogen was significant until the last day before menstruation. Progesterone levels were significantly lower from day 9 to the last day before menstruation in women with PMS symptoms than in women in the control group. (Bäckström et al., 1976)

In the part of the participants' statements about their health condition (physical, mental and emotional state), 44.4% of them answered that they were satisfied, but would like to work on their overall health, while 26.6% were not satisfied and needed to take something to improve their health, while 5.5% of participants are completely satisfied with their health. A study conducted in which questionnaires and scales were used to assess the activation level of the body's hormones shows the influence of hormones on how we feel. Research suggests that in the premenstrual and menstrual phases the levels of activation are reduced (when the levels of sex hormones are also reduced), while in the rest of the cycle there is an increase in the level of activation (when the levels of one or more sex hormones are elevated). The phases of the cycle in which the levels of sex hormones are elevated are periods of optimal activation, and according to the theory of activation, greater efficiency can be expected. (Šimić&Gregov, 2009)

After analyzing the questions about hormones and awareness of the participants, the first hypothesis H1 is confirmed, which states that the participants were not sufficiently informed, but were only partially informed, because out of six questions the participants gave three correct answers, while the other three were incorrect. Table 1 shows that the average respondent has 3.03 points +/- 1.32, i.e., exactly about 50% (Table 1).

Table 1. Descriptive data for hormone awareness: arithmetic mean ($\bar{X}$), standard deviation (SD) and range of results

	$\bar{X}$	SD	Min	Max
<i>Test of Hormone Awareness</i>	3,03	1,32	0	6

(source: authors)

Given that no statistically significant difference in hormone awareness was obtained between older and younger respondents and that all participants showed the same level of knowledge, hypothesis H2 is confirmed which stated that knowledge about hormones in this study did not depend on the age of the participant.

Table 2. Results in the difference in awareness of hormones depending on age

	Age	Levene's test	p	$\bar{X}$	SD	F	df1&df2	p
<i>Awareness of hormones</i>		0,99	0,42			0,55	3,308	0,70
	<25 years			2,91	1,23			
	25-35 years			3,05	1,37			
	35-45 years			3,24	1,43			
	45-55 years			3,10	1,35			
	>55 years			3,00	1,31			

Remark * $p < 0,05$

(source: authors)

Following the obtained results related to the acquired information on eating habits and dietary satisfaction of the participants, we can see that 61% know how to work on proper nutrition, 24.4% are satisfied, and 5.5% are not satisfied with their diet. Furthermore, 40.9% answered that their appetites change depending on what part of their menstrual cycle they are in. The BioCycle study in the period 2005-2007, examined 259 healthy women who did not use hormonal contraception, through 2 menstrual cycles using mixed linear models adjusted for body fat percentage and age, with the likelihood of changes in body weight depending on physical activity, kilocalorie intake and other reproductive hormones. The primary goal of the latter study was to examine leptin levels during the menstrual cycle, and the results indicate stable leptin serum levels from the first day of menstruation until the late luteal phase, while in the follicular phase until the last day before menstruation leptin levels increased by 10%. (Ahres et al., 2015)

Also, the largest number of participants, when asked how they feel after a meal, 60.4% answered depending on what they eat, which is logical because each food is broken down differently and at a different rate in the digestive system. A percentage of 46.8 does not take a dietary supplement (vitamins, minerals, probiotics, omega 3, etc.) while 13.6% take them. Given today's diet, which is relatively depleted of micronutrients, research shows that occasional intake of dietary supplements can improve or maintain health,

and several essential nutrients affect women's health during different stages of life. Most women experience the symptoms of PMS, and adding calcium to their diet significantly reduces physical and mental symptoms.

PMS can be a predictor of osteoporosis caused by low calcium intake, while calcium intake in combination with vitamin D significantly reduces the risk of hip fractures. In the prenatal phase, multivitamin supplementation reduces the risk of premature birth and low birth weight by 50% and improves maternal health during pregnancy. Supplementation with calcium and vitamins D and E significantly reduces the risk of preeclampsia. (Bendich, 2001)

A number of the following questions provided insight into the eating habits of the participants, with the largest percentage of 31.5% using olive oil in the preparation of meals, which supports a lot of research on olive oil as one of the healthiest oils. 85.4% of participants most often consume water, of which 37.1 in the amount of 4-6 glasses per day. Only 16.6% of participants try to include fruits and vegetables in their every meal, and 22.1% of them in at least one meal, while the highest percentage of 25.4% includes 1-3 times a week, and 24.4% 3-5 times a week. At the same time, it is not insignificant that 11.4% of participants rarely eat fruits and vegetables. Regarding the consumption of sweets or cakes, 58.8% of respondents eat something sweet several times a week. Breakfast consumption is not present in 26.7% of participants (drink coffee or tea), and 16.9% eat breakfast cereals with the addition of some fruit, nuts or seeds. For a snack, 28.6% of participants eat fruits or vegetables, and 7.8% nuts or seeds, while 15.6% state that they do not eat anything for a snack.

The results obtained were used in the calculation of three analyses of variance by the Leven test to determine awareness of the relationship between diet and hormones. Since no statistically significant difference in hormone information was obtained between older and younger participants and all showed the same level of knowledge, hypothesis H2a was confirmed which stated that knowledge about hormones in this study did not depend on the participant's age (Table 2). However, there is a statistically significant difference in information about hormones in respondents depending on their eating habits, those participants who choose a more proper breakfast and snacks (fresh juice or smoothie of fruits or vegetables, cereals with added fruit, nuts or seeds or eggs, yoghurt, milk and kefir) are better informed about hormones, thus confirming hypothesis H2b (Table 3-4). That is, no statistically significant difference was obtained in hormone awareness and snack selection, thus the second hypothesis was only partially confirmed in breakfast selection.

