

Investigating the Types of Eating Behavior among Shift Workers in the Machine-Building Industry

Margarita A. Todorova¹, Antoniya H. Yaneva², Desislava R. Bakova³, Stanislava N. Harizanova¹

¹ Department of Hygiene, Faculty of Public Health, Medical University of Plovdiv, Plovdiv, Bulgaria

² Department of Medical Informatics, Biostatistics and E-Learning, Faculty of Public Health, Medical University of Plovdiv, Plovdiv, Bulgaria

³ Department of Healthcare Management, Faculty of Public Health, Medical University of Plovdiv, Plovdiv, Bulgaria

Corresponding author: Margarita A. Todorova, Department of Hygiene, Faculty of Public Health, Medical University of Plovdiv, 15A Vassil Aprilov Blvd., 4002 Plovdiv, Bulgaria; Email: todoroff.md@gmail.com; Tel.: 0888 515 595

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Abstract

Introduction: Shift work has become the norm and an absolute necessity in various sectors of public life. Different production processes, technologies, and the nature of certain jobs lead to various health risks. Unhealthy eating behaviors remain common among shift workers across all economic sectors.

Aim: This study aims to compare the eating habits and dietary patterns of shift workers and fixed daytime workers in the Bulgarian machine-building industry, focusing on identifying differences that may influence health outcomes.

Materials and methods: A cross-sectional study was conducted at three work sites of a machine-building enterprise in Bulgaria, involving 309 workers (149 shift workers and 160 fixed daytime workers). Data on eating habits were collected using a 54-item Food Frequency Questionnaire (54-FFQ) adapted for the local population. Descriptive statistics were used to summarize the demographic and dietary data. Group comparisons between shift workers and fixed daytime workers were made using the Mann-Whitney U test for non-normally distributed continuous variables. A p-value of less than 0.05 was considered statistically significant.

Results: The study found significant differences in eating habits between shift workers and fixed daytime workers. Shift workers were more likely to consume white bread ($p=0.003$), fast food ($p=0.045$), margarine ($p=0.001$), fried potatoes ($p=0.041$), and processed meats ($p=0.021$) than fixed-daytime workers were. In contrast, fixed-daytime workers had a higher consumption of fruits ($p=0.034$), vegetables ($p=0.047$), and alcoholic beverages like beer ($p=0.008$), wine, and spirits ($p=0.005$) than shift workers. These differences suggest that work schedules may significantly influence dietary choices and impact workers' health outcomes.

Conclusion: Shift work disrupts the natural daily rhythm and leads to changes in eating behavior, such as irregular meals, skipping breakfast, and eating late in the evening and at night. Our study highlights how these behaviors are associated with the regular consumption of processed, energy-dense foods rich in carbohydrates and fats but low in fiber and essential nutrients. The eating habits observed in our research are a significant risk factor for developing cardiometabolic diseases.

