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The influence of the shift work system on dietary factors contributing to the development of cardiovascular disease

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ABSTRACT

Aim. The aim of this study was to assess eating behavior in the groups of women who are working on different, unchanged shifts as well as identifying differences in the consumption of nutrients that may increase the risk of cardiovascular disease.

Material and Methods. The study was carried out among 300 randomly selected women working in a permanent shift (morning, afternoon, night). In the study, the assessment of the daily intake was carried out using 24-h dietary recall. Anthropometric measurements were carried out to assess the nutritional status. The interview regarding the food consumption was complemented by dietary questionnaire about selected lifestyle parameters contributing to the development of cardiovascular disease and the type of their work.

Results. The body mass index (BMI) in all groups was within the adequate values. The analysis of waist to hip ratio (WHR) showed that in the morning and night shift, was exceeded the adequate values recommended in the prevention of cardiovascular disease (WHR = 0.83 ± 0.1 in both groups). The analysis of the daily food rations of women revealed disparities regarding nutritional recommendations. Statistically significant differences in protein and saccharose intake were observed ($p > 0.05$). The average vitamin D content in the daily food rations of women was insufficient (average 1.4 µg per day); however, it was not statistically significant.

Conclusions. The shift work system was influence on eating behaviors in study women. In particular in women which were worked on the night shift, which may contribute to the development of cardiovascular disease in the future.

Keywords: work system; nutritional status; dietary intake; dietary habits; cardiovascular disease; vitamin D.

Introduction

Cardiovascular disease is the most common cause of death in the world and contribute a significant epidemiological issue. Modern lifestyle can create a number of circumstances that aid inappropriate nutrition and inadequate health habits, which may contribute to the development of cardiovascular disease. Fast pace of life, shift work system and the duties related to it result in reduced time to prepare home-cooked meals and favour the consumption of ready-made meals, highly-processed or fast-food products, becoming at the same time one of the most signifi-

cant risk factors for the development of disease of affluence [1, 2]. On the other hand, fashion for slimness among women leads to reduction of the energy value of food rations, which may also contribute to the development of cardiovascular disease [3, 4]. Moreover, inadequate health habits may be caused by the shift work system. An irregular sleep-wake rhythm and the long-term reduction of sleep contribute to a change in metabolism, a decrease in the resting metabolic rate and an increase in the glucose level in blood serum, which may eventually increase occurrence of obesity, diabetes, cardiovascular disease, gastrointestinal disease, sleep disorders or depression, thus leading to the development of the cardiovascular disease [5–9]. Additionally, vitamin D deficiency may occur among people working night shifts due to limited exposure to the sun [10, 11]. Additional factors that may contribute negatively to the development of cardiovascular disease are stress and low physical activity [12, 13].

Aim

The aim of this study was to asses eating behavior in the groups of women who are working on different, unchanged shifts. Simultaneously, comparison the consumption of selected nutrients which may increase the risk of cardiovascular disease.

Material and Methods

The study was carried out among 300 randomly selected women working in a different shift system, from the Wielkopolska Voivodeship aged between 18 and 61 years. The women participating in the study were divided into three groups, depending on their shift time (morning, afternoon, night).

The dietary intake level was assessed through the 24-hour dietary recall method according to the National Institute of Food and Nutrition (NIFN) quidelines [14]. Each woman was instructed on how to fill in the questionnaire for diet assessment. The 24-h dietary recall interviews were carried out individually (face to face) with each participating woman. Album of Photographs of Food Products and Dishes [15] was used to determine the amount of consumed foodstuffs. To analyse the qualitative and quantitative composition of daily food rations, databases prepared in the MS Access 2010 program were applied. The assessment of the nutrition was conducted the Standards of Human Nutrition [16].

The anthropometric measurements (body weight, height, waist and hip circumferences) were measured and use it to estimate nutritional status. The body mass index (BMI) was calculated as weight/height squared (kg/m^2) and waist to hip ratio (WHR) as the proportion of waist to hip circumferences.

The dietary intake was completed by dietary questionnaire about selected lifestyle parameters which may contribute to the development of cardiovascular disease.

The statistical analysis was conducted using the statistical program StatSoft, Inc. (2011) STATISTICA (data analysis software system), version 10. Distribution normality of the study groups was determined use the Shapiro-Wilk test.

Analyzing the differences between variables within three groups (for independent variables), for the normal distribution and equal variances, ANOVA test was used. In the absence of normality, the Kruskal-Wallis test was used. In the data analyses carried out, $\alpha = 0.05$ was assumed as the materiality level.

Results

The anthropometric characteristics of the studied groups of women was presented in **Table 1**.

There were no statistically significant differences between the studied groups in the age, body weight, high and BMI value. It is worth noting that the BMI value in all groups was within the adequate. The analysis of the WHR indicated that in the group of women working in the morning and the night shifts the adequate values were slightly exceeded. In the group of women working in the night shift, the WHR value was correct. The differences between the studied groups were statistically significant.

