

# A MULTIFACETED ASSESSMENT OF THE NUTRITIONAL STATUS, DIET AND EATING HABITS OF MIDWIVES WORKING ON A SHIFT SCHEDULE IN WROCŁAW, POLAND: EVALUATION OF MACRONUTRIENTS, VITAMINS AND MINERALS IN THE DIETS OF MIDWIVES PARTICIPATING IN THE STUDY

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## Abstract

**Objectives:** The aim of the study was to assess the nutritional status and diet of midwives working on a shift schedule in public hospitals in Wrocław, Poland, and to analyze the variation in their diet according to their working hours (day shift, night shift) and on a non-working day. **Material and Methods:** In the group of 50 midwives, employed in 4 public hospitals in Wrocław weight and body composition, waist and hip circumference, waist-hip-ratio and BMI were assessed. The nutritional habits and quality of the study participants' diets were assessed by 3-days food dietary recall, including 1 day shift day, 1 night shift day, and 1 non-working day. **Results:** More than half of the subjects were assessed as having excess body weight (BMI  $\geq 25$  kg/m<sup>2</sup>). Thirty percent of participants had BMI  $\geq 25$ – $<30$  kg/m<sup>2</sup> and 24% BMI  $\geq 30$  kg/m<sup>2</sup>, 70% had a body fat percentage  $>30\%$ . Fifty-six percent of the diets had an energy value  $<90\%$  of the subject's total daily energy expenditure. Significantly higher energy value of diets on the night shift day compared to the morning shift day (1959.05 $\pm$ 596.09 kcal vs. 1715.36 $\pm$ 654.55 kcal,  $p = 0.01$ ) were observed. The same relationship applied to cholesterol content (349.50 $\pm$ 155.33 mg vs. 261.39 $\pm$ 190.59 mg,  $p = 0.002$ ). A high intake of phosphorus and sodium, exceeding the recommended dietary intake, was noticed. **Conclusions:** The occurrence of a night shift in the shift work schedule is an element of that model that may have a significant impact on the nutritional and health value of shift workers' diets. Therefore, it seems reasonable to implement nutritional education programs promoting healthy eating choices and habits during night work. *Int J Occup Med Environ Health.* 2023;36(5):618–31

## Key words:

overweight, diet, midwives, vitamins, circadian rhythm, shift work

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## INTRODUCTION

According to available data from Statistics Poland (Główny Urząd Statystyczny – GUS), the percentage of Poles working on a shift schedule may be as high as 30% [1]. Variable working hours can cause disruption of the circadian rhythm [2], which regulates the normal course of physiological processes, including the secretion of hormones by the endocrine system [3]. People working in this way are characterised by greater feelings of physical and mental fatigue and a higher incidence of impaired sleep quality and abnormal sleep duration compared to those working only during the day. In addition, they are more likely, especially women, to experience lowered mood and depressive symptoms [4].

Cardiovascular risk factors are more frequently identified among shift workers compared to those working standard hours [5].

Endocrine disruption resulting from shift work contributes to a higher incidence of type 2 diabetes, improper glycaemic control [6] and insulin resistance [7]. It has also been suggested that among women, prolonged shift work may be associated with a higher risk of excess body weight [8] and abdominal obesity [9].

There are reports showing that reduced sleep duration, poor sleep hygiene and lower rest scores correlate with lower diet quality [10]. Healthcare professionals often work in shifts. Although they have knowledge of proper nutrition, this does not translate into their eating habits [11].

In the available literature, growing interest in assessing the impact of shift work on the health, diet quality, and nutritional choices of shift workers is observed. Most of the available studies on the Polish population of shift workers compared the quality of diets and eating habits between groups of shift workers and day workers [12–15]. Similar tendencies are presented in foreign studies [16,17].

Due to the fact that significant differences in the quality of diets and eating habits were observed between shift workers and day workers, to expand the current knowl-

edge, in this study, the authors assumed a comparison of the quality of diets in the group of the same people depending on the shift type day.

The aim of the study was to assess the nutritional status of midwives working on a shift schedule in Wrocław public hospitals and to analyse the variation in their diet according to their working hours. In order to observe which of the shift schedule elements (day shift, night shift, or a non-working day) might have an impact on the deterioration of diet quality.