Keywords

dietary patterns, health promotion, nighttime eating, public health, shift work

INTRODUCTION

With the rapid growth of industrialization and urbanization, shift work has become a necessary and widely accepted standard globally, especially in sectors such as healthcare, public safety, transportation, machine-building, and other industries that require 24-hour production and service.^[1] According to EUROSTAT data from 2023, about 19% of the workforce in Europe is engaged in shift work. In 2021, approximately 19.8% of the workforce in Bulgaria worked in shifts, representing a significant portion of the country's total employment. So far, there has been no universally accepted definition and characterization of shift work by health and labor organizations at both national and international levels. Scientific literature often uses the term "non-standard work schedule," which refers to work outside the standard daytime hours of 7-8 a.m. to 5-6 p.m.^[2] This includes afternoon, evening, night, or early morning work, with schedules that can be either permanent or rotating.^[3] Employees who work on weekends are also considered shift workers, as they work outside standard weekday hours.^[4] It is important to note that shift workers work at night or on weekends as part of their regular schedule, not as overtime. Therefore, shift work should be distinguished from overtime work. A significant portion of the adult population spends about one-third of their day at work, where their health is constantly affected by the work environment. Unhealthy eating habits are common among shift workers in all industries.^[5] Shift workers often exhibit eating behaviors characterized by irregular meals and frequently skipping one of the main meals in the cycle of breakfast, lunch, or dinner.^[6] Eating late in the evening and at night is common, as is the frequent consumption of unhealthy foods such as chips, snacks, wafers, sweets, sugary drinks, and energy drinks.^[7] Unhealthy eating among employees with non-standard work schedules is linked to the presence of vending machines at work, which provide quick and easy access to inadequate and processed yet hunger-satisfying foods and drinks.^[8] Additionally, the lack of proper meal facilities, such as a cafeteria or dining area, is common, especially during night shifts. In these conditions, workers have limited access to healthy food options, which makes proper nutrition more challenging.^[9] This often leads to the regular consumption of processed foods high in carbohydrates, saturated fats, and trans fats.^[7] As a result, their diet is typically low in fiber, essential vitamins, minerals, antioxidants, and polyunsaturated fatty acids (PUFAs).^[10,11] Shift workers are also prone to increased alcohol consumption, often using it as a sleep aid and in some industries, alcohol use is promoted as a way to socialize and relieve stress after shifts.^[12]

Shift work increases the risk of obesity, type 2 diabetes (T2D), and cardiovascular diseases (CVD), likely due to the mismatch between work schedules and typical patterns of work and rest in society.^[13] When sleep, eating, and rest schedules do not align with human chronobiology, it leads to chronic disruptions in circadian rhythms, which are of-

ten the primary cause of these health risks.^[14] Poor eating habits, combined with other common factors among shift workers (such as disrupted circadian rhythms, irregular work and rest schedules, reduced sleep, psychosocial stress, and low physical activity), disrupt metabolic balance and increase the risk of developing cardiometabolic diseases, including CVD, T2D, and metabolic syndrome (MetS).^[15,16] Studies have shown that shift work is associated with a higher incidence of depressive and psychosomatic symptoms among employees.^[17] It is largely attributed to chronic sleep disturbances, which lead to a lower quality of life, disrupted social life, increased tension, depressive moods, high levels of anxiety, and a higher likelihood of abusing alcohol and medications.^[18] This pattern can also worsen the nutritional status and eating habits of shift workers.

AIM

The goal of the study is to analyze and compare the dietary habits of shift workers and fixed-daytime workers in the Bulgarian machine-building industry. Specifically, it aims to identify significant differences in the frequency and types of foods consumed, with a focus on understanding the influence of shift working on eating habits. Through this comparison, the study goal is to uncover key differences that could have impact on the health and well-being of the shift workers.

MATERIALS AND METHODS

The cross-sectional study was conducted within three work sites of a machine-building enterprise, located in Sopot, Kalofer, and Karnare. A total of 309 workers, both on shift and fixed daytime schedules, participated. The 54-FFQ questionnaire was used to comprehensively assess lifestyle, eating habits, and the frequency of food intake among the workers. The questionnaire is an adapted version of the validated KomPAN^[19] and 72-item SQ-FFQ^[20] questionnaires. The KomPAN (Dietary Habits and Nutrition Beliefs Questionnaire) is designed for individuals aged 15-65 and is available in two formats: one administered by an interviewer and the other self-administered. It assesses dietary habits, frequency of food consumption, nutrition beliefs, lifestyle, and personal data. 72-Item Semi-Quantitative Food Frequency Questionnaire (72-Item SQ-FFQ) is designed to assess the habitual dietary intake of adults by evaluating the frequency of consumption of 72 food items over the past year, providing a comprehensive assessment of energy and nutrient intake. The adaptation process, carried out by the research team, considered local dietary habits and national dietary characteristics. The original list of 72 food items from the Kowalkowska and Lidia Wadolowska questionnaire was reduced to 54 items, removing products that were uncommon or unfamiliar to the Bulgarian population. Additionally, specific types of fruits and vegetables

were consolidated into general categories of “fruits” and “vegetables.” The questionnaire consists of eight sections: sections 1 through 7 contain questions related to lifestyle, while section 8 (54 questions) provides a detailed list of the food intake frequency. This section includes various categories such as sugary products, dairy products, meat, cereals, fruits, vegetables, fats and oils, snacks, and beverages. For each food item, participants indicated their frequency of consumption, ranging from “never or rarely”, “once a month or less”, “several times a month”, “several times a week”, “once a day” to “several times a day”.

