International Journal of Occupational Medicine and Environmental Health 2014;27(5):693–706
http://dx.doi.org/10.2478/s13382-014-0298-0

NIGHT SHIFT WORK AND MODIFIABLE LIFESTYLE FACTORS

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Abstract
Objectives: Night shift work has been linked to some chronic diseases. Modification of lifestyle by night work may partially contribute to the development of these diseases, nevertheless, so far epidemiological evidence is limited. The aim of the study was to explore association between night shift work and lifestyle factors using data from a cross-sectional study among blue-collar workers employed in industrial plants in Łódź, Poland. **Material and Methods:** The anonymous questionnaire was self-administered among 605 employees (236 women and 369 men, aged 35 or more) – 434 individuals currently working night shifts. Distribution of the selected lifestyle related factors such as smoking, alcohol drinking, physical activity, body mass index (BMI), number of main meals and the hour of the last meal was compared between current, former, and never night shift workers. Adjusted ORs or predicted means were calculated, as a measure of the associations between night shift work and lifestyle factors, with age, marital status and education included in the models as covariates. **Results:** Recreational inactivity (defined here as less than one hour per week of recreational physical activity) was associated with current night shift work when compared to never night shift workers (OR = 2.43, 95% CI: 1.13–5.22) among men. Alcohol abstinence and later time of the last meal was associated with night shift work among women. Statistically significant positive relationship between night shift work duration and BMI was observed among men ($p = 0.029$). **Conclusions:** This study confirms previous studies reporting lower exercising among night shift workers and tendency to increase body weight. This finding provides important public health implication for the prevention of chronic diseases among night shift workers. Initiatives promoting physical activity addressed in particular to the night shift workers are recommended.

Key words:
Night shift work, Life style, Physical activity, Body mass index

INTRODUCTION

Night shift work has been linked to some chronic diseases such as cardiovascular, metabolic diseases and cancer [1–3]. The proposed underlying mechanisms included circadian rhythm disruption, sleep deficit, stress and hormonal disturbances [4]. Several modifiable risk factors contribute to the etiology of these diseases. For example, smoking is a well-established risk factor for coronary artery disease, colon and prostate cancer [5]. Physical activity plays a role in prevention of atherosclerotic heart

This project is supported by a grant "The risk of selected cancers in the night shift workers" from the National Science Centre, Grant No. PB5169/B/P01/2010/38. Principal Investigator: Beata Pepłońska MD, PhD.
Received: September 6, 2013. Accepted: June 5, 2014.
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disease [6], type 2 diabetes [7], colon [8], breast [9] and prostate cancer [10]. Obesity has been a well-established risk factor for diabetes, coronary artery disease, hypertension and some cancers (e.g., colon, or breast cancer in postmenopausal women) [11].

Night shift work might have an impact on personal life, in particular social and family life [12]. Moreover, unhealthy lifestyle changes have been suggested as contributors in the etiology of potential health effects of shift work [13] and the evidence for the association between night shift work and lifestyle factors, like smoking [14–28], alcohol consumption [15,17,18,20,24,27,29–32], physical activity [21,25,27,29,33] and dietary habits [34] has been mounting. Nevertheless, epidemiological data on this subject are so far relatively sparse and inconclusive. Therefore, the aim of our study was to explore association between night shift work and modifiable risk factors using data from a cross-sectional study among blue-collar workers employed in industrial plants in Lodz, Poland.

MATERIAL AND METHODS

The cross-sectional study was carried out over the years 2011–2012 in Łódź, Poland. The study was carried out in cooperation with occupational physicians performing prophylactic examinations of the workers in 4 outpatients clinics. Participants of the study, while admitted to the clinics for periodic health check-ups, were invited to participate in the anonymous self-administered short questionnaire. In the case of 4 settings, the questionnaires were distributed among workers in their workplaces.