## MATERIAL AND METHODS

The studied group consisted of 50 midwives who fully completed the study and were employed in all 4 public hospitals in Wrocław, Poland, in the following departments: gynaecology-obstetrics (22%), neonatology (6%), delivery room (26%), neonatal intensive care and emergency room (4%), and pregnancy pathology (38%).

All midwives employed in public hospitals in Wrocław, the third most populous city in Poland, were invited to participate in the study. Seventy-seven caucasian race midwives began the study and 50 of them fully completed it (response rate approx. 65%).

The mean age of the subjects was  $45 \pm 10.94$  years (min.–max 25–70 years).

All the midwives worked in a shift schedule mainly based on consecutive days with a morning shift (working hours 7:00–19:00), then a day with a night shift (19:00–7:00), and 2 days off.

The criteria for inclusion in the study group were employment as a midwife, shift work lasting >1 year, with night shifts at least 4 times a month, consent to participate in the study, correct completion of the food diary recall.

The criteria for exclusion in the study group were shift work lasting <1 year, with night shifts <4 times a month, no consent to participate in the study, incorrect completion of the food diary recall, inability to perform electrical bioimpedance analysis, pregnancy or following high

specific diets such a ketogenic diet, vegan diet or strict elimination diets resulting from medical indications.

Ninety-eight percent of study participants followed the omnivorous diet. Only 1 person limited dairy products (but used butter) and limited dietary sources of gluten, without medical indications.

The following measurements were taken among the study participants: height, using a free-standing, portable Tanita HR-001 (Tanita, Tokyo, Japan) stadiometer, and weight and body composition, using bioelectrical impedance analyser Tanita BC 545 (Tanita, Tokyo, Japan). Waist and hip circumference were measured using a standard measuring tape with an accuracy of 1 cm. The waist circumference was measured halfway between the top of the hip bone and the lower rib curve. Hip circumference was measured at the widest point below the wings of ilium, at the bulge of the buttocks.

In addition, on the basis of anthropometric measurements, in order to assess the subjects' nutritional status, waist-hip-ratio (WHR) values, BMI values and total daily energy expenditure (TDEE) were calculated from the equations:

$$\text{WHR} = \frac{\text{waist circumference (cm)}}{\text{hip circumference (cm)}} \quad (1)$$

where:

values  $<0.85$  were considered as normal,

$$\text{BMI} = \frac{\text{weight (kg)}}{\text{height (m)}^2} \quad (2)$$

where:

values  $\geq 18.5$ – $<25$   $\text{kg/m}^2$  were considered as normal [18,19].

$$\text{TDEE} = \text{BMR} \times \text{PAL} \quad (3)$$

where:

BMR – basal metabolic rate,

PAL – physical activity level.

Basal metabolic rate values were taken from an electrical bioimpedance analyser, whose algorithms are based on indirect calorimetry. The physical activity level was set at 1.5 [20]. In the study, 90–100% TDEE was considered the correct dietary energy value.

The nutritional habits and quality of the study participants' diets were assessed by 3-days food dietary recall. The dietary food recall included consecutive 1 day shift day, 1 night shift day and 1 non-working day, in order to compare the nutritional value of their diets between these days. The participants were asked to record their typical daily diet and not to choose unusual days, such as those with parties or holidays. The mass of consumed food, expressed in household measures, were specified with the use of *Album of photographs of food products and dishes* [21]. The computer program "Food Processor" SQL v. 9.8.1. (ESHA Research, Salem, USA), which contains a Polish database of products and dishes, was used to analyse the dietary interviews [22].

Based on the data obtained, the nutrient content (protein, carbohydrates, fat) and water content of the studied diets were determined, as well as the content of selected vitamins (A, D, E, C, B<sub>1</sub>, B<sub>2</sub>, B<sub>6</sub>, B<sub>12</sub>, folic acid) and minerals (calcium, iron, copper, phosphorus, magnesium, zinc, iodine, sodium, potassium). Then, the percentage of energy from each macronutrient in the daily ration was calculated. The obtained values were compared to the current norms for the Polish population [20]. Also, the vitamins and minerals content in 1000 kcal of the diet was calculated.

The study was approved by the Ethics Committee of Wrocław Medical University.

## Statistics

The statistical analysis of the collected data compared and assessed the significance of the differences between the results of anthropometric measurements, the nutritional value of the diet, and fulfilment of population

norms for macro- and micronutrients between each of the assessed 3 days.