Statistical analysis

Statistical analysis was performed using SPSS for Windows v. 22. Descriptive characteristics of quantitative variables were presented as mean \pm SE (arithmetic mean \pm standard error of the mean) and SD (standard deviation), while categorical variables were expressed as absolute and relative frequencies (N, %). The Mann-Whitney U test was used to compare two independent groups for non-normally distributed parameters. The association between categorical variables was assessed using Fisher’s exact test for 2x2 tables and the chi-square test (χ^2) for larger tables. A p-value of less than 0.05 was considered statistically significant. Microsoft Excel 2016 was used for the graphical presentation of the results.

RESULTS

The study involved 309 workers, with 160 (51.80%) on fixed daytime schedules and 149 (48.20%) on shift schedules. Demographic details of the respondents are shown in **Table 1**.

The average age of the participants is 44.76 ± 0.66 , $SD=11.57$ (**Table 2**).

The average total years of employment for participants is 22.51 ± 0.66 years ($SD=11.65$) and the average number of years in their current job is 12.74 ± 0.59 years ($SD=10.34$). In assessing participants’ eating habits over the past four weeks, we found that 247 (79.9%) of them did not limit their calorie intake, and 245 (79.3%) did not restrict their salt consumption. Among shift workers, 78.5% did not limit their calorie intake, and 79.9% did not restrict their salt consumption. There were no statistically significant differences between the two groups regarding these dietary practices or in adherence to restrictive diets over the past four weeks (**Table 3**).

Table 1. Characteristics of participant, N=309

Characteristics	Mean \pm SE N (%)
Sex	
Male	82 (26.5%)
Female	227 (73.5%)
Age	44.76 \pm 0.66
Years of experience in current job	12.74 \pm 0.59
Education	
Primary	1 (0.3%)
Secondary	15 (4.9%)
High school	105 (34.0%)
Vocational secondary	97 (31.4%)
Professional bachelor	4 (1.3%)
Bachelor’s degree	29 (9.4%)
Master’s degree	58 (18.8%)
Marital status	
Married	169 (54.7%)
Single	52 (16.8%)
Divorced	15 (4.9%)
Separated	2 (0.6%)
Widowed	17 (5.5%)
In a partnership	54 (17.5%)
Tobacco use	
Smoker	171 (55.3%)
Non-smoker	138 (44.7%)
Income	
Below the average for Bulgaria	160 (51.8%)
At the average for Bulgaria	135 (43.7%)
Above the average level for Bulgaria	14 (4.5%)

Regarding the three main meals (breakfast, lunch, and dinner), 64.7% of participants reported not following a regular meal schedule. There were no significant differences between the two groups in adherence to these meals ($\chi^2=0.719$, $df=1$, $p=0.407$) or in the consumption of foods between meals ($\chi^2=6.752$, $df=4$, $p=0.150$). However, when analyzing the frequency of nighttime eating, significant differences were found between the two groups ($\chi^2=27.887$, $df=2$, $p<0.001$) (**Fig. 1**).

Table 2. Distribution of participants by sex and age in shift and fixed daytime schedule groups

Group	Sex	N	Mean \pm SE	SD	Min	Max
Fixed daytime schedule	Male	52	40.69 \pm 1.84	13.28	18.00	68.00
	Female	108	44.07 \pm 1.05	10.88	21.00	63.00
Shift work	Male	30	45.07 \pm 2.45	13.41	25.00	76.00
	Female	119	47.08 \pm 0.96	10.42	21.00	64.00