The analysis of food rations pointed out differences between the studied groups (**Table 1**).

Statistically significant differences between the studied groups were observed only in energy value, protein content and in the percentage of energy

Table 1. Characteristics of the studied groups of women depending on the shift work

	Morning shift (N = 100)		Afternoon shift (N = 100)		Night shift (N = 100)		P-value*
	Mean	SD	Mean	SD	Mean	SD	
Demographies							
Age (year)	33.9	10.5	33.3	10.2	32.3	10.1	0.5066**
Height (cm)	166	6.3	166	6.1	165	11.8	0.2741**
Body weight (kg)	60.5	8.7	57.9	5.5	59.1	8.1	0.1249**
BMI (kg/m^2)	21.9	3.1	21.1	2.1	21.7	2.6	0.1944**
Waist circumference (cm)	70.6	12.0	72.2	9.2	76.0	10.8	0.0012**
Hip circumference (cm)	84.7	13.6	90.6	8.4	91.4	10.0	0.0002**
WHR	0.83	0.1	0.79	0.1	0.83	0.1	0.0009**
Diet							
Energy (kcal)	1485	528	1608	423	1547	394	0.0365**
Protein (g)	60.2	23.1	68.5	17.0	67.9	17.3	0.0004**
Protein (%)	16.4	4.3	17.5	4.0	18.0	4.1	0.0124**
Fat (g)	57.8	24.5	62.6	21.5	62.9	22.6	0.1674**
Fat (%)	35.2	10.5	35.4	10.3	36.6	10.4	0.4845**
Carbohydrates (g)	185	79.3	196	79.4	181	67.0	0.4570**
Carbohydrates (%)	49.5	11.2	47.9	10.8	46.4	10.8	0.1882**
Cholesterol (mg)	369	260	331	203	369	260	0.4493*
Dietary fiber (g)	12.8	6.9	12.9	6.2	13.5	6.6	0.7538*
Saccharose (%)	11.1	7.9	10.3	6.2	8.72	5.6	0.0348*
Vitamin D (µg)	1.1	1.7	1.4	1.5	1.7	0.9	0,2525*

* ANOVA test
** Kruskal-Wallis test
SD — standard deviation, P — ns – not significant, BMI — Body mass index, WHR — waist to hip ratio

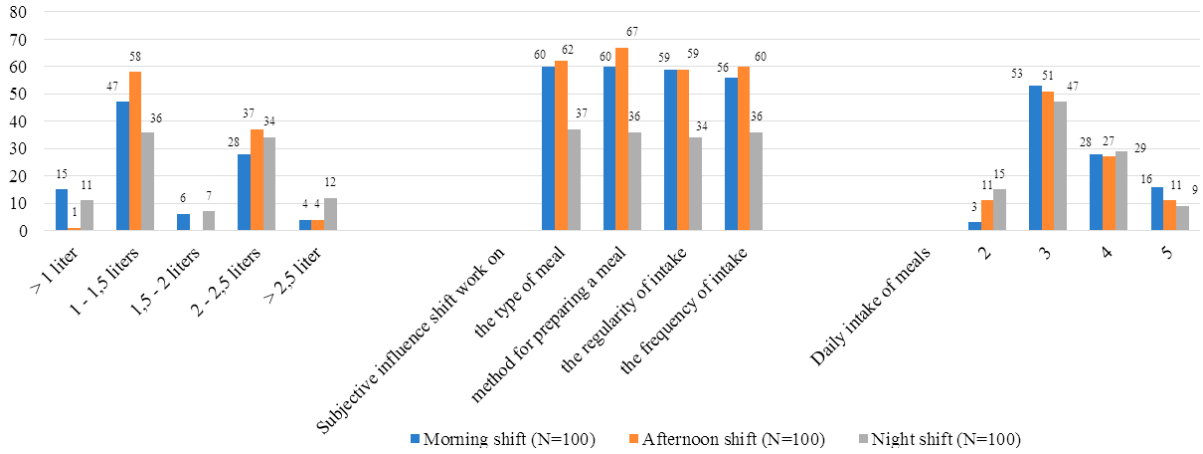

Figure 1. Selected dietary habits of the studied groups of women depending on the shift work

from saccharose. The estimate energy requirement in the all studied groups was insufficient — the average energy value for this group of women should be around 2000 kcal per day. While assessing the percentage of energy derived from saccharose, some insignificant excess of the recommended values was stated in the morning and night shifts. In the third group, this value was correct.

The analysis of energy from fat showed, that in all studied groups, it exceeded the adequate values. Similar results were obtained in the case of the dietary cholesterol content in the food rations, which in all groups exceeded 300 mg per day. The next analysed parameter was the dietary fiber content. It was revealed that the average content of this component was insufficient in all studied groups, and did not exceed 52% of adequate intake. The average vitamin D content in the studied groups was only 9.5% of adequate intake.

