THE INFLUENCE OF CERTAIN LEADING FACTORS ON THE DEVELOPMENT OF INSULIN RESISTANCE AND PROPOSED DIETARY MODELS AS NUTRITION THERAPY

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Abstract: People's way of life is being formed under influence of the geographical, ecological, political, cultural and religious environment and it is about the characteristics of the population in certain region, place and time. The health of one's person, the physical, social and mental well - being are under influenced by the lifestyle. The way of living, working and functioning can be a reason for development of a certain conditions called illness of the lifestyle. They include: obesity, heart diseases, diabetes, cancer etc. These illnesses usually develop slowly and if timely intervention is made, through changing the habits that decrease the exposure of potential risk factors, can prevent or delay the beginning of the disease. Main risk factors for development of insulin resistance and diabetes are nutrition and lifestyle habits. On the other hand, they are also main tools that can help in prevention and improvement of the condition.
This research assesses the influence of certain risk factors and quality of the lifestyle in people with insulin resistance that have increased body mass. It is chosen a group of 175 people, from which 103 are women and 73 men, aged above 25 years, and have increased body mass index (BMI) (BMI>25 kg/m^2) and have hyperinsulinemia. A statistically significant difference was determined (p<0,028), between BMI and HOMA-IR. Most of them have a sedentary lifestyle. From the group that is in employment (69 people), the work isn't related to physical activity. Most often, they practice walking as an additional physical activity, once or twice a week, in duration of 30 to 45 minutes. Biggest part of the people in the selected group (118 people), have regular sleep-in duration of one day. Professional support with instructions for a hygienic-diet regimen that would reduce body mass, education for nutrition and changing of lifestyle habits are needed, to achieve timely prevention and decrease of the insulin resistance, and with that to stop or to delay its progression towards diabetes.
Keywords: insulin resistance, HOMA-IR, nutrition, BMI

1. INTRODUCTION

Several factors influence the occurrence of lifestyle diseases. They arise from the interaction between social and ecological problems and certain specific risk behaviors. Bad and irregular nutrition, disordered sleep, sedentary lifestyle and physical inactivity are most common factors that influence on the development of non infective diseases. In the same group are the diseases of the lifestyle. They begin with metabolic changes: overweight body mass, increased blood pressure, hyperglycemia and dyslipidemia, which lead to the appearance of the metabolic syndrome. Increasment of the body mass and adipose tissue are related to the risk of hyperinsulinemia, decreased sensitivity to insulin and metabolic disorders through increase in inflammatory cytokines, decreasing insulin sensitivity, inappropriate effect on the composition and weight gain (Eaton & Eaton, 2017; DiMenna et al. 2018). Environmental factors and hereditary factors can cause hypersecretion of insulin and according Thomas et al. (2019) reducing these burdens prevent or improve the condition. Reducing insulin when hungry, using a carbohydrate-restricted, calorie-restricted nutrition, improves insulin sensitivity and may lead to remission of type 2 diabetes (Sutton et al. 2018).
Nutritional therapies are becoming popular for the treatment of patients with diabetes. Balanced diet where all the important nutrition components are represented contributes to prevention or delay of insulin resistance and diabetes. In R.N. Macedonia in 2019 year, are registered 5378 newly diagnosed people. To most of the them (52.67%), was recommended oral therapy with medicines whilst change in the nutrition received (33.44%) of them (Memeti et al. 2020).
In this research, some of the lifestyle habits are analyzed, which are leading factors for the development of insulin resistance, the quality of life of people with hyperinsulinemia and the influence of increased body mass on the level of HOMA-IR, in respondents in Republic of North Macedonia. Also, a brief review of dietary model that provide positive health effects in people with insulin resistance will be made.

2. MATERIALS AND METHODS

The data for analysis were obtained from subjective statements, through surveying with a questionnaire. Given criteria for age above 25 years, increased body mass with BMI>25kg/m^2 and ascertained condition of hyperinsulinemia have fulfilled the 175 people and the same were included in the testing. From them, 71 are men, and 104 are women. It is calculated BMI according the formula, body mass ration (kg) and body height on square. It is calculated the level of insulin resistance with help of the HOMA-IR tools, obtained as a quotient from the product of the value of glycemia and insulinemia, with the value 22.5. The analysis is done in the program software Python, version 3.4. The Person's X^2 quadratic test of independence was used in hypothesis testing.