It was performed using the program Statistica v. 12.0 PL from StatSof Inc. (USA). The significance of the differences in diet composition between days with a morning shift, night shift and a non-working day were assessed using Friedman's ANOVA, Kendall's coefficient of concordance and a post hoc test of absolute differences between rank means. The level of statistical significance was  $p < 0.05$ .

## RESULTS

### Anthropometric assessment of nutritional status

Table 1 shows the mean results of the anthropometric measurements and the calculated anthropometric indices.

According to BMI values, 54% of the subjects were assessed as having excess body weight. 30% of women were diagnosed as overweight and 24% as obese. Seventy percent of the studied midwives had a body fat percentage  $>30\%$ . Among 66% of the subjects, the waist circumference exceeded 80 cm. The WHR values of  $>0.85$  were recorded among 30% of the study participants, thus they

were diagnosed with abdominal obesity. However, only 6% of the subjects had abnormally high visceral body fat as assessed based on the bioimpedance analysis.

### Composition of the diet

Table 2 shows the mean energy values, mean nutrient and vitamin and mineral contents by working day.

The study observed significantly higher energy value of diets on the night shift day compared to the morning shift day ( $1959.05 \pm 596.09$  kcal vs.  $1715.36 \pm 654.55$  kcal;  $\chi^2$  ANOVA [N = 49, df = 2] = 9.102041;  $p = 0.01056$ ). Moreover, the energy value of diets on the night shift days fulfilled a significantly higher percentage of TDEE compared to the morning shift days ( $94.82 \pm 31.41\%$  vs.  $82.92 \pm 33.06\%$ ;  $\chi^2$  ANOVA [N = 49, df = 2] = 9.102041;  $p = 0.01056$ ). The same relationship applied to cholesterol content ( $349.50 \pm 155.33$  mg vs.  $261.39 \pm 190.59$  mg;  $\chi^2$  ANOVA [N = 49, df = 2] = 12.68718;  $p = 0.00176$ ).

Fifty-six percent of the diets had an energy value  $<90\%$  of the subject's requirements. Approximately 8% of the assessed diets were correct and 36% had too high an

**Table 1.** Anthropometric measurements, basal metabolic rate, and total daily energy expenditure of midwives (N = 50) working on shift schedule in public hospitals in Wrocław, Poland

Variable	M $\pm$ SD	Min.	Max
Age [years]	45.88 $\pm$ 10.95	25.00	70.00
Body weight [kg]	70.88 $\pm$ 14.35	48.60	105.20
Height [cm]	162.65 $\pm$ 5.43	152.00	175.00
BMI [kg/m <sup>2</sup> ] (ref. $\geq 18.5$ to $<25$ )	26.81 $\pm$ 5.44	18.48	40.08
Circumference [cm]			
waist (ref. $<80$ cm)	85.18 $\pm$ 13.20	63.00	120.00
hips	103.68 $\pm$ 11.56	61.00	129.00
Waist to hip ratio (ref. $<0.85$ )	0.82 $\pm$ 0.08	0.71	1.11
Body fat [%] (ref. 20–30%)	33.41 $\pm$ 8.04	16.90	47.80
Visceral fat level (ref. 0–14)	6.52 $\pm$ 3.30	1.00	14.00
Free fat mass [kg]	43.83 $\pm$ 4.56	36.70	55.00
Basal metabolic rate [kcal]	1397.64 $\pm$ 156.89	1163.00	1794.00
Total daily energy expenditure [kcal]	2096.46 $\pm$ 232.96	1747.5	2452.5

**Table 2.** The nutrient, vitamin and mineral content of diets on morning shift days, night shift days and non-working days of midwives (N=50) working on shift schedule in public hospitals in Wrocław, Poland