Table 3. Restriction of calorie and salt intake

	No N (%)	Yes N (%)	χ^2	df	p
Have you restricted your calorie intake over the past four weeks?					
Fixed daytime schedule	130 (81.3%)	30 (18.8%)	0.358	1	0.572
Shift work	117 (78.5%)	32 (21.5%)			
Have you restricted your salt intake over the past four weeks?					
Fixed daytime schedule	126 (78.8%)	34 (21.3%)	0.058	1	0.888
Shift work	119 (79.9%)	30 (20.1%)			
Have you followed a diet over the past four weeks?					
Fixed daytime schedule	144 (90.0%)	16 (10.0%)	0.355	1	0.692
Shift work	137 (91.9%)	12 (8.1%)			

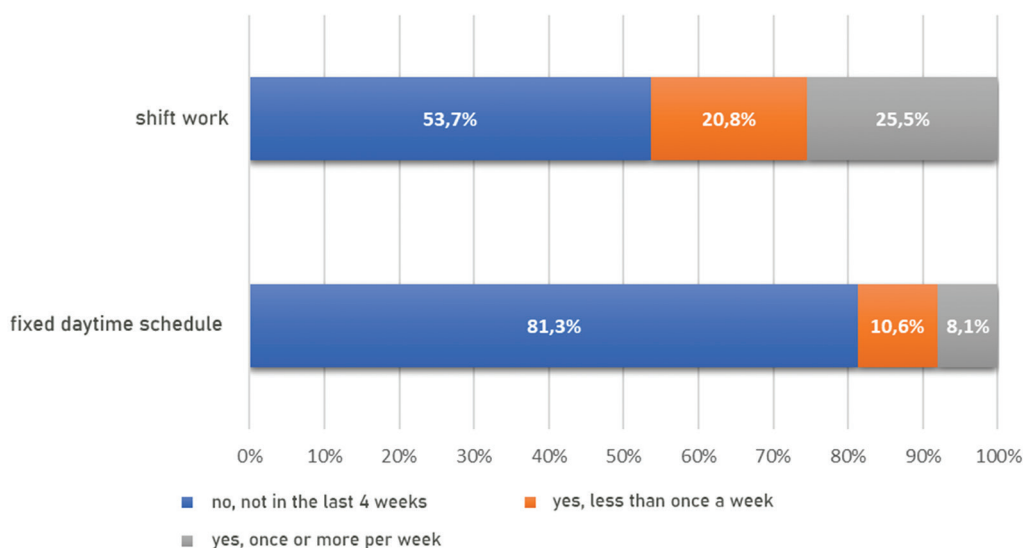


Figure 1. Frequency of nighttime eating in fixed and shift work groups.

In both groups we studied, sugary foods were the most commonly consumed items during nighttime eating, with fruits and vegetables following in frequency (**Fig. 2**)

In the shift work group, the consumption of different food categories was fairly balanced: 34.4% of participants ate fruits and vegetables, 32.3% consumed sugary foods, another 32.3% preferred sandwiches, 21.9% ate snacks like pretzels and crackers, and 10.4% consumed dairy products.

We identified statistically significant differences between the two groups in the types of foods consumed during nighttime eating ($\chi^2=15.639$, $df=6$, $p=0.016$). Those on a fixed daytime schedule were more likely to eat sugary foods at night, whereas shift workers tended to eat sandwiches more frequently during nighttime. Despite these differences, 96.8% of participants reported that they primarily consume cooked meals.

Additionally, to align with the study’s objective, it was

essential to assess the frequency of food intake across various categories of commonly consumed foods and beverages in the Bulgarian population, covering a total of 54 food items. Significant differences between the two groups were observed (**Table 4**). Shift workers exhibited a higher tendency to consume white (wheat) bread ($U=9583.0$, $p=0.003$), fast food ($U=10352.0$, $p=0.045$), margarine ($U=9552.0$, $p=0.001$), fried potatoes and chips ($U=10329.5$, $p=0.041$), and processed meat such as sausages and hot dogs ($U=10182.5$, $p=0.021$) compared to those with fixed daytime schedules. In contrast, those on fixed daytime schedules were more likely to consume fruits ($U=10230.0$, $p=0.034$) and vegetables (excluding potatoes) ($U=10344.0$, $p=0.047$). They also showed a higher preference for drinking beer ($U=9988.0$, $p=0.008$), alcoholic cocktails ($U=8537.5$, $p<0.001$), and spirits ($U=9890.5$, $p=0.005$). Detailed results are presented in **Table 4**.