3. RESULTS

The results of the research are clearly and concisely presented in the next section and the statistical significance is commented on.

3.1 Demographic

Total respondents are 175 people, from which 104 women and 71 men, are aged from 25 to 75 years. The female respondents have an average age of 34,33 ± 12,66 year, and men from 47,06 ± 11,00 year. The average height from 163,48 ± 6,69 cm and BMI from 32,21 ± 3,57 kg/m^2, have the female respondents, and 172,26 ± 7,24 cm and BMI 33,02 ± 3,32 kg/m^2, are male. According the professional status, employed are 137 respondents, 20 are retired, 14 unemployed and 4 are students.

3.2 Body mass index (BMI)

The distribution of BMI according to gender and age by age groups is shown in table 1.

Table 1. BMI according to gender and age

Gender	Age (years)	Obesity ≥ 25 (kg/m^2) - < 30 (kg/m^2)	Obesity type I ≥ 30 (kg/m^2) - < 35 (kg/m^2)	Obesity type II ≥ 35 (kg/m^2) - < 40 (kg/m^2)	Obesity type III ≥ 40 (kg/m^2)
Men	25-40	2	17	3	1
	41-55	9	17	6	1
	56-75	5	9	0	1
	Total	**16**	**43**	**9**	**3**
Women	25-40	9	21	7	2
	41-55	17	19	8	0
	56-75	4	11	5	1
	Total	**30**	**51**	**20**	**3**
Total		**46**	**94**	**29**	**6**

3.3 Level of insulin resistance

The determination of the level of insulin resistance was achieved using the HOMA-IR tool. The middle value of glycemia when hungry in the respondents is 6,16 ± 0,48 mmol/L, whilst to middle value of insulinemia when hungry is 18,98 ± 4,76 mIU/L.

Middle value of HOMA-IR in respondents is 5,21 ± 1,44. HOMA-IR values are divided in three levels: low level of IR for values <2,6, moderate level of IR for value of the index from 2,6 to 3,8 and high level of IR for the value of the index >3,8. With high level of IR are 130 respondents and they are the largest part, middle value or moderate value of IR have 44 respondents and low level of IR has only one person.

3.3.1 Dependence between BMI and HOMA-IR

Determination of the dependence between BMI and HOMA–IR, are made with setting a null hypothesis, where HOMA–IR and BMI are independently variable, against the alternative hypothesis, where HOMA–IR and BMI are dependable variables (Figure 1).