The participants were eligible for the study if aged 35 or more, working on blue collar positions for at least 1 recent year in industrial enterprises operating in shift work systems including night shifts. They have been working in 29 various enterprises within 14 categories of production or services according to the Polish Classification of Activities [35] i.e., 14 – Manufacture of wearing apparel, 18 – Printing and reproduction of recorded media, 22 – Manufacture of rubber and plastic products, 25 – Manufacture of fabricated metal products, 27 – Manufacture of electrical equipment, 29 – Manufacture of motor vehicles (including trailers and semi-trailers), 31 – Manufacture of furniture, 46 – Wholesale trade with the exception for motor vehicles, 47 – Retail trade, except for motor vehicles and motorcycles, 49 – Land transport and transport via pipelines, 62 – Computer programming, consultancy and related activities.

Of 1100 distributed questionnaire sheets, 605 were returned (response rate 55%). The questionnaire included questions on age, education, diagnosed diseases, symptoms – complaints, tobacco smoking, alcohol drinking, recreational physical activity, dietary habits, menopausal status, sleeping habits, reproductive history, family history of cancer, participation in cancer screening examinations as well as occupational history including current night shift work and total night shift work duration.

The study was approved by the ethical institutional review board at the Nofer Institute of Occupational Medicine, Łódź, Poland.

Statistical analysis

Arithmetic means with standard deviations and the frequencies of basic characteristics were calculated. The ANOVA-test was used to compare the means of the continuous variables, and the Chi-square (Chi^2) test was employed to compare distribution of categorical characteristics among the employees working night shifts and the day-shift workers. The differences were considered statistically significant when p was less than 0.05 ($p < 0.05$).

Based on the data collected via the questionnaire, the following variables describing current and total night shift work were formulated: current night shift work (yes/no); ever working night shifts (yes/no) and night shift work duration (in years). Smoking was categorized into: never smokers, past and current smokers. We classified the

subjects by their reported average physical activity into recreationally inactive (those who reported not engaging in recreational activity at all or less than 1 h per week), slightly active (reporting ≥ 1 h/week to < 2 h/week) and active (reporting ≥ 2 h per week). Current reported weight and height were used to calculate body mass index (BMI) in kg/m^2, with obesity defined as BMI ≥ 30 and overweight as BMI ≥ 25 to < 30. We used 2 categories of alcohol drinking: non-drinker and drinker (if the subject reported more than 0 drinks per week). The average number of main meals per day and usual time of the last meal in the days off work were also analyzed.

Associations between night shift work and lifestyle factors were analyzed using multinomial logistic regression or linear regression. Odds ratios, ORs (or predicted means) were calculated with age, education and marital status included in the models. All analyses were carried out separately for women and men according to the employment status in 3 categories: never night shifts workers – a reference group, former and current night shift workers. Analyses were also carried out with total duration of the night shift as a continuous variable.

The analyses were run using Stata version 9 (StataCorp LP).

RESULTS

Selected characteristics of the studied population, by current system of work in the total population and according to gender are presented in Table 1. Of the total 605 employees (236 women, 369 men) as many as 72% were currently working night shifts. In the case of 4 current day workers information about their past night shift work was missing and therefore, they were excluded from the analysis.

Distribution of gender and average age was similar in current night shift, former and never night shift workers (46.7 vs. 47.3 and 47.1 years in total population, respectively). Among women, the majority were premenopausal women in each group by work system. Majority of the workers had primary, vocational or secondary education (about 90% in each category). Current night shifts workers worked night shift for an average of 11.8 years (8.5 years in the case of women, and 13.8 years in the case of men), with 52.1% working night shifts for 10 years or longer (34.1% women, 63.6% men). Among current day workers, 46.7% had ever worked night shifts and the majority (70.6%) had short night shift work duration (less than 4 years).

Work system with 7–8 night duties per month and 5 consecutive night duties was prevailing. As many as 96.0% of the night shift workers had short pauses during the duty, with single pause reported by 64.7% of employees. Typically, the night shift workers could not nap during the night shift (data not shown).