Discussion

The diet plays a significant role in the maintaining health. It can also contribute to the development of cardiovascular disease by influence on many factors such as: blood pressure, anthropometric parameters and lipid profile parameters. It is widely known that shift work affecting the nutrition [17–21]. However, there is still a lack of information about what differences in the nutrition in different shift work and how these differences influence on the risk of cardiovascular disease.

The analysis of the selected anthropometric parameters showed that the BMI value in the studied groups was within the adequate values; however, the highest values of this parameter were stated in the group of the morning and night shifts. It can increase the risk of development of cardiovascular disease in these groups of women. It is also confirmed by research carried out by other authors, which indicated that night shift work correspondents to an increase in body mass and an occurrence of higher BMI values [21–25]. A similar relationship was stated in the case of the WHR, which may prove that people working the morning and night shifts have an increased tendency toward an excessive body mass [22, 23].

According to the American Heart Association guidelines, inadequate nutritional habits may contribute to the development of cardiovascular disease. An increase in the fat intake in the diet, in particular of saturated fatty acids, increased the content of energy from saccharose, decreased the content of fibre or increased dietary cholesterol content and inappropriate content of vitamins and minerals may significantly increase the risk of development of cardiovascular disease [26].

In this studied, there were statistically significant differences between the groups regarding specific parameters of diet assessment. The analysis of the intake level among the groups of women taking part in this studied showed statistically significant differences between energy intake as well as in the protein and saccharose content. The daily food rations did not provide sufficient energy intake. In the morning and night shifts, these values were slightly higher than the Basal Metabolic Rates, which may result from lack of time for preparing and eating meals during the day (frequent meals, but with low energy value). It cannot be ruled out that the participants undervalued the declared levels. According to the most recent dietary guidelines, the demand for energy among women, taking into account low physical activity level, should reach from 1650 to 2350 kcal per day [16]. Low energy value of the daily food rations as compared to anthropometric values may indicate frequent changes in the diet, which may increase the risk of cardiovascular disease.

The analysis of protein intake and the indicated statistically significant differences between the groups may suggest that female night shift workers consumed so-called 'comfort foods' such as yogurt, cream cheese, kefir, quark, and meat, which are rich in protein more frequently in comparison to the other groups. Further analysis indicated that the highest percentage of energy derived from saccharose, with the adequate value reaching up to 10% of the energy value of the diet, was observed in the morning and night shifts [16]. The daily food rations of these groups were abundant in sweet snacks such as candy bars, cookies, and chocolate, which are the primary sources of saccharose. Moreover, an increased saccharose content could be the reason for a higher WHR values in these groups. Nevertheless, Assis et al. studied presents different results. In this research night shift workers consumed more saccharose as compared to the people working the morning shift, which was due to more frequent consumption of sweets [17]. The differences in the obtained results may be triggered by the diversity of cultural and nutritional habits.

The observed low intake of fiber and excessive intake of dietary cholesterol in all studied group may significantly increase the risk of the cardiovascular disease in the future.

According to the current literature, vitamin D plays a significant role in the prevention of cardiovascular disease. The research results conducted over the last few years reveal an increased risk of the occurrence of vitamin D deficiency among people doing shift work. That applies particularly to the people working the night shift. Therefore, the studied also takes into consideration the assessment of the consumption of vitamin D in the daily food rations. [10, 27]. The vitamin D intake within the diet should reach 15 µg per day, and in the case of women participating in the studied, it constituted about 10% of the demand [16]. However, it should be noted that the

primary source of vitamin D is its production in the skin, and its synthesis depends on exposure to the sun.

Thy analysis of the daily food rations revealed irregularities concerning the intake of specific nutrients within all the examined groups of women. In the group of night shift workers, the daily food rations were characterized by the percentage of energy derived from protein, fats, and carbohydrates that came closest to the standard; however, the percentage of saccharose was the highest in this group. This group had the highest number of meals during a day as compared to the others and consumed the lowest number of fluids. The results comply with the research of other authors. Reeves et al. underline in their research the difference between the number of consumed meals between the groups — the morning group had more meals during a day. What is more, a statistically significant difference in fluid (beverages containing caffeine) intake was observed in the group of women working the night shift [20]. Based on the analysis it was stated that in the case of night shift participants, the content of specific energy components and nutrients was the most deviated from the standard and was characterized by the highest percentage of energy derived from protein and fats and rich in dietary cholesterol. This group had the lowest number of meals per day as compared to the other groups and relatively large amounts of liquids, including a high intake of caffeine-rich beverages. Similar results were obtained in Love et al. [28].

Summing up the obtained results of the studied it should be noted that the shift work system has an impact on eating behaviors among the examined group of women. The impact of the shift work system is particularly visible in the case of night shift, which favours inadequate dietary habits, and its long-term effects may contribute to the occurrence of nutrient deficiency and may aid obesity, arterial hypertension and development of cardiovascular disease.

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Conflict of interest statement
The authors declare no conflict of interest.

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