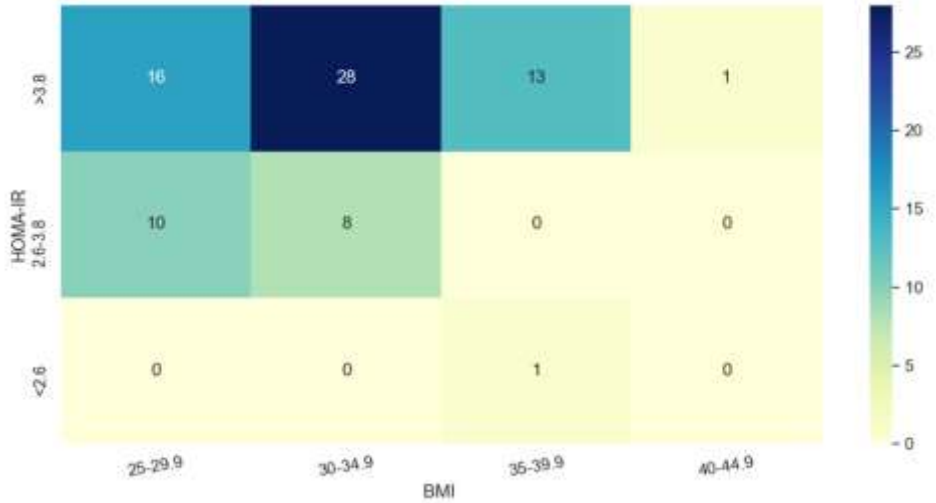
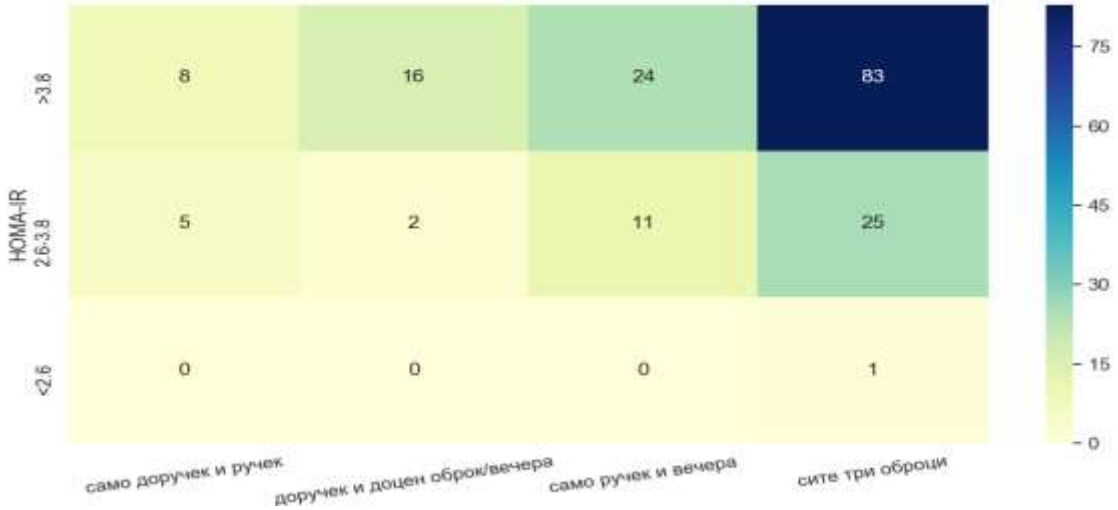


Figure 1. Dependence between BMI and HOMA-IR

In statistical processing we obtained that X^2 test of independence is 7.148747938222, with a degree of variation 2, α=0,05, and p-value is 0.028032969. The obtained *p*-value is lower in comparison to the level of significance α=0,05, that's why we conclude that the both indexes are dependable and we reject the null hypothesis. This analysis proves that the HOMA-IR index depends on BMI, that is, the increased body mass index of the subjects is a factor for an increased HOMA-IR index.

3.4 Number of meals in one day

The number of meals that people with insulin resistance have is important in maintaining glycemic control, because they allow the distribution of carbohydrates and calories during the day. We analyze the representation of the three main meals: breakfast, lunch and dinner. In addition, options are offered in which one of the main meals is absent (Figure 2).



Figire 2. Dependence between the number of meals and HOMA-IR

Figire 2, shows an almost identical distribution in the different groups of division according to the degree of HOMA-IR index. There is no statistical dependence between the number of meals during the day and the HOMA-IR index. Most of the respondents have regular, three main meals or breakfast is mostly missing.

3.5 Number of snack during one day

Except the number of main meals, we analyze the number of snacks that they have in between the meals (Figure 3).