Distribution of the lifestyle related factors and associations with night shift work

Distribution of lifestyle factors by the system of work and odds ratios for associations with night shift work are presented in Tables 2 and 3. Among the female current night shifts workers (Table 2), the prevalence of current smoking and overweight was higher when compared to both, never or former night shift workers. Frequency of recreationally active (≥ 2 h per week) women and of alcohol drinkers was lower in both current and former night shift workers when compared to never night shift workers. The only significant association was observed in the analysis of alcohol drinking. The OR for alcohol drinking was reduced by approximately 50% (OR = 0.45) among the current night shift workers when compared to the day workers. Although statistically insignificant, the ORs were increased for current smoking and slight physical activity both in women currently working and formerly working night shifts when compared to these never working night shifts.

Table 1. Selected characteristics of the studied group by system of work in the total population and according to gender

Variable	Total (N = 601)				Women (N = 234)				Men (N = 367)			
	current night shift workers (N = 434)	current day shift workers (N = 167)		p[2]	current night shift workers (N = 170)	current day shift workers (N = 64)		p[2]	current night shift workers (N = 264)	current day shift workers (N = 103)		p[2]
		former night shift workers (N = 78)	never night shift workers (N = 89)			former night shift workers (N = 36)	never night shift workers (N = 28)			former night shift workers (N = 42)	never night shift workers (N = 61)	
Age (years) (AM±SD)	46.7±0.4	47.3±0.7	47.1±0.7	0.705	45.9±0.5	46.0±1.0	46.1±1.0	0.978	47.2±0.5	48.4±1.0	47.6±0.9	0.615
Age (years) [n (%)]												
35–39	87 (20.0)	12 (15.4)	14 (15.7)	0.058	37 (21.8)	8 (22.2)	3 (10.7)	0.416	50 (18.9)	4 (9.5)	11 (18.0)	0.051
40–44	100 (23.0)	15 (19.2)	14 (15.7)		35 (20.6)	6 (16.7)	5 (7.9)		65 (24.6)	9 (21.4)	9 (14.8)	
45–49	92 (21.2)	17 (21.8)	28 (31.5)		46 (27.1)	9 (25.0)	14 (50.0)		46 (17.4)	8 (19.1)	14 (23.0)	
50–54	74 (17.1)	21 (26.9)	22 (24.7)		33 (19.4)	11 (30.6)	4 (14.3)		41 (15.5)	10 (23.8)	18 (29.5)	
55–59	62 (14.3)	13 (16.7)	7 (7.9)		17 (10.0)	2 (5.6)	2 (7.1)		45 (17.1)	11 (26.2)	5 (8.2)	
≥ 60	19 (4.4)	0 (0)	4 (4.5)		2 (1.2)	0 (0)	0 (0)		17 (6.5)	0 (0)	4 (6.6)	
Menopausal status[1] [n (%)]												
premenopausal	–	–	–	–	101 (59.4)	21 (58.3)	20 (71.4)	0.640	–	–	–	–
postmenopausal	–	–	–	–	44 (25.9)	11 (30.6)	6 (21.4)		–	–	–	–
Marital status[1] [n (%)]												
single	26 (6.0)	5 (6.4)	5 (5.6)	0.604	12 (7.1)	3 (8.3)	3 (10.7)	0.979	14 (5.3)	2 (4.8)	2 (3.3)	0.343
married	350 (80.6)	59 (75.6)	75 (84.3)		123 (72.4)	25 (69.4)	20 (71.4)		227 (86.0)	34 (81.0)	55 (90.2)	
separated or divorced	32 (7.4)	10 (12.8)	5 (5.6)		21 (12.3)	5 (13.9)	4 (14.3)		11 (4.2)	5 (11.9)	1 (1.6)	
widow	14 (3.2)	4 (5.1)	2 (2.3)		10 (5.9)	3 (8.3)	1 (3.6)		4 (1.5)	1 (2.4)	1 (1.6)	
Education[1] [n (%)]												
primary or vocational	219 (50.5)	42 (53.9)	38 (42.7)	0.133	87 (51.2)	23 (63.9)	18 (64.3)	0.205	132 (50.0)	19 (45.2)	20 (32.8)	0.056
secondary	184 (42.4)	30 (38.5)	40 (44.9)		78 (45.9)	13 (36.1)	9 (32.1)		106 (40.1)	17 (40.5)	31 (50.8)	
university	17 (3.9)	5 (6.4)	8 (9.0)		2 (1.2)	0 (0)	0 (0)		15 (5.7)	5 (11.9)	8 (13.1)	