Component	Diets content												p
	morning shift days (N = 50)				night shift days (N = 50)				non-working days (N = 49)				
	M±SD	min.	max	M±SD	min.	max	M±SD	min.	max	M±SD	min.	max	
Total energy intake [kcal]	1715±654.55	512.00	4074.35	1959.05±596.09	822.14	3873.01	1958.18±672.95	1064.25	3558.05	0.01056*			
Protein [g]	74.0±23.97	16.59	128.43	82.86±23.54	40.7	139.64	85.55±26.89	37.53	138.49	0.07488			
Carbohydrates [g]	224.1±89.15	54.50	550.64	255.65±92.64	75.61	585.04	238.00±92.40	101.74	546.84	0.04589****			
Sucrose [g]	38.47±29.68	3.89	153.40	51.15±41.98	4.08	213.27	46.88±31.36	5.38	149.37	0.13813			
Dietary fibre [g]	21.29±8.34	2.53	41.84	25.09±12.82	9.44	69.33	22.71±10.66	5.59	59.87	0.15612			
Glycaemic load	94.93±45.16	18.15	278.80	108.00±46.81	8.52	266.75	100.67±46.34	28.27	285.33	0.11035			
Fat [g]	62.98±32.77	19.04	164.51	72.54±29.27	15.28	140.47	77.69±39.12	23.74	176.40	0.07488			
Fatty acids [g]													
saturated (SFA)	24.68±14.81	6.66	88.70	28.01±12.74	5.59	61.86	28.33±16.63	5.980	79.41	0.18009			
monounsaturated (MUFA)	21.04±12.99	3.81	65.67	25.42±11.79	4.00	55.11	29.09±16.49	4.66	70.29	0.00337**			
polyunsaturated (PUFA)	10.73±8.95	1.92	57.35	11.57±7.01	2.51	34.50	13.06±7.66	2.96	32.88	0.10380			
Cholesterol [mg]	261.39±190.59	47.90	833.90	349.50±155.33	58.00	684.69	339.23±204.11	34.30	1006.08	0.00176*			
Vitamin													
A [µg]	1226.45±1036.39	93.55	6543.15	1426.75±1540.87	352.90	8270.45	1318.38±1376.18	114.80	7311.30	0.67858			
B <sub>1</sub> [mg]	1.09±0.47	0.25	2.69	1.23±0.57	0.55	3.93	1.27±0.66	0.48	3.48	0.28177			
B <sub>2</sub> [mg]	1.56±0.52	0.31	2.92	1.86±0.49	0.77	2.74	1.85±0.67	0.65	3.74	0.00810***			
B <sub>6</sub> [mg]	1.85±0.86	0.21	5.38	2.26±1.02	0.80	5.38	2.04±0.68	0.99	4.47	0.15612			
B <sub>12</sub> [µg]	3.31±3.49	0.32	18.87	4.29±3.6	0.40	16.91	3.59±2.41	0.49	13.73	0.01585*			
C [mg]	141.74±97.71	10.35	462.04	173.84±128.44	32.16	573.44	159.80±151.43	25.20	846.06	0.07189			
D [µg]	2.57±4.14	0.00	25.37	3.37±3.98	0.19	21.08	3.37±4.28	0.00	21.30	0.03012****			
E [mg]	11.28±8.31	0.79	51.57	11.41±6.35	3.61	30.57	12.43±6.40	2.6	28.77	0.53118			
Folate [µg]	332.78±148.5	54.52	997.75	363.49±164.54	153.63	1016.00	347.33±157.12	74.00	828.78	0.22542			
Sodium [mg]	1987.52±905.22	547.48	4165.44	2044.70±1073.47	434.30	4865.95	2009.91±1098.05	311.90	5063.22	0.41580			
Potassium [mg]	3260.44±1064.76	923.85	6072.51	3757.30±1196.42	1599.95	7958.99	3699.60±1157.89	1551.40	7773.18	0.00702***			
Calcium [mg]	776.69±296.09	153.30	1016.00	866.98±332.16	223.70	1569.75	883.10±515.34	181.50	2302.53	0.21203			

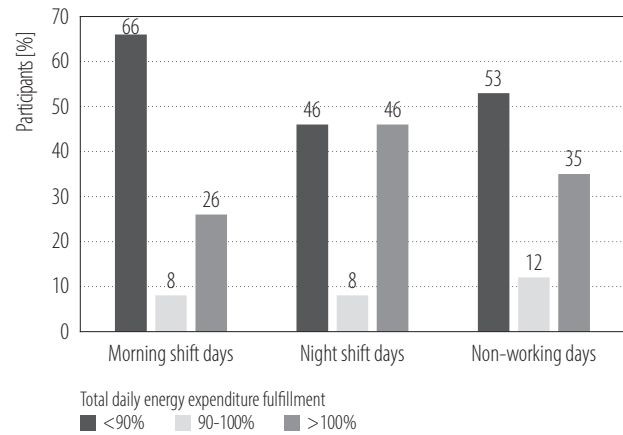
**Table 2.** The nutrient, vitamin and mineral content of diets on morning shift days, night shift days and non-working days of midwives (N=50) working on shift schedule in public hospitals in Wrocław, Poland – cont.

