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Original papers

Meal time, working in shifts and body mass index – a pilot study

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Abstract

Introduction: Meal time influences the body mass index and night shift can have an impact on the nutrition habits. In this study, we have compared the meal timing of night shift with daily workers and the relation with the body mass index (BMI).
Material and Methods: A convinience sample was recruted via internet. The participants were asked to fill in a questionnaire including demographics, meal habits and physical activity.
Results: There were 38 participants working in night shifts (NSW) and 179 controls. The NSW had higher BMI (p=0.06), with higher percentages of overweight and obesity, significantly higher level of occupational activity (chi2=26.41, p=0.00003) and a significant change (earlier breakfast) in the non working days compared to the working days. In the multivariate regression model, with independent variables (age, time of first meal, time of last meal of the day, occupational physicial acivity and working night shifts) and BMI as outcome, the only significant relation was age (p=0.001). The relation between BMI and having meal after 21h. became marginally significant.
Conclusion: Having late meals and posible irregular ones could be related to the increase in BMI in in NSW.

Keywords: *shift work, meal time, body mass index*

Introduction

Working in night shift has been frequently associated with overweight and obesity, in particular with abdominal disposition of the fat, a main risk factor for the metabolic syndrome [1] and reduction in the prevalence of obesity and its cardio-metabolic consequences is a constant interest in occupational medicine [2]. For example, in a meta-analysis involving 311 334 participants the relative risk for overweight was 1.25 (95% CI = 1.08–1.44] and 1.17 for obesity (95% CI: 1.12–1.22) [3]. The explanation from experimental studies on healthy inviduals was mainly linked to the higher take of energy during the night shift [4] and the disruption of the normal circadian hormonal response to food ingestion, which impairs the glucose tolerance. If diet was restricted to daytime the glucose tolerance was preserved [5]. Not eating at night is a preventive measure supported by various studies. For example, in a controled study on healthy persons that compared eating at night during the night shift with avoiding eating during the night showed that in the second group fasting insulin and glucose were not impaired [6]. In another study, the cardiovascular effects of night shift ([7] assesed as heart rate variation parameters were not affected if meals were restricted to the daytime. Epidemiological research revealed a low level of physical activity [8] in night shift workers, as contributiong factor to obesity.

Meal pattern is a complex concept, covering many aspects such as frequency and timing of food intake, format of meal (food type and combinations or sequencing of nutrients) and context (local, social intake, eating while doing other activities etc). [9]. Large epidemiological studies have tried to identify which is the best meal pattern preventing obesity, but a consensus has not been reached yet. Some studies showed that obesity is related to food intake in the late afternoon or night [10], others that skipping breakfast is a risk [11] or, on the opposite, that large early main meals should be blamed [12]. In a comprehensive review, Pepłońska et al. have identified several poor nutritional habits in night shift nurses such as more alcohol consumpation, less fruit and vegetables, more frequent snacks, later time of the last meal including eating at night and meals irregularity [13].

View of the importance of this public health issue, we have conducted a survey to investigate the frequency and timing of meal intake in night shift wokers (NSW) compared to workers without night shifts in relation with the body mass index (BMI).

Material and methods

A convinience sample of workers was recruited via internet communication. The participants were asked to fill in an anonimous questionnaire and all consent that these data to be further analized. The questionnaire included basic demographic data, weight, height, an item about working in night shifts, occupational physical activity, meal time (breakfast, lunch and dinner) and number of snacks/zi during working days.

BMI was calculated based on the formula: weight (kg)/height (m)2. A BMI value < 18.5 kg/m2 was classified as underweight, between 18.5-25 kg/m2 as normal weight, higher than 25 kg/m2 but less or equal to 30 kg/m2 as overweight, and more than 30 kg/m2, obese. Occupational physical activity had the following options for answering: a) my occupational activity is sedentary almost all the working time; b) my occupational activity is rather sedentary (30-70%) of the working day; c) my occupational activity is rather sedentary less than 30% of the working day; d) my occupational activity involves a medium physical activity almost the whole duration of the working day; e) my occupational activity involves frequent moments of intense physical activity. The answers were coded sequential, from sedentary to high activity level , namely from 0 to 4.