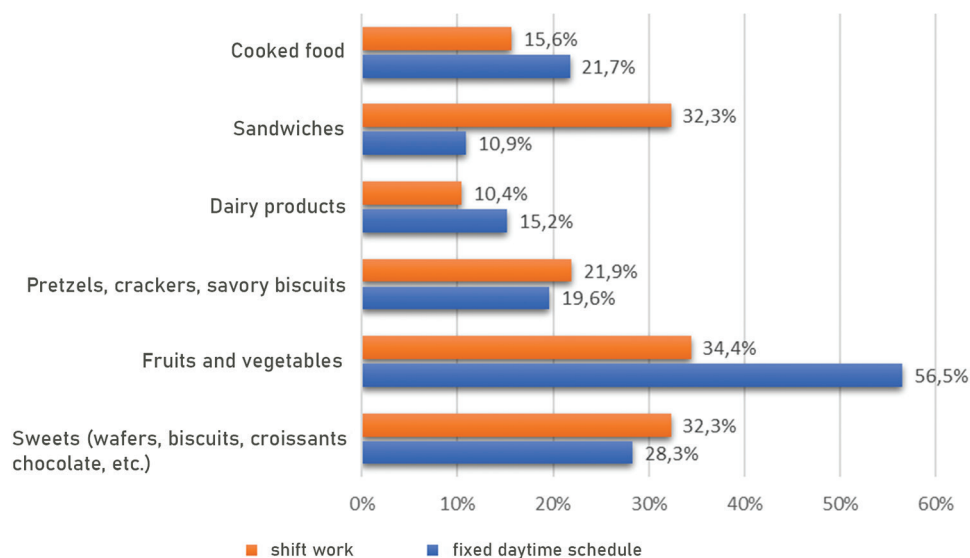


Figure 2. Distribution of food categories consumed during nighttime eating in the study groups.

Table 4. Frequency of food intake among workers on fixed daytime schedule and shift work schedule

Food items and drinks	Work Schedule	N	Mean rank	U	z	p
Ice creams and custards	Fixed daytime schedule	160	145.56			
	Shift work	149	165.14	10409.5	-2.009	0.045
White (wheat) bread	Fixed daytime schedule	160	140.39			
	Shift work	148	169.75	9583.0	-2.956	0.003
Fast food	Fixed daytime schedule	160	145.20			
	Shift work	148	164.55	10352.0	-2.007	0.045
Margarine	Fixed daytime schedule	160	140.20			
	Shift work	148	169.96	9552.0	-3.387	0.001
Fruits	Fixed daytime schedule	160	164.56			
	Shift work	148	143.62	10230.0	-2.124	0.034
Vegetables (potatoes excluded)	Fixed daytime schedule	160	163.85			
	Shift work	148	144.39	10344.0	-1.987	0.047
Fried potatoes and chips	Fixed daytime schedule	160	145.06			
	Shift work	148	164.71	10329.5	-2.045	0.041
Hot dogs, sausages, and frankfurters	Fixed daytime schedule	160	144.14			
	Shift work	149	166.66	10182.5	-2.303	0.021
Beer	Fixed daytime schedule	160	167.08			
	Shift work	149	142.03	9988.0	-2.640	0.008
Wine and alcoholic cocktails	Fixed daytime schedule	160	176.14			
	Shift work	149	132.30	8537.5	-4.518	0.001
Spirits	Fixed daytime schedule	160	167.68			
	Shift work	149	141.38	9890.5	-2.833	0.005

DISCUSSION

Shift work and unhealthy nutritional behavior

A key aspect that distinguishes our study from others is that respondents have had access to organized meals and

cooked dishes for each work shift at every site, all aimed at promoting healthy eating habits. Despite these measures, we found a strong association between shift work and unhealthy eating habits. Shift workers often consume more calories and salt, which may heighten their risk of obesity and hypertension.^[21] They frequently eat salty and calorie-dense foods such as fried potatoes, chips, fast food, sausages, hot dogs, margarine and white (wheat) bread,

as supported by similar findings in previous research.^[5] Our study further corroborates these observations, indicating that the dietary patterns of shift workers in the machine-building industry align with these trends. Almost all participants reported not monitoring or limiting their calorie and salt intake, regardless of their shift type. This behavior is particularly worrying due to late-night eating and the high salt and calorie content typical of traditional Bulgarian cuisine.^[22] Several factors may contribute to this lack of control, including challenges in meal planning caused by irregular work schedules, a lack of educational programs on healthy eating for shift workers, and insufficient time and motivation for monitoring dietary intake.