Component	Diets content									p
	morning shift days (N = 50)			night shift days (N = 50)			non-working days (N = 49)			
	M±SD	min.	max	M±SD	min.	max	M±SD	min.	max	
Phosphorus [mg]	1215.01±393.47	242.10	2017.39	1381.79±392.83	671.36	2501.95	1388.22±444.18	645.10	2504.60	0.05862
Magnesium [mg]	338.22±144.24	103.35	968.20	373.65±154.32	141.97	1165.70	370.40±126.23	167.10	790.62	0.01146***
Iron [mg]	11.70±4.37	3.25	25.07	12.86±5.11	5.37	34.01	12.78±5.24	4.73	27.10	0.13813
Zinc [mg]	9.57±3.05	2.33	16.23	10.78±3.43	5.60	22.87	10.56±3.96	3.23	22.29	0.11195
Iodine [µg]	29.68±12.28	5.54	65.06	42.41±35.80	8.83	262.03	37.64±35.46	7.64	204.76	0.00014****

Significant differences between \* morning shift days and night shift days, \*\* morning shift days and non-working days, \*\*\* night shift days and non-working days.

\*\*\*\* No *post hoc* test confirmation.

Significant differences of  $\chi^2$  ANOVA Friedman test –  $p < 0.05$



**Figure 1.** Fulfillment of the energy requirements of the study participants by the energy value of their diets in the ranges depending on the working days of midwives (N=50) working on shift schedule in public hospitals in Wrocław, Poland

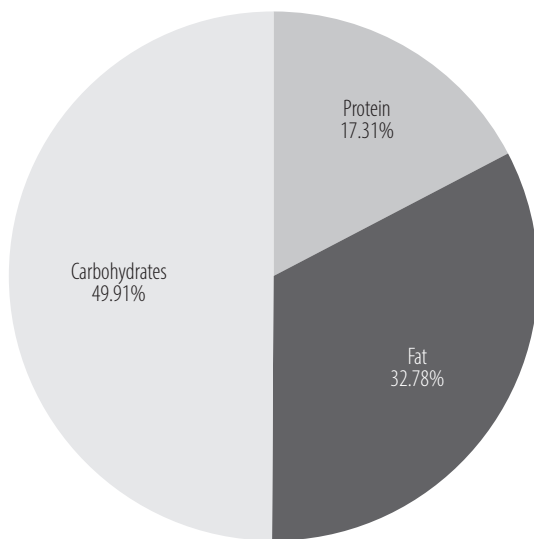
energy value in relation to the estimated requirement. The percentage of fulfilment of the energy requirements of the studied midwives by the energy value of their diets, differed significantly (79.48% vs. 103.55%; Welch's t-test,  $p = 0.002$ ) in the groups of overweight and normal weight women.

Figure 1 shows the percentage of fulfilment of the energy requirements of the subjects in the <90%, 90–100% and >100% ranges on each of the described 3 days.

The percentage of energy value obtained from proteins, fats, and carbohydrates did not differ significantly between the working days. Therefore, to assess the energy structure of midwives' diets, Figure 2 presents the average percentages of energy value (average from 3 days) obtained from macronutrients in their diets.

Figure 3 presents the percentages of energy value obtained from selected fatty acids depending on the day of shift work.

The significant difference between the percentage of energy value obtained from MUFA between the day off and the day with the morning shift was assessed ( $12.72 \pm 4.35\%$  vs.  $10.49 \pm 4.35\%$ ;  $\chi^2$  ANOVA ( $N = 49$ ,  $df = 2$ ) = 6.367347;  $p = 0.04143$ ).