It is generally considered that non working days would be the ones reflecting the reference for the circadian rhytm. Therefore we have compared the breakfast time during working and non working days (BTW-nonW) to see what would be the ideal preference of the breakfast hour if there were no time constraints related to the working schedule. A difference of more than 2h between working and non working time was considered significant.

We used an SPSS software (StatPlus:mac, AnalystSoft Inc. - statistical analysis program for macOS. Version v8) to calculate differences between the two groups and regression analysis to identify the correlations. WE apllied the chi^2 test for the categorical items and Mann Whitney test for the numerical ones. The significance threshold was set at 95%.

Results

A total number of 217 responses were colected. There were 38 participants working in night shifts (NSW) and 179 controls. The responders were mainly women (164). In terms of education, 43 had less than 12 years of formal education, 118 had a university degree and 56 a post university degree. No statistically significant difference was noticed between gender and working in night shifts (chi^2=0.78, p=0.37), but night shift was more frequent in those with lower level of education (34.21%) compared to the highest level of education (7.89%) (chi^2=10.64, p=0.005).

The avearge age was 44.68 years SD ±9.31 in NSW and 40.74 years (SD ±11.7) in controls. The difference was marginally statistically significant (U=2710.5, p=0.051) between NSW and controls.

In terms of occupations there were 97 persons working in various services and professional activities (research, accounting, marketing, etc), 46 in healthcare, 25 in education, 10 working in artistic and recreative services, 14 in manufacturing, and 21 in other activities, containing less than 5 person from the same occupational domain. The highest percentage of NSW was in healthcare (43.47%), followed by manufacturing (28.57%), and the group of “others” (23.81%).

The physical level of occupational activity was significantly different between NSW and controls (chi^2=26.41, p=0.00003). 34.21% of NSW declared a high level of intensity of occupational physical effort, compared with only 9.49% in the control group. A moderate level of physical effort almost the whole duration of the working day was mentioned by 28.95% of the NSW versus 18.44% in controls.

The average BMI on the total sample was 24.9 kg/m2, with a SD ±4.29. In NSW the average BMI was 26.2 kg/m2 (SD=4.4), while in the control group the average was 24.62 kg/m2 with SD ±4.23 (p=0.06).

BMI distribution by range in NSW and in the control cases is represented in Figure 1 and Figure 2. Overall, 13 subjects (6.02%) were underweight (all in the control group), 102 had normal weight (47.22%), 70 were overweight (32.41%) an 31 obese (14.35%). The proportion of overweight and obese was higher in NSW (61%) compared to controls (44%). Comparison of this distribution showed a marginally statistically significant difference (chi^2=7.62, p=0.054).

Figure 1. Distribution of BMI in night shift workers

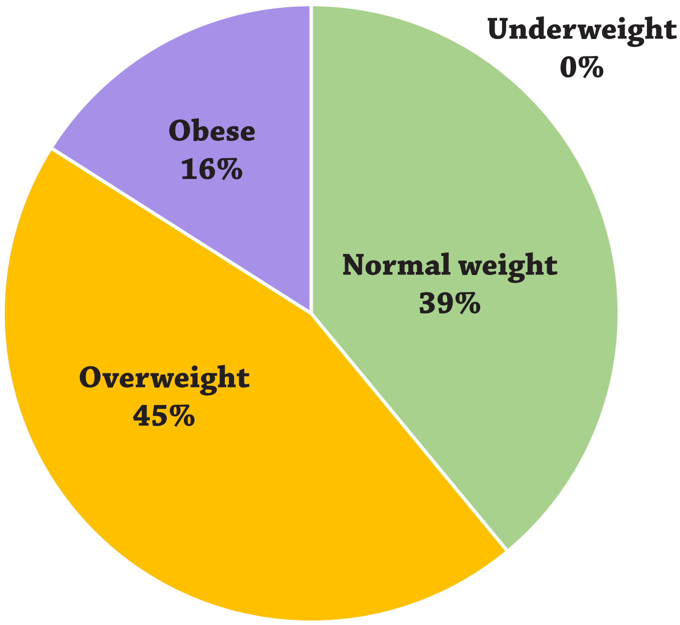
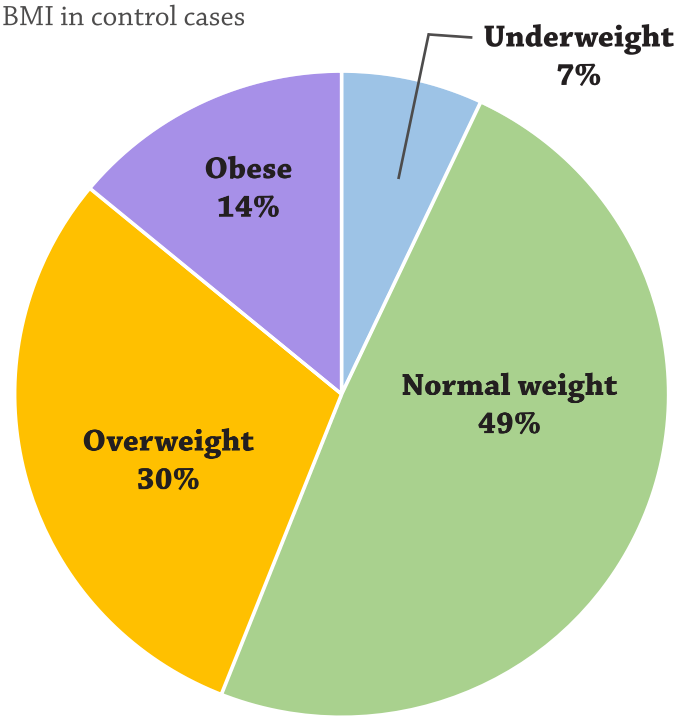