Night shift work duration (years)												
total (AM±SD)	11.8±0.4	6.7±0.7	0	0.000	8.5±0.5	6.4±0.9	0	0.000	13.8±0.6	6.9±1.0	0	0.000
≤ 4 [n (%)][1]	77 (17.7)	29 (37.2)	89 (100.0)	0.000	43 (25.3)	13 (36.1)	28 (100.0)	0.000	34 (12.9)	16 (38.1)	61 (100.0)	0.000
5–9 [n (%)][1]	109 (25.1)	27 (34.6)	0 (0)		54 (31.8)	15 (41.7)	0 (0)		55 (20.8)	12 (28.6)	0 (0)	
≥ 10 [n (%)][1]	226 (52.1)	16 (20.5)	0 (0)		58 (34.1)	6 (16.7)	0 (0)		168 (63.6)	10 (23.8)	0 (0)	

AM – arithmetic mean; SD – standard deviation.
[1] The frequencies do not sum up to 100% due to missing values, which are not shown in the Table: on 25 night shift and 6 day shift for menopausal status, on 12 night shift and 2 day shift workers for marital status, on 14 night shift and 4 day shift workers for education, on 22 night shift and 6 day shift workers for night shift duration.
[2] ANOVA or Chi^2 test.

Table 2. Distribution of the selected modifiable factors and associations with night shift work among women

Factor	Current day workers [n (%)]		Current night shift workers [n (%)]	Adjusted OR[2] (95% CI)		
	never night shifts workers	former night shift workers		current night vs. current day shifts	former vs. never night shifts	current vs. never night shifts
Smoking[1]						
never	12 (42.9)	11 (30.6)	69 (40.6)	1.00	1.00	1.00
past	6 (21.4)	11 (30.6)	31 (18.2)	0.59 (0.26–1.30)	2.22 (0.56–8.78)	0.93 (0.30–2.97)
current	5 (17.9)	12 (33.3)	69 (40.6)	1.56 (0.74–3.26)	2.66 (0.68–10.46)	2.60 (0.84–8.06)
Recreational physical activity[1]						
active (≥ 2 h/week)	11 (39.3)	12 (33.3)	55 (32.4)	1.00	1.00	1.00
slightly active (1– < 2 h/week)	2 (7.1)	9 (25.0)	39 (22.9)	1.64 (0.69–3.88)	8.66 (0.92–81.22)	7.68 (0.94–62.89)
non active (< 1 h/week)	13 (46.4)	14 (38.9)	66 (38.8)	1.04 (0.52–2.07)	1.08 (0.34–3.45)	1.07 (0.42–2.73)
Alcohol consumption (drinks/week)[1]						
0	14 (50.0)	22 (61.1)	130 (76.5)	1.00	1.00	1.00
>0	7 (25.0)	8 (22.2)	27 (15.9)	0.45 (0.21–0.97)	0.69 (0.19–2.52)	0.39 (0.13–1.14)

Table 2. Distribution of the selected modifiable factors and associations with night shift work among women – cont.