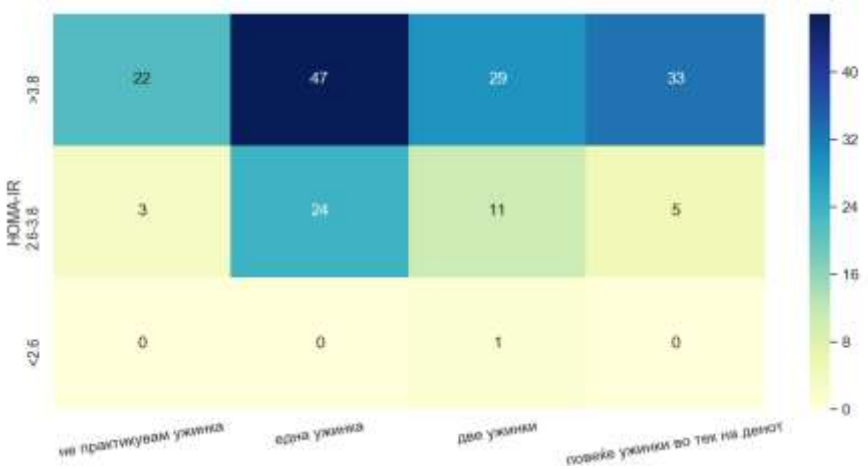


Figure 3. Dependence between the number of snacks and HOMA-IR

From figure 3, it can be noticed that the number of snacks during the day is different in the division groups according to the HOMA-IR index. The respondents that have more snacks during the day, have also higher value of HOMA-IR index.

3.5.1 Dependence between the number of snacks with HOMA-IR

Determining the dependence between the number of snacks and HOMA-IR, we do according the set null hypothesis, in which HOMA-IR and the number of snacks are independent variables, against the alternative hypothesis, in which HOMA-IR depends on the number of snacks during the day.

In the statistical processing, we obtained that in the X^2 test of independence it is 8.21872205473, with level of variable 3 and α=0.05, the p-value is 0.041701179. The obtained p-value is lower compared to the significance level α=0.05. We conclude that the both indexes are dependent and we rejected the null hypothesis. This analysis proves that the HOMA-IR index depends on the number of snacks, that is, a greater number of snacks between meals is a factor for an increased HOMA-IR index.

3.6 Physical activity

In order to determine the active time with physical activity, among the respondents who are employed, the relationship between work and physical activity was analyzed, while the additional physical activity practiced by all respondents was determined. The employed respondents, for the most part or 69 people, have a job that is not related to physical activity, 51 people have a job with a low intensity of physical activity, 16 have work duties related to a moderate intensity of physical activity, and 4 people have work obligations with a high intensity of physical activity.

The analysis of the additional physical activity, in all respondents, showed that the most expressed duration of the additional physical activity is from 30 to 45 min. which is the case with 88 of the respondents, 42 of them have physical activity with a duration of 45 to 65 minutes, while physical activity longer than 60 minutes is practiced by 20 of them. The recommendations for the practice of physical activity indicate that the minimum duration of moderate physical activity should be 150 minutes of exercise per week, while for exercises with a higher intensity of 90 minutes per week or more. 11 of the respondents declared that they practice physical activity with a duration of less than 30 minutes and they are not satisfied with the recommended weekly duration of physical activity, as well as 14 people who do not practice physical activity at all. The most numerous respondents are those who set aside time for additional physical activity once or twice a week or 73 people. With a frequency of three to five times a week, 43 people practice exercises, and 16 do it daily. 29 people from the respondents, who practice physical activity sometimes, have an unsatisfactory duration of the weekly recommended additional physical activity.

In the group of respondents who have time for additional physical activity, 77 people usually favor walking, 33 people choose cycling or swimming, 23 people practice exercising at home, and 16 people visit a fitness center, aerobics or Pilates.

According to the set null hypothesis, that the frequency of physical activity during a week will not depend on the gender of the respondents, with the statistical processing we get that the X^2 test of independence is 6.00459254891, with level of variable 4, α=0.05, and the p-value is 0.19880556157. The resulting p-value is greater than the significance level α. We conclude that the regularity of the respondents, physical activity does not depend on their gender.

3.7 Duration of sleep

To get a clearer picture of the respondents lifestyle habits, we also analyzed the sleep duration. Most of the total of 118 people examined, have regular sleep during one day and night with a duration of 6 to 8 hours, 28 of them sleep from 8 to 10 hours, and 29 sleep between 4 and 6 hours.

From the obtained results and the availability of the professional literature in this area, in the next part we will give an overview of the diet models that showed an improvement in the condition or contributed to reducing the occurrence of hyperinsulinemia and development towards diabetes.