Figure 2. Distribution of BMI in control cases



The comparison of the meal time data is presented in Table 1. In the total sample, the average hour of having breakfast was rather late, with a median of 10 h in both groups. Although NSW had, on average, more snacks during the working days, the difference was not statistically significant (p=0.43). Almost half f both groups had late breakfast.

In total, 22.54% of the participants changed their breakfast hours with more than 2 h during the non working days, compared to working days. Half of them took breakfast earlier and half later. While NSW changed the breakfast hour predominatly to an earlier one, the persons in the control group prefered to have it later; tthis difference, as mentioned in Table 1 was statistically significant.

Table 1. Meal timing in night shift workers and controls

	NSW	Controls	p
Number of snacks/working days (mean + SD)	2.41 (+ 2.23)	1.89 (+ 1.27)	0.43
First meal after 10 a.m (number, %)	16 (44.44%)	77 (43.75%)	0.93
The last meal of the day after 21h (number and %).	6 (16.22%)	30 (16.94%)	0.91
Change in BTW-nonW (number and %)* Earlier breakfast hour Later breakfast hour	 6 (87.71%) 1 (14.28%)	 18 (43.9%) 23 (59.1%)	0.04

Table 2. Relation between night shift and other variables and BMI

	Independent variables	Coeficients	p
Model 1	NSW vs controls (controls as reference)	1.58	0.43
Model 2	NSW (controls as reference) Occupational physical activity	1.67 -0.14	0.93
Model 3	NSW (controls as reference) Early breakfast Dinner before 21 h	1.18 -022 -1.81	0.91
Model 4	NSW (controls as reference) Early breakfast Dinner before 21h Occupational physicial activity Age	0.82 -0.09 -1.46 -0.02 0.08	0.04

All regression models are synthetized in Table 2. All models have BMI as dependent variable.

In the simple regression analysis, BMI was associated with working night shifts (p=0.04). Occupational physical activity did not influenced this relation: in the model including night shift and occupational physical activity as independent variables and BMI as dependent one, the relation with night shift maintained its statistical significance (p=0.04), while ccupational physical activity was statistically non significant (p=0.55).

On the other side, having a meal after 21 h modified the relation between night shift and BMI, namely made this relation statistically non significant (Table 2).

However, if in the multivariate regression model, when all independent variables (age, time of first meal, time of last meal of the day, occupational physicial acivity and working night shifts) were introduced, the only significant relations were with age (p=0.001). In this model, the relation between BMI and having meal after 21 h became marginally significant (Table 2).

Discussion

Identification, and as much as possible avoidance of the influencers of BMI in the working age (people less than 65 years old) is important, as BMI at this ages is correlated with higher mortality [14].

