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Association between Shift Working and Markers of Obesity: A Cross Sectional Study on Taxi Drivers in Yazd, Iran

Vida Rezaei Hachesu; MSc[1] & Shadi Naderyan Feli; MSc*[2]

[1] *Department of Occupational Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.*
[2]*Department of Biostatistics and Epidemiology, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.*

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Corresponding author:
Naderyan67@yahoo.com
Department of Biostatistics and Epidemiology, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

Postal code: 8915173160
Tel: +983538209114

ABSTRACT

Background: Obesity is one of the most important health problems, so it is very important to identify its causes. Shift work is one of the factors that causes people to become obese. The aim of this study was to examine the relationship between shift work and obesity in taxi drivers. **Methods:** In this cross sectional study conducted in 2016, 120 male taxi drivers from Yazd were studied for demographic characteristics and some anthropometric indices. To describe the data, descriptive statistics were used; to compare the prevalence of overweight, general and abdominal obesity, chi-square test was used and to compare quantitative variables, independent t-test and Mann-Whitney test were used. **Results:** The results showed that the mean weight, waist circumference, body mass index and waist to hip ratio (WHR) were significantly higher in shift workers ($P < 0.05$). In this study, the prevalence of overweight in shift and day workers was 41.4 and 46% ($P = 0.61$), general obesity was 34.3 and 20% ($P = 0.08$), and abdominal obesity was 82.9 and 82% ($P = 0.90$), respectively. Spearman correlation coefficient showed a positive and significant correlation between age and WHR as well as work experience and WHR in shift workers (r = 0.34 and r = 0.31, respectively). Also, a positive and significant correlation was found between age and WHR in day workers (r = 0.35). **Conclusions:** The results of this study showed that shift work in taxi drivers is associated with an increased probability of overweight, general and abdominal obesity.

Keywords: *Taxi drivers; Shift work; Obesity*

Introduction

Any work done out of the usual daily working hours (contracted from 7 a.m. to 6 p.m.) is considered shift work. Shift work is one of the stressful occupational factors and has adverse effects on the human health (Wang *et al.*, 2011). Shift work in terms of various aspects can have devastating effects on the physical and mental health, safety, efficiency, family and social status (Bøggild and Knutsson, 1999, Knutsson, 2003). Shift work-related diseases mentioned in some studies can be cardiovascular diseases, digestive disorders, diabetes, cancer, and metabolic disorders (Kim *et al.*, 2013, Tada *et al.*, 2014). The mechanisms that link shift work to health

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problems are not entirely clear, but changes in circadian rhythm, sleep problems, stress, inappropriate lifestyle like unbalanced diets and smoking are potential causes (Knutsson, 2003). Weight gain in shift workers can be attributed to several factors such as genetic factors, glucose and lipid hemostasis, thrombogenic responses, nutritional patterns at night, and hormonal neurological factors such as leptin and ghrelin (Antunes *et al.*, 2010).

Obesity is a risk factor for many chronic diseases. Many studies have demonstrated that the prevalence of overweight and obesity among shift workers is higher than that of day workers (Di Lorenzo *et al.*, 2003, Macagnan *et al.*, 2012). Some studies also have pointed to the relationship between obesity and shift work (Manenschijn *et al.*, 2011, Samara *et al.*, 2016, Van Drongelen *et al.*, 2011). In the study conducted by Kim et al. among female nurses, the prevalence of overweight and obesity was significantly higher in shift work nurses (18.6 and 7.4%, respectively) (Kim *et al.*, 2013). In addition, the results of the 14-year retrospective cohort study of 7,254 male workers from Japan steel industries between 1991 and 2005 by Suwazon et al. showed that rotational shift work is an independent risk factor for obesity (Suwazono *et al.*, 2008).

Today, obesity is a major health concern and drivers, especially those who have shift working, are among the most at risk groups. Despite that, association between shift work and obesity has not been well known (Kim *et al.*, 2013, Peplonska *et al.*, 2015, Tada *et al.*, 2014) and the status of obesity in shift work taxi drivers has been less frequently studied. Therefore, the present study was conducted to examine the relationship between shift work and obesity of urban taxi drivers in Yazd city in Iran.

Materials and Methods

Study design: The present study is a cross sectional study that was conducted in the spring of 2016 among 120 taxi drivers of Yazd in two groups of shift workers (n = 70) and day workers (n = 50). Sampling was done by a simple random sampling method and using a sampling frame; so that the list of drivers' names was taken from the taxi union and then numbered, after that, the names were removed and 120 numbers (drivers) were selected randomly from the numbers. The number of samples required for the study was calculated by taking into consideration p = 0.22 of similar studies and d = 0.07 using the sample size formula for estimating the proportion. The inclusion criterion was working at least one year in Yazd taxi and having a second job was the exclusion criterion. In this study, shift work was defined as working hours out of 7 a.m. to 6 p.m. when drivers work rotationally in day-to-day taxi.

Data collection: Age, work experience and work system (shift work/day work) were recorded based on verbal interview of the subjects. The weight was measured by a calibrated digital scale (Omron, Japan) and the height was measured by placing the heel, hip and head in a direction by the fixed tape meter on the wall. The waist circumference was measured in the interspaced area between the last rib and the iliac crest (WHO, 2011) and the hip circumference was measured in the area of the largest pelvic circumference area using a non-elastic strip meter. The above measurements were performed with minimum coverage and no shoes.