4. MODELS OF DIET

Several nutrition patterns have been adopted that have been shown to improve glycemic control. These are the low-fat diet, the low-carbs diet, the Mediterranean diet, the vegan diet, and the vegetarian diet.

Reducing the proportion of fat in the nutrition is the most common practice in reducing body mass. In this diet, fats are represented by 20-35% of the total energy intake, proteins by 10-35% and carbohydrates by 45-65%. The main sources of carbohydrates and vegetable fibers are: fruits, vegetables and whole grains. Vegetable oils (with the exception of coconut and palm oils) are favored as healthy sources of oils. Fewer animal foods, low-fat dairy products (fat-free or low-fat), or plant-based protein sources are recommended (McGuire, 2011).

Although there are many variations of the Mediterranean diet, the term generally defines a diet that includes a high amount of monounsaturated fatty acids (MUFA), mostly from olive oil. It includes an abundance of plant foods (fruits, vegetables, breads and other forms of cereals, legumes, nuts and seeds). Seasonally fresh and locally grown food, which is minimally thermally processed. Concentrated sugars and honey are consumed periodically, olive oil as the main source of lipids, dairy products (cheese and yogurt) are consumed in small to moderate amounts, less than 4 eggs per week, red meat is consumed in small amounts and periodically, wine in small amounts to moderate amounts generally with meals (Evert et al. 2013). The Mediterranean diet model is favored in people with diabetes because it has been noted to help reduce glucose when hungry. It provides a feeling of satiety, which helps prevent overeating and allows this pattern to be applied over a long period of time (Noah & Truswell, 2001). Diet model with limited or minimal intake of carbohydrates, in which the amount of allowed carbohydrates can range from 12 to 40% of the total daily energy intake. It focuses on foods rich in animal and vegetable proteins and fats up to about 75% of the daily energy content (Shai et al. 2008).

Vegan and vegetarian diet in people with type 2 diabetes have been shown not to improve glycemic control or CVD risk factors. During the implementation of these regimes, a decrease in body mass was observed due to the reduced caloric intake. Further research is needed to assess the quality of vegan and vegetarian diet, as studies to date often focus on what is not consumed rather than what is consumed through the nutrition (Evert et al. 2013).

The „DASH“ model (Dietary approaches to stop hypertension), it is initially intended for prevention of hypertension, control of the blood pressure, and lowering the risk of CVD. However, due to its overall health benefits, it is often recommended as a healthy nutrition for the general population as well. The emphasis is on the consumption of fruits, vegetables and low-fat dairy products, whole grains, poultry, fish and nuts, reduced intake of saturated fat, red meat, sweets and drinks containing sugar. Additionally, sodium intake in the nutrition is controlled in this model (Blumenthal et al. 2010). With people with diabetes type 2, with application of DASH nutrition, that includes limited sodium intake of 2,300 mg per day it is noticed improvement of the hemoglobin values A_1C, normalization of blood pressure and other cardiovascular risk factors (Azadbakht et al. 2011).

5. CONCLUSION

Lifestyle and eating habits significantly influence the development and prevention of insulin resistance and type 2 diabetes. Therefore, promotion of healthy eating patterns and leading a healthy lifestyle is the first option in the treatment of hyperinsulinemia. Increased body mass is an indicator that insulin resistance is present, and the HOMA-IR rate also depends on the degree of obesity. Reducing body mass within a normal BMI can significantly improve the condition. Individuals with insulin resistance who have increased body mass are recommended to choose dietary patterns with the potential to reduce insulin resistance. A nutrition rich in carbohydrates leads to increased secretion of insulin. Therefore, nutrition patterns that do not exclude, but rather limit the intake of carbohydrates and favor unprocessed foods based on Mediterranean principles, can provide maximum benefit. The introduction of a hygienic-dietary regime, which implies not only adequate changes in the nutrition and reduction of body mass, but also the practice of regular physical activity, regularity of meals and snacks and regular sleep, can lead to an improvement in the state of health and prevention of development of type 2 diabetes and other chronic diseases.

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