In our pilot study, NSW had significant higher BMI, higher occupational physical activity and more irregular breakfast times and meals after 21 h. The most significant influencer of BMI was age, while having dinner after 21 h was marginally significant.

Age influence on BMI is an expected result. In earlier studies, BMI had an inverted U shape in the population according to age, reaching the highest level in adulthood, which corresponds to the working age [15]. This pattern have changed nowadays and from the last Romanian population statistics, there is a tendency of constant increase in prevalence or the overweight and obesity by age groups. In the most recent published data, this prevalence was 45.6% in 25-34 years, 59.6% in the group of 35-49 years and 71.7% in the group age 50-64 years [16]. Compared to these figures, our group has lower prevalence of overweight and obesity and, therefore should be entirely representative of the Romanian population. Nevertheless, age strong influence on BMI has been confirmed in our study and was a confounder of the correlation between night shift and BMI.

Another interesting result is that having late meals (after 21 h) associates higher BMI. This finding is in line with litterature data which showed that the regular night meals [17] are associated with BMI increase. The peripheral circadian genes have different expression after food intake dependent on the time of day. In an experimental study, more genes involved in lipid metabolism are expressed after a food intake in the mornig than in the night [18]. For that reason, same caloric food have different consequences according to the time of day when this intake takes place. A meta-analysis also showed that food intake during the night lead to a poorer glucose tolerance than daily intake [19]. Other study found that daytime eating and avoidance of eating during night, may mitigate changes in cardiovascular risk factors [7]. These findings support the integration of nutrition behavior as part of the strategy to minimize the adverse changes of circadian misalignment in NSW.

In NSW, there is a shift towards earlier breakfasts in the non working days, while in the control group the tendency is the opposite. This result could reflect the fact that breakfast meal time is disaligned in NSW and the spontaneous behaviour to correct it in non working days, when there are no more occupational constraints. Weather this is a correction mechanism or not we could not appreciate, but what we have some evidence about is that irregular meals increase the change of metabolic syndrome [19]. Other study found that daytime eating and avoidance of eating during night, may mitigate changes in cardiovascular risk factors [7] but that earlier breakfast or earlier midpoint meal (the average between first and last meal) are healthier habits [20].

We did not found any relation between the occupational physical activity and BMI. Marginal association with BMI in women and no association in men was found in a large Canadian study [21] and a direct relation (high physicial activity, high BMI) in a large US study involving the Hispanic community members. [22]. This paradox extends to the studies investigating the influence of the occupational physical activity and the cardiovascular risk. Mainly from studies conducted in developed countries, a this paradox refers to the inverse relation between the effects of leisure and occupational physical activity on BMI: while leisure physical activity seams to be beneficial, occupational physicial activity, particularly of high intensity appears to be detrimental [23]. The explanation proposed for this paradox includes: duration of the effort which is constraint and not voluntary (therefore, increasing the heart rate for too long), heavy lifting with maintaining akward positions or low time for recovery with persistance of the low grade inflammation related to exercise [24].

In what concerns the NSW, it is also significant to mention the total energy expenditure (TEE) is composed by resting metabolic rate (RMR), the thermic effect of food (TEF) and the energy requested for the physical effort. The first components represent the largest part of the TEE, around 60-80% for RMR, and 10% for TEF [25]. Both forms of energy expenditure are lower during the night [26]. Even more, the TEF, for the same calories intake, is lower in night time compared to daytime meals.

Limitations

This is a pilot study to test the hypothesis that meal time influences BMI in NSW and these preliminary results encourage the continuation of the research in this field. The small number of participants and the predominantly women and NSW from one domain (healthcare), reduces the representativity of the results to all NSW. Due to the limited number of the participants we could not stratify our results by age, to directly compare only people in the same age category in order to eliminate this confounder.

Another limitation is the collection of data via the internet, without the possibility to contact the responders and to complete the missing data.

However, it looks like our hypothesis could be tested further on, on a large sample, with various categories of NSW to conclude about the significance of the meal time changes (modifiable risk factor) in the prevention of overweight and obesity in this category of personel.

Conclusions

This is one of the few studies on Romanian workers concerning the HCW and their meal habits. These preliminary results, showing that having late meals and posible irregular ones in NSW are related to the increase in BMI, should be confirmed in future, larger studies.

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