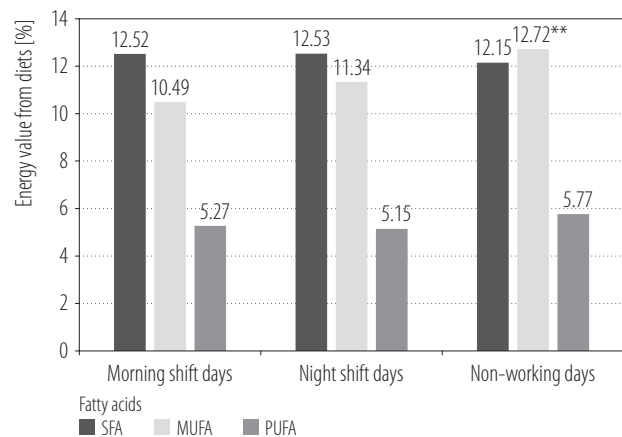
**Figure 2.** The mean percentage of energy value (E) of participants' diets obtained from protein, carbohydrates and fat from 3-day food dietary recall of midwives (N=50) working on shift schedule in public hospitals in Wrocław, Poland

### Vitamins and minerals

Significant differences in I, K, vitamin B<sub>12</sub> and vitamin B<sub>2</sub> were observed in the diets between the morning shift day and the night shift day. The higher intake of these nutrients was observed for the night shift day. In addition, the women's diets contained significantly more Mg, K and vitamin B<sub>2</sub> on the day off compared to the morning shift day. Also, significant difference in I content between night shift days and non-working days was observed.

In order to compare the nutritional quality of the diets on selected days, regardless of their energy values, the content of vitamins and minerals per 1000 kcal of the diet was calculated. Using this criterion, a significant difference only in iodine content between the day off and the day with the night shift was confirmed ( $20.62 \pm 24.77$  mcq/1000 kcal vs.  $22.80 \pm 19.33$  mcq/1000 kcal;  $\chi^2$  ANOVA (N = 49, df = 2) = 6.000000; p = 0.04979).

Additionally, the mean vitamin and mineral contents of the diets (from 3-day food dietary recall) met the requirements for the assessed nutrients. Only the vitamin D ( $20.61 \pm 18.11\%$ ) and iodine ( $38.41 \pm 17.82\%$ ) contents did



MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids; SFA – saturated fatty acids.

\*\* Significant difference ( $\chi^2$  ANOVA (N = 49, df = 2) = 6.367347, p = 0.04143) between morning shift days and non-working days.

**Figure 3.** The mean percentage of energy value (E) of participants' diets obtained from saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids depending on morning shift days, night shift days and non-working days of midwives (N=50) working on shift schedule in public hospitals in Wrocław, Poland

not meet 90% of the norm. A high intake of phosphorus ( $228 \pm 53.86\%$ ) and sodium ( $133.98 \pm 43.57\%$ ), exceeding the recommended dietary intake, was observed in the diets of the studied midwives.

### DISCUSSION

It has been estimated that disruption of the circadian rhythm resulting from shift work, particularly regular night shift work, can increase the risk of becoming overweight or obese by up to 29% compared to a rotating schedule [9]. Shift work is positively correlated with the incidence of excess body weight, irrespective of the physical activity performed and a person's dietary habits [23].

Even though healthcare workers, including midwives, are a group considered to be well informed about etiology and risks of overweight and obesity, studies conducted so far have consistently found them to be disproportionately having a higher risk of overweight and obesity compared to the general population [24]. Excess body weight

was observed in more than half of the studied midwives in the present study. Analysis of the results of the Corce et al. [25] study showed that shift workers presented a higher BMI compared to day workers, despite a better quality diet and comparable levels of physical activity. Correlations between shift work and excess body weight were also shown in a study by Barbadoro et al. [26]. The authors of the paper identified shift work as one of the risk factors for excess body weight and abdominal obesity. Similar findings were obtained in the study by Samhat et al. [27], in which both the BMI value and waist circumference of the subjects increased in direct proportion to the number of years worked in shift work, as well as the total number of night shifts over the entire work history. Those findings were convergent with the study of the Polish nurses and midwives working on night shifts, by Peplonska et al. [28]. Cumulative night shift work showed significant associations with BMI, waist and hip circumference, and waist to hip ratio. It was found that the BMI value increasing by  $0.477 \text{ kg/m}^2/1000$  night duties and by  $0.432 \text{ kg/m}^2/10\ 000$  night shift hours. Furthermore, a higher prevalence of diet-related metabolic diseases such as diabetes, dyslipidaemia and metabolic syndrome has been observed compared to people working conventional hours [28].