Factor	Current day workers [n (%)]		Current night shift workers [n (%)]	Adjusted OR[2] (95% CI)		
	never night shifts workers	former night shift workers		current night vs. current day shifts	former vs. never night shifts	current vs. never night shifts
Body mass index (kg/m^2)[1]						
< 25	15 (53.6)	22 (61.1)	89 (52.4)	1.00	1.00	1.00
25– < 30	8 (28.6)	8 (22.2)	58 (34.1)	1.72 (0.84–3.51)	0.80 (0.23–2.75)	1.49 (0.56–3.97)
≥ 30	4 (14.3)	5 (13.9)	18 (10.6)	0.70 (0.29–1.71)	0.96 (0.21–4.36)	0.82 (0.23–2.92)

[1] The frequencies do not sum up to 100% due to missing values which are not shown in the Table: on 5 never and 2 former and 1 current night shift workers for smoking, on 2 never and 1 former and 10 current night shift workers for recreational physical activity, on 7 never and 6 former and 13 current night shift workers for alcohol consumption, on 1 never and 1 former and 6 current night shift workers for body mass index.
[2] Adjusted for age, marital status and education.
OR – odds ratio; CI – confidence interval.

Table 3. Distribution of the selected modifiable factors and associations with night shift work among men

Factor	Current day workers [n (%)]		Current night shift workers [n (%)]	Adjusted OR[2] (95% CI)		
	never night shifts workers	former night shift workers		current night vs. current day shifts	former vs. never night shift	current vs. never night shift
Smoking[1]						
never	17 (27.9)	9 (21.4)	72 (27.3)	1.00	1.00	1.00
past	14 (22.9)	16 (38.1)	86 (32.6)	1.10 (0.58–2.09)	2.02 (0.65–6.28)	1.51 (0.67–3.40)
current	26 (42.6)	13 (30.9)	104 (39.4)	1.01 (0.55–1.86)	0.89 (0.30–2.68)	0.98 (0.47–2.02)
Recreational physical activity[1]						
active (≥ 2 h/week)	35 (57.4)	15 (35.7)	109 (41.3)	1.00	1.00	1.00
slightly active (1– < 2 h/week)	12 (19.7)	14 (33.3)	64 (24.2)	1.24 (0.68–2.26)	2.39 (0.85–6.76)	1.79 (0.84–3.85)
non active (< 1 h /week)	11 (18.0)	11 (26.2)	78 (29.5)	1.61 (0.89–2.93)	2.57 (0.89–7.41)	2.43 (1.13–5.22)
Alcohol consumption (drinks/week)[1]						
0	14 (23.0)	10 (23.8)	78 (29.6)	1.00	1.00	1.00
>0	36 (59.0)	25 (59.5)	165 (62.5)	0.87 (0.50–1.54)	1.20 (0.44–3.28)	0.91 (0.45–1.84)

Body mass index (kg/m^2)[1]							
< 25	15 (24.6)	7 (16.7)	60 (22.7)	1.00	1.00	1.00	
25– < 30	28 (45.9)	27 (64.3)	136 (51.5)	0.85 (0.46–1.56)	2.11 (0.72–6.20)	1.18 (0.57–2.47)	
≥ 30	18 (29.5)	8 (19.0)	61 (23.1)	0.85 (0.42–1.74)	0.86 (0.56–2.47)	0.86 (0.38–1.95)	

[1] The frequencies do not sum up to 100% due to missing values, which are not shown in the Table: on 4 never and 4 former and 2 current night shift workers for smoking, on 3 never and 2 former and 13 current shift workers for recreational physical activity, on 11 never and 7 former and 21 current shift workers for alcohol consumption, on 7 current night shift workers for body mass index.
[2] As in Table 2.
Abbreviations as in Table 2.

Among men (Table 3) overweight as well as none or slight recreational activity was more common in the current night shift workers when compared to the never night shifts workers. Recreational inactivity was significantly associated with current night shift work when compared to the never night shift workers (OR = 2.43, 95% CI: 1.13–5.22).

No difference was observed for the average number of main meals per day by night shift work status among both, women and men (Table 4). Nevertheless, current night shift workers tended to report later time of the last meal, in particular among women – on average 29 min later among the current night shift workers when compared to the women never working night shifts. The difference between the female current night shift workers and the current day shift workers was statistically significant (by 25 min, p = 0.04) (data not shown).