Irregular meal patterns

Regardless of the work shift, most of the workers in the study eat irregularly and do not follow the three main meals in the breakfast-lunch-dinner cycle. Stress and fatigue common in the machine building industry, along with a lack of time for meal preparation, may contribute to missing these key meals. Shift workers eat significantly more frequently at night than those with fixed daytime schedules, which is consistent with recent research findings.^[23,24] Eating at night is linked to a higher risk of developing MetS, insulin resistance, T2D, and obesity.^[25,26]

Consumption of sugary foods

Both groups of participants report that they most frequently consume sugary foods at night. A meta-analysis explains this common behavior among shift workers by the convenience and easy accessibility of packaged sweet products, as well as the presence of vending machines at the workplace.^[8] For those on regular daytime shifts, this tendency may be attributed to the need to alleviate fatigue and stress after the workday, which increases the craving for sweet foods in the evening.^[27] High-calorie foods offer comfort and pleasure during times of psychological stress^[28] and although this finding primarily stems from experiments conducted on mice under chronic stress conditions, it is important to consider that psychological stress experienced by shift workers in the machine-building industry may lead to increased preferences for high-calorie foods as coping mechanism.

Alcohol consumption patterns

In contrast to our findings, some studies have reported that shift work is associated with increased alcohol consumption.^[29] However, in our study workers on a fixed daytime schedule showed a stronger preference for consuming beer, alcoholic cocktails, and spirits compared to their shift-working counterparts. The difference between the two groups can be attributed to several factors: workers on fixed daytime schedules may consume more frequently alcohol in social settings to alleviate stress at the end of

the day shift, while shift workers, due to their irregular and demanding schedules, may have fewer social interactions outside of work thereby reducing opportunities for alcohol consumption. Another factor could be the different coping mechanisms employed by shift workers, who might rely more on other forms of stress relief, such as comfort eating, rather than alcohol. Furthermore, the higher proportion of women in our sample could also influence these findings, as women typically consume less alcohol than men. These factors suggest that the relationship between shift work and alcohol consumption is complex and may vary depending on the specific population and context being studied.

Impact of organized meal services

Despite 96.8% of participants reporting that they mainly eat cooked meals, due to the organized meal service provided for each work shift, there is a clear preference for unhealthy foods at night. Shift workers consume a mix of healthy and unhealthy foods, with a notable tendency towards sugary items, sandwiches, pretzels, and crackers. This pattern is concerning due to the high intake of salt and refined sugar. Despite shift workers consuming healthier options like fruits, vegetables, and dairy products, there is still a need for better education and promotion to encourage greater selection of these foods. Improving awareness and support for making healthier food choices could significantly enhance the overall health of shift workers.

CONCLUSION

This study revealed distinct differences in the eating habits between shift workers and fixed daytime workers. Shift workers were more likely to engage in irregular meal patterns, including skipping breakfast and eating late at night. In contrast with fixed daytime workers, who were found to consume more fruits and vegetables, shift workers exhibit a higher intake of processed, energy-dense foods such as sugary products, fast food, and snacks. The behaviors we observed contribute to a higher intake of carbohydrates and fats, which are linked to increased health risks. On the other hand, despite having a more regular eating schedule, fixed-daytime workers still preferred high-calorie foods, particularly in the evening, along with higher alcohol consumption. Our findings emphasize the need for targeted nutritional interventions for shift workers to address the irregular and unhealthy eating patterns associated with their work schedules. The exact mechanisms by which shift work affects eating behavior remain unclear.^[30] Considering the negative health impacts associated with unhealthy eating patterns during night shifts, employers need to prioritize promoting healthy eating habits among shift workers.^[31] Understanding the dietary profile and eating patterns of shift workers is critical for developing effective nutritional interventions. Specialized programs and recommendations are needed to address specific dietary deficiencies and

risks associated with shift work. Implementing and strictly following these measures could significantly improve the health outcomes of shift workers.