Body mass index (BMI) was calculated based on the weight in kilograms divided by height squared in meters. According to WHO recommendation for Asian populations, the range of this index from 18.5-24.9 kg/m² was normal weight, 25-29.9 kg/m² was overweight and equal or greater than 30 kg/m² was general obesity (WHO, 2004). By dividing the waist circumference by the hip circumference the waist to hip ratio (WHR) was obtained. According to WHO criteria, if this value is greater than or equal to 0.90 in men, it is considered as abdominal obesity (WHO, 2011).

Data analysis: The data were analyzed using SPSS 16 software. The descriptive statistics (mean, standard deviation, and frequency distribution table) were used to describe the data.

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To compare the grouping variables, chi-square test was used and for the comparison of quantitative variables, independent t-test and Mann-Whitney U test were used. The significance level of statistical tests was considered as $P < 0.05$.

Ethical considerations: This study was conducted after obtaining the approval of the Ethics Committee of Shahid Sadoughi University of Medical Sciences in Yazd, and the informed consent of all participants in the research was taken.

Results

All subjects were male in this study. A total of 41.7% of them were day drivers and 58.3% of them were shift drivers. In **Table 1**, the mean and standard deviation of the demographic and anthropometric variables of the subjects are presented in terms of the shift work status. According to this table, the mean weight, waist circumference, BMI and WHR in shift drivers was significantly higher than that of day drivers ($P < 0.05$). No significant difference was found between the mean age, work experience, height and hip circumference in the two groups.

The prevalence of general and abdominal obesity in shift drivers was higher than that of day drivers, but the prevalence of overweight is higher in day drivers (**Table 2**).

The prevalence of overweight in those who worked 8 hours and less per day was higher than those who worked more than 8 hours. The prevalence of general and abdominal obesity among those who worked more than 8 hours per day was higher than those who worked 8 hours and less (**Table 3**).

Based on the correlation coefficients presented in **Table 4**, a positive and highly-significant correlation was found between age and WHR as well as work experience and WHR among shift drivers ($P = 0.004$ and $P = 0.008$, respectively). Also, a positive and significant correlation was seen between age and WHR among day drivers ($P = 0.011$).

Table 1. The demographic and anthropometric variables of the participants

Variables	Mean ± SD	P-value
Age (year)		
Shift work	48.60 ± 12.67	0.08[a]
Day work	44.08 ± 10.54	
Work experience (year)		
Shift work	11.24 ± 7.11	0.55[†]
Day work	11.40 ± 9.32	
Weight (kg)		
Shift work	84.52 ± 14.35	0.01[a]
Day work	78.27 ± 10.62	
Height (cm)		
Shift work	172.65 ± 6.47	0.39[b]
Day work	171.58 ± 7.02	
Waist circumference (cm)		
Shift work	100.43 ± 15.70	0.04[a]
Day work	96.86 ± 7.59	
Hip circumference (cm)		
Shift work	105.31 ± 12.35	0.12[a]
Day work	103.48 ± 5.49	
Body mass index (kg/m^2)		
Shift work	28.33 ± 4.31	0.01[b]
Day work	26.59 ± 3.27	
Waist to hip ratio		
Shift work	0.96 ± 0.16	0.04[a]
Day work	0.94 ± 0.04	

[a]: Mann-Whitney U test; [b]:Student *t-test*

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Table 2. Comparison of shift and day drivers' anthropometric status

Variables	N (%)	P-value[a]
Normal body mass index		
Shift work	14 (20.0)	0.13
Day work	16 (32.0)	
Overweight		
Shift work	29 (41.4)	0.61
Day work	23 (46.0)	
General obesity		
Shift work	24 (34.3)	0.08
Day work	10 (20.0)	
Abdominal obesity		
Shift work	58 (82.9)	0.90
Day work	41 (82.0)	

[a:] Chi-square test

Table 3. Comparison of the participants' anthropometric status according to working hours

Variables	Working hours	N (%)	P-value[a]
Normal body mass index	8 hours and less	16 (32.0)	0.13
	more than 8 hours	14 (20.0)	
Overweight	8 hours and less	23 (46.0)	0.61
	more than 8 hours	29 (41.4)	
General obesity	8 hours and less	10 (20.0)	0.08
	more than 8 hours	24 (34.3)	
Abdominal obesity	8 hours and less	41 (82.0)	0.90
	more than 8 hours	58 (82.9)	

[a:] Chi-square *test*

Table 4. Correlation coefficient between studied variables

Variables	Spearman correlation coefficient	P-value
Age & Body mass index		
Shift work	0.009	0.941
Day work	0.121	0.402
Work experience & Body mass index		
Shift work	0.141	0.246
Day work	0.008	0.956
Age & Waist to hip ratio		
Shift work	0.344	0.004
Day work	0.357	0.011
Work experience & Waist to hip ratio		
Shift work	0.313	0.008
Day work	0.130	0.367

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Discussion

In our study, the mean weight, waist circumference, BMI and WHR were significantly higher among shift workers. In Uki Tada study on female nurses, the mean BMI was significantly higher in shift workers than in day workers (Tada *et al.*, 2014). In Ishizaki study on workers of a metal melting plant, the mean BMI and WHR were significantly higher in shift workers than in day workers (Choi *et al.*, 2017). Moreover, in the study conducted by Marqueze et al. on truck drivers, the mean BMI was significantly higher in shift workers than in day workers (Marqueze *et al.*, 2013), which is in line with our study results. The results of our study indicated the high prevalence of overweight and general