Duration of the night shift work was not significantly associated with any of the category of lifestyle factors in both, women and men ever working night shifts (Table 5 and 6). Although, statistically insignificant, some tendency of increasing night shift work duration was observed for increasing BMI categories among both sexes. When BMI was introduced into the model as a continuous variable, a statistically significant and positive relationship with night shift work duration was observed among men (p = 0.029) (data not shown).

DISCUSSION AND CONCLUSIONS

In this cross-sectional study of the middle aged industry workers, we investigated the prevalence of several modifiable factors and their association with night shift work, by current and past night shift work status. To our knowledge, this is the first epidemiological study among Polish night shift blue-collar workers focusing on the lifestyle factors contributing to various chronic diseases. The only statistically significant associations of current night shift work that we observed were: association with recreational

Table 4. Habitual frequency of meals per day and time of the last meal according to the system of work and gender

Factor	Gender	System of work (AM±SD)			p*
		current night shift	former night shift	never night shift	
Meals (n/day)	women	3.30±0.80	3.10±0.90	3.40±0.70	0.365
	men	3.10±0.70	3.10±1.00	3.20±0.80	0.205
Time of last meal (h, min)	women	19:37±1:23	19:15±1:06	19:08±1:19	0.207
	men	19:38±1:16	19:37±1:04	19:25±1:09	0.254

* ANOVA test, adjusted for age, marital status and education.
Abbreviations as in Table 1.

Table 5. Association between the selected modifiable factors and duration of night shift work among women ever working night shifts

Factor	Duration of night shift work [n (%)]		Adjusted[2] years of night shift work duration	
	< 10 years	≥ 10 years	AM	p
Smoking[1]				
never	55 (39.9)	17 (33.3)	9.6	0.653
past	32 (23.2)	10 (19.6)	9.8	
current	49 (35.5)	23 (45.1)	10.6	
Recreational physical activity[1]				
active (≥ 2 h/week)	31 (22.5)	12 (23.5)	9.4	0.605
slightly active (1– < 2 h/week)	49 (35.5)	15 (29.4)	10.5	
non active (< 1 h/week)	48 (34.8)	23 (45.1)	10.4	
Alcohol consumption (drinks/week)[1] (n)				
0	99 (71.7)	39 (76.5)	10.2	0.869
>0	27 (19.6)	8 (15.7)	10.1	
Body mass index (kg/m^2)[1]				
< 25	83 (60.4)	23 (45.1)	9.2	0.271
25– < 30	39 (28.3)	20 (39.2)	10.9	
≥ 30	12 (8.7)	7 (13.7)	11.0	

[1] The frequencies do not sum up to 100% due to missing values, which are not shown in the Table: on 2 workers with < 10 years and 1 worker with ≥ 10 years of night shift for smoking, on 10 with < 10 years and 1 with ≥ 10 years for recreational physical activity, on 12 with < 10 years and 4 with ≥ 10 years for alcohol consumption, on 4 with < 10 years and 1 workers with ≥ 10 years for body mass index.
[2] As in Table 2.
AM – arithmetic mean.

physical inactivity among men, with alcohol abstinence, and later time of the last meal among women.

In addition, our study suggests an association of the night shift work duration with BMI. In general, ORs were similar between the current or past night shift workers when compared to the employees with no history of night work used as a reference.

The subject of potential links between night shift work and chronic diseases has been studied in numerous epidemiological studies. According to the recent review by Wang

Table 6. Association between the selected modifiable factors and duration of night shift work among men ever working night shifts