Table 3: Difference in the result of the hormone awareness test depending on breakfast

	Breakfast	Levene's Test	p	$\bar{X}$	SD	F	df1 & df2	p
<i>Awareness of hormones</i>		0,99	0,43			2,46	6,308	0,03*
	I don't have breakfast;I drink coffee or tea			3,12	1,33			
	I buy something from the bakery			2,58	1,25			
	Eggs, yoghurt, milk, kefir			3,16	1,50			
	Muesli, Cornflakes or similar cereal			2,60	1,31			
	Freshly squeezed juice or smoothie made of fruits or vegetables			3,45	1,21			
	Healthy cereals with the addition of some fruits, nuts or seeds			3,38	1,21			
	Ham, salami, bacon, meat breakfast, etc.			2,85	1,15			

Remark * $p < 0,05$ (source: authors)

Table 4: Difference in the result of awareness of hormone dependence and snack consumption

	Snack	Levene's Test	p	$\bar{X}$	SD	F	df1 & df2	p
		1,45	0,21			2,00	5,308	0,08
	Fruit or vegetable			3,11	1,40			
	Sandwich or pastry from a bakery			2,75	1,23			

<i>Awareness of hormones</i>	Sweets or salty snacks			3,11	1,40			
	Nothing			2,71	1,01			
	Coffee or juice			3,25	1,45			
	Nuts, seeds or dried fruits			3,46	1,25			

Remark * $p < 0,05$ (source: authors)

Participants also answered four questions related to some aspects related to hormones and diet. One of the questions was what they think is the way we can most influence the improvement, i.e., the establishment of hormonal balance. The largest number of participants or 51% answered that it is a proper diet, and only 2.6% believe that hormonal balance is established by taking pills or other forms of hormones, which confirms the last hypothesis H3 which stated that most participants are aware that proper nutrition is the best way for establishing hormonal balance. As a continuation of the question, the participants were asked: "Which is the most dominant disorder or disease caused by long-term hormonal imbalance and improper diet", to which 42% of the participants believe that all diseases occur due to hormonal imbalance and malnutrition.

It is also known that polycystic ovary syndrome (PCOS) is the most common endocrinological disorder in women of reproductive age. It is associated with excessive secretion of male sex hormones and high levels of insulin. Participants were asked how they think it is best to control PCOS. The highest percentage of 43.6% believe that it is best to control a diet with a low glycemic index, while 36.8% believe that PCOS is controlled with birth control pills.

Regarding the current health situation of the participants, we get an insight into some of the symptoms of hormonal imbalance, with 15.3% saying that they noticed a sudden drop in energy and frequent fatigue in the last six months as one of the most dominant symptoms while the rarest symptoms include weight gain in the waist and hot flashes and attack only 1%. Other offered answers (16) provided insight into the average value of responses related to severe PMS, irregular cycles, acne and facial hair, and indigestion and bloating, which supports scientific and clinical evidence of hormonal imbalance in women.

Collected information on the use of hormones for contraceptive or therapeutic purposes showed that 85% of participants answered that they do not use hormones for any purpose, i.e., the use of hormones as contraception

is present in 15.6%, while for therapeutic purposes it is present in 14.9% of participants.

To the last question of what is the physical activity of the participants, i.e., what does it specifically refer to, 43% answered that they do not engage in any form of physical activity, although they are aware that they should. 8% of participants are engaged in recreational running, cycling, walking or hiking, while 5.9% of participants are engaged in active sports or hobbies. Research shows that the prevalence of insufficient activity in Croatia is very similar to that on a global level, to which is added the fact that almost 60% of Croatians do not include exercise at all, and the fact that as many as 92% of girls in Croatia are inactive which greatly affects the current but also later health status, and the only logical solution is a strategy to improve physical activity.(Jurakić&Hajmer, 2012)

CONCLUSION

As women are particularly sensitive to hormonal changes and their body weight tends to vary, a questionnaire "Women's awareness of the relationship between diet and hormonal status" was created with the aim of collecting data on women's understanding of the impact of hormones on the body, eating habits and attitudes about the dietary impact on the appropriate work of hormones.

As a conclusion related to the survey research we state:

- **The first hypothesis H1 is confirmed**, which states that the participants were not sufficiently informed, i.e., they were only partially informed, because of the six questions the participants gave the correct answer to only three questions, while the other three were answered incorrectly;
- **Hypothesis H2 was confirmed**, which stated that the knowledge about hormones in this research did not depend on the age of the participants;
- Given that no statistically significant difference in hormone information was obtained between older and younger participants and that all show the same level of knowledge, **hypothesis H2a was confirmed** that knowledge about hormones in this study did not depend on the age of the participant;
- There is a statistically significant difference in hormone awareness among respondents depending on their eating habits, those participants who choose a healthier breakfast and snacks are better informed about hormones, which **confirms hypothesis H2b**, i.e., no statistically significant difference in hormone awareness and choice of snacks is shown whereby the second hypothesis is only partially confirmed, only for choosing breakfast;

- **Hypothesis H3** was confirmed since most participants are aware that proper nutrition is the best way to restore hormonal balance

In order to be able to balance our hormones and contribute to our health, it is necessary to know, i.e., have basic information about the functioning of hormones and know some basic guidelines for proper and balanced nutrition. We hope that the obtained data will encourage women to think about this topic to contribute to a better understanding of the relationship between proper nutrition and hormones, and ultimately improve their health.

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