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Competing Interests

The authors have declared that no competing interests exist.

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Исследование типов пищевого поведения у сменных рабочих машиностроительной отрасли

Маргарита А. Тодорова¹, Антония Х. Янева², Десислава Р. Бакова³, Станислава Н. Харизанова¹

¹ Кафедра гигиены, Факультет общественного здравоохранения, Медицинский университет – Пловдив, Пловдив, Болгария

² Кафедра медицинской информатики, биостатистики и электронного обучения, Факультет общественного здравоохранения, Медицинский университет – Пловдив, Пловдив, Болгария

³ Кафедра „Управление здравоохранением“, Факультет общественного здравоохранения, Медицинский университет – Пловдив, Пловдив, Болгария

Адрес для корреспонденции: Маргарита А. Тодорова, Кафедра гигиены, Факультет общественного здравоохранения, Медицинский университет – Пловдив, бул. „Васил Априлов“ № 15А, 4002 Пловдив, Болгария; E-mail: todoroff.md@gmail.com; тел.: 0888515595

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Резюме

Введение: Сменная работа стала нормой и абсолютной необходимостью в различных секторах общественной жизни. Различные производственные процессы, технологии и характер определённых работ приводят к различным рискам для здоровья. Нездоровый режим питания остается распространённым среди сменных работников во всех секторах экономики.

Цель: Целью данного исследования является сравнение пищевых привычек и режимов питания сменных работников и постоянных дневных работников в болгарской машиностроительной промышленности с упором на выявление различий, которые могут влиять на результаты в отношении здоровья.

Материалы и методы: Было проведено поперечное исследование на трёх рабочих площадках машиностроительного предприятия в Болгарии с участием 309 работников (149 сменных работников и 160 постоянных дневных работников). Данные о пищевых привычках были собраны с помощью 54-пунктного вопросника по частоте приема пищи (54-FFQ), адаптированного для местного населения. Для обобщения демографических и диетических данных использовалась описательная статистика. Групповые сравнения между сменными работниками и постоянными дневными работниками проводились с использованием U-критерия Mann-Whitney для ненормально распределённых непрерывных переменных. Значение p менее 0.05 считалось статистически значимым.

Результаты: Исследование выявило значительные различия в привычках питания между сменными работниками и постоянными дневными работниками. Сменные работники чаще потребляли белый хлеб ($p = 0.003$), фастфуд ($p = 0.045$), маргарин ($p = 0.001$), жареный картофель ($p = 0.041$) и мясные полуфабрикаты ($p = 0.021$), чем работники с фиксированным рабочим временем. Напротив, у работников с фиксированным рабочим временем повышены показатели потребления фруктов ($p = 0.034$), овощей ($p = 0.047$) и алкогольных напитков, таких как пиво ($p = 0.008$), вино и крепкие спиртные напитки ($p = 0.005$), чем у сменных работников. Эти различия свидетельствуют о том, что график работы может существенно влиять на выбор рациона питания и влиять на состояние здоровья работников.

Заключение: Сменная работа нарушает естественный суточный ритм и приводит к изменениям в пищевом режиме, таким как нерегулярные приёмы пищи, пропуск завтрака и приём пищи поздно вечером и ночью. Наше исследование подчёркивает, как эти формы поведения связаны с регулярным потреблением обработанных, высококалорийных продуктов, богатых углеводами и жирами, но с низким содержанием клетчатки и необходимых питательных веществ. Пищевые привычки, наблюдаемые в нашем исследовании, являются существенным фактором риска развития кардиометаболических заболеваний.

Ключевые слова

режим питания, укрепление здоровья, ночное питание, общественное здравоохранение, сменная работа