Factor	Duration of night shift work [n (%)]		Adjusted[2] years of night shift work duration	
	< 10 years	≥ 10 years	AM	p
Smoking[1]				
never	42 (27.8)	35 (24.3)	8.8	0.990
past	47 (31.1)	53 (36.8)	9.2	
current	56 (37.1)	56 (38.9)	9.1	
Recreational physical activity[1]				
active (≥ 2 h/week)	62 (41.1)	61 (42.4)	8.3	0.471
slightly active (1– < 2 h/week)	37 (24.5)	36 (25.0)	9.3	
non active (< 1 h/week)	42 (27.8)	42 (29.2)	7.6	
Alcohol consumption (drinks/week)[1] (n)				
0	37 (24.5)	45 (31.3)	9.1	0.931
>0	97 (64.2)	88 (61.1)	8.9	
Body mass index (kg/m^2)[1]				
< 25	35 (23.2)	31 (21.5)	8.7	0.169
25– < 30	80 (53.0)	75 (52.1)	10.7	
≥ 30	29 (19.2)	38 (26.4)	10.8	

[1] The frequencies do not sum up to 100% due to missing values, which are not shown in the Table: on 6 workers with < 10 years of night shift work for smoking, on 10 with < 10 years and 5 with ≥ 10 years for recreational physical activity, on 17 workers with < 10 years and 11 with ≥ 10 years for alcohol consumption, on 7 with < 10 years for body mass index.
[2] As in Table 2.
AM – arithmetic mean.

et al., the evidence for cardiovascular diseases, including coronary heart disease and stroke, was rated as moderate [1]. Similar conclusion has been made for metabolic syndrome, with associations observed for its components, i.e., obesity, hypertension and increased triglycerides. Data for diabetes type 2, although suggestive, are inconclusive at this point [1,36,37]. Additionally, in some studies, the increased risk of breast, prostate and colon cancer was observed among night shift workers [38–40].

Research on the association between night shift work and lifestyle factors has been less abundant. Nevertheless, in some studies, inferences similar to ours have been observed. Participation in sports activities has been found to be lower among workers of a large international manufacturer [27], blue collar males in Japan [33] and among nurses in Denmark [25] with a tendency for negative change in sport engagement in the run of night shift work [21,29]. Other authors, however, have not reported differences in physical activity between day and night shift workers [16,32] or even have reported higher physical activity as has been observed in the Million Women Study [14].

The studies on this topics are relatively scant thus, the results are inconclusive and more research is needed to clarify these issues. Future investigations, distinguishing between the sources of physical activity would be of importance, since night shift workers might have more physically demanding jobs and hence might report more job-related physical activity, while having lower recreational activity.

In most studies that have addressed smoking habit, a higher prevalence of smoking has been observed among

night shift workers than among these working only during the days [14–27,33], with moderately increased odds ratios for current smoking, up to OR = 1.59 among nurses working night shifts in the US [18]. Moreover, smoking inception seems to be more likely soon after engaging in the night shift work as observed by van Amelsvoort et al. [19]. Remarkably high variability of smoking prevalence has been reported between studies, with as low as 9% current smokers among nurses working night shift in Norway up to 76.9% among Japanese blue collar male workers [33], indicating that not only the year of the survey and gender but also country and performed job matter.

In our study, among women, we saw that current night shift workers had almost twice higher prevalence of current smoking than that observed among never night shift workers (40.8% vs. 21.7%). In the previous study in Polish nurses working rotating night shifts, as many as 35% of women declared current smoking [28]. Among adult women in 2009 in general population of Poland, 22.8% were current smokers (while the respective value for men was 36.8%) [41]. We did not observe differences in current smoking by work system among men, which was relatively high (~40%) in all categories, and about 70% of men ever smoked.

When comparing past smoking, one may observe that in the case of both genders it was more prevalent among former night shift workers relative to the current night shift workers. This suggests that changing system of work from night to day is associated with quitting smoking. One of potential explanations is selection due to the health reasons. Indeed, among former night shift workers (in nurses study) we observed higher frequencies of some diseases diagnosed, for example: coronary heart disease, heart attack, hypertension and high cholesterol [42].