The energy value of the diets of the overweight subjects met the estimated energy requirements to a lower degree compared to the normal weight subjects. These results may indicate an underestimation of the portion sizes consumed by the study participants. The phenomenon of underestimating portion sizes and thus the energy value of the diet positively correlates with the incidence of obesity [29]. It was observed that misalignment of sleeping hours influence energy expenditure, and metabolic and appetite hormones. Shift work reduced energy expenditure by approx. 3%. Furthermore, changes in appetite hormones occurred that promote hunger and energy intake. Even if energy intake does not seem to be higher in shift workers comparing to non-shift workers, food choices might be less healthy [30].

In the present study, the highest dietary energy intake was estimated to occur during the night shift. In the study by Peplonska et al. [12] as much as about 28% of nurses working night shifts were found to consume more energy than the recommended value, however respective proportions among day workers was about 18%. Similarly, a study by Hulssegge et al. [31] observed increased dietary energy intake among shift workers compared to those working only day shifts, despite no differences in diet quality. In the study by Bonell et al. [32] although no differences in energy intake between the shifts were noted, higher energy density of the food products chosen during night shifts was observed. However, the findings of the research are inconclusive. They indicate both higher and lower dietary energy intake on night shift days among shift workers [33].

Although the percentage of energy obtained from total fat in the diets of the studied midwives was in line with the norm for the Polish population, the proportion of individual fatty acids was unfavourable. It is suggested that dietary fat might contribute to cardiovascular disease (CVD) via inflammatory and oxidative stress mechanisms. Saturated fatty acid (SFA) and trans fatty acids (TFA) can increase pro-inflammatory and oxidative stress, excessive oxidative stress and inflammation contributes to the development of CVD [34].

In this study the average percentage of energy from SFAs exceeded 12%, while recommendations indicate that the proportion of these fatty acids should be as low as possible [20]. The WHO recommends that the percentage of the energy value of a diet obtained from them should not exceed 10%, in order to reduce the risk of vascular and cardiovascular diseases [35], which are one of the leading causes of death, ranking first globally [36].

Moreover, in the studied diets, the percentage of energy obtained from SFAs was higher than the percentage of energy obtained from MUFAs, and the reverse ratio is recommended. The higher dietary fat intake, including SFAs



among women working on a shift schedule compared to women working only during the day was also confirmed by an analysis of the results of the study by Hemio et al. [37]. A higher intake of total fats, SFAs and cholesterol in diets on night shift days was also reported by Ulusoy et al. [38] in a study involving shift-working nurses. Similar trends were observed in the present study.

A significant difference was found between the intake of MUFAs on the morning shift day compared to the day off. A similar difference was observed in the study by Mortas et al. [39].

In the present study, no significant differences were observed in the percentage of energy obtained from total fat and the intake of SFAs between working days. Similarly, no differences were observed in the sucrose intake and glycaemic load values of the diets between days. In the study led by Peplonska et al. [12] conducted among Polish nurses and midwives working rotating shifts and day working, a significantly higher adjusted mean intake was found for the total energy, total fatty acids, as well as for cholesterol, carbohydrates and sucrose among nurses and midwives working rotating night shifts when compared to day workers.

In the study by Shaw et al. [40] during night shifts, saturated fat consumption (as a proportion of total energy) was significantly lower compared to day shifts and days off. In contrast, total sugar consumption (as a proportion of total energy) was significantly higher on nights.

In the diets of the studied midwives, the average intake of dietary fibre was low. Only on the night shift day was it equal to the lower limit recommended in the norms for the Polish population, which is >25 g [20]. On the other days it was lower than this value.

In the present study, midwives' diets on night shift days contained the most cholesterol compared to day shift days or days off. A higher dietary cholesterol intake among shift workers compared to day shift workers was also observed in the study by Hulssegge et al. [31].

In addition, in a study by Przeor et al. [41], the diets of female shift workers were characterised by low levels of nutrients such as fibre, Ca, Mg, Fe, vitamin D, folic acid. The diets of the women participating in the study, like those of the participants in the present study, were also found to be unfavourably high in sodium and phosphorus. The reason for the high intake of the above-mentioned nutrients may have been the high proportion of highly processed meat products in the subjects' diets. An insufficient intake of vitamin A, D, E and zinc in the diet of shift workers compared to day workers was also observed in a study by Linseisen et al [42].

In the diets of studied midwives insufficient vitamin D and iodine intake was observed. Similar results were observed in another study among Polish nurses and midwives by Peplonska et al. [12]. It is difficult to meet the recommended 15 µg of vitamin D intake from the diet, and because of insufficient sun exposure, supplementation is recommended for the Polish population during all seasons [43]. However, the available data show that, although the correction of vitamin D deficiency is necessary, additional supplementation may not have added health benefits [44]. The use of extra added salt was not noted in the food diaries. In Poland, law regulation dictates that salt producers add iodine [45], meaning that the use of salt in everyday food preparation can significantly increase its intake. As food product derived sodium values in the studied diets were already high, the authors assume the sodium intake significantly exceeded the recommended values. Meta-analysis by Wang et al. [46] found significant linear association between dietary sodium intake and risk of CVD, with the high sodium intake compared to low sodium intake increasing the risk of CVD by 19%.

Although the presence of night shift surely influences the food choices some researches observed also other factors that should be considered. In the study of Bouillon-Minois [47] differences in energy intake were observed

depending on gender and workplace (university or non-university hospital). Fats intake was observed to be influenced by age and family situation (single vs. non-single). Cholesterol intake was increased with age, male gender and work experience. Other factors as: work stress, sleep deprivation hours, intensity of the shift can influence the differences in food intake between the shifts, too. Availability of specific food products during night shifts is also considered as a factor of specific food choices. Few studies concluded that the fast food intake between night shifts workers is popular because it is the most common type of food easily obtained overnight [48,49]. A study by Samhat et al. [27] reported that it studied nurses who regularly consumed fast food, declared it was not by preference for that type of food but by obligation because they did not always manage to take foods with them to work. On the other hand, study by Almajwal et al. [50] showed that night shift nurses consume more fast food at work because they like it. It is also suggested that shift workers consumed more sweet food, high fat and fast and snack food during night duty in order to keep them awake and resume energy due to heavy workload and long shift [51]. Also working night shifts was suggested to make healthcare workers prone to abnormal emotional and restraint eating behaviour [49]. Some recommendation in the former studies were given, for the hospitals to provide healthy night snack options within the hospital compound. These could include purposive render machines and refrigerators with fresh food and provision of more healthy food options as one of the terms included in the contract of canteen service. Healthy food promotion programs among staff were also recommended [49].

### Limitations

Our study is a cross-sectional study with some limitations that should be emphasized. The study was designed to include all midwives employed in public hospitals to obtain a highly homogeneous group of participants representing one distinctive occupation and workplace.

Therefore, only midwives were included in the study, without combining them with other representatives of the medical profession, as in other studies [12,13,52]. In addition, only public hospitals located in Wrocław were selected, excluding those near Wrocław. Both assumptions contributed to the unification of the group but limited its size.

In addition, due to the high work intensity of midwives and their low motivation to participate in the study, some did not agree to participate in the study or did not provide completed food diary recalls ( $N = 27$ ), indicating that it was too time-consuming.

Increasing the number of the study group would increase the credibility of the obtained results, and its current size ( $N = 50$ ) is the main limitation of this study.

Considering the intensity of the work of midwives, the unpredictable rhythm of the working day, and the irregularity of breaks (especially in the delivery room), the 3-day food dietary recall was chosen as a relatively easily accessible and easily supplemented method for assessing the diets. However, it has limitations, such as the possibility of skipping a meal or product, incorrect/incomplete records of consumed products, and fault estimation of portions.

The authors are aware that the combination of the 3-day food dietary recall with other methods, such as photo-assisted recall or the double weighting method, could increase the refinement of the obtained results and increase their credibility. However, in the current study group, the use of, for example, the double weighing method requiring appropriate storage and collection of samples, increasing the effort of the subjects, would additionally limit their number.

### CONCLUSIONS

Significant unfavourable trends were found for higher energy as well as cholesterol intake during night shifts compared to morning shift days and days off. The eating habits of the midwives participating in the study are characterised by a high intake of saturated fatty acids and

cholesterol and a low intake of dietary fibre and mono- and polyunsaturated fatty acids, as well as high sodium and phosphorus intake.

Based on the obtained data, it seems that the occurrence of a night shift is an element of the shift work model that may have the significant impact on the nutritional and health value of shift workers' diets.

Therefore, it seems reasonable to implement nutritional education programs promoting healthy eating choices and habits during night work. In addition, due to the high prevalence of excess body weight among midwives, it seems substantial to promote dedicated nutritional strategies and lifestyle changes for losing weight which are suitable to the midwives' working characteristics.

#### Author contributions

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