Epidemiological data on associations between night shift work and alcohol drinking are inconsistent, with higher alcohol consumption among night shift workers [15,18,29–31], lower [17,20,24,27,32] or not different [14,16,23,25–27,33,39,43] from that of day workers. Buschnel has observed higher prevalence rate for moderate or heavy drinking among 12-h rotating shift group, while in other categories (including night shift work or rotating with 8 h or 10 h shifts) rates of alcohol consumption were lower in comparison to the 8-h day group [27].

Most women in our study (70%) reported abstinence from drinking alcohol, and only 2 women and 12 men reported drinking more than 7 alcoholic drinks per week, which precluded deeper analysis. Nevertheless, we observed that alcohol abstinence in women was significantly associated with current night shift work. This is in line with the results of our previous study in nurses [28] as well as with the results of several other studies [17,20,24,27,32].

Links between overweight (obesity) or weight gain and the night shift work have been studied most frequently [14–17,20,21,23,24,27,29,31,33,39,44–52], with majority of the studies reporting positive association [14–17,20,23, 24,27,31,39,44–46,48–51]. The recently published review of longitudinal studies addressing weight change vs. shift work by Drongelen et al. identified 8 such studies (2 retrospective and 6 prospective) with the follow up period from 12 months to 14 years [53]. Half of these studies have found positive and significant associations. Our results do not show statistically significant associations for either overweight or obesity, although ORs for overweight were moderately increased among the women currently working night shifts when compared to the current day workers and never night shifts workers. In addition, BMI was significantly related to the night shift work duration among men, which is in line with previous reports.

It has been suggested that night shift may change eating habits. One of the recent reviews identified 20 studies till date examining eating behaviors among night shift workers in comparison to day or afternoon shift workers [54]. Some of them addressed meals frequency and time of the last meal [21,55–57]. Similarly to our results no change in the meal frequency was reported in the early study

of 1300 workers in Japan [54] and in one small study of 16 male shift workers [57]. Others reported either more frequent meals [55,56] or less frequent ones [21].

Interestingly, in our study the hour of the last meal was significantly later among women working night shift, which could contribute to the weight gain, as suggested by some research [58]. Similarly to our finding, a later hour of the last meal has been found in the study of nurses and security staff working late shift: the last meal on average at 22:27 while among day shift workers at 17:52.

Several limitations of this study need to be acknowledged. Even if data were collected through a self-administered anonymous questionnaire, the response rate was relatively low – 55%. Responses to some of the questions were missing (up to 11% for alcohol drinking among women). Information on body weight and height was self-reported, which could result in some misclassification, owing to the general tendency for underestimation of body weight, in particular in people with higher BMI [59]. Therefore, the results must be interpreted with caution. Nevertheless, frequencies of overweight and obesity among the reference group of never night shift workers were comparable to that observed in the general population of Poland [41].

Given the nature of the study, we simplified the study tools in order to obtain a short and simple survey. Therefore, the information we collected was crude with respect to the physical activity and diet. We asked about recreational activities (including sports) but not about household, commuting or occupational physical activity. As regards the diet, we did not attempt to estimate dietary components according to food frequency questionnaire, but instead, we asked about the number of main meals and the hours of the last meal. In addition, the population we studied was heterogeneous with respect to occupational settings. Thus, both occupational co-exposures and physical work demands could vary. Physical overload at work contributes to the overall physical activity and one's fitness. Night shift work occupational co-exposures may be important for the analyses of health outcomes, although, as far as we know, there have been no strong associations between occupational exposures and lifestyle factors established yet.

In summary, in the case of this survey of blue collar workers we did not observe strong associations among women. However, among men we found statistically significant associations between night shift work and poor recreational activity, and between night shift work duration and BMI. These factors contribute to the development of chronic diseases and are modifiable.

ACKNOWLEDGEMENTS

We would like to thank 4 outpatient clinics in Poland: Medicover Centre, Łódź; Health Care "Profilaktyka i Zdrowie," Łódź; Health Care "Remedium," Konstantynów Łódzki, and Medical Practice of Dr. Grażyna Podlasek for their contribution to organization of the study and recruitment of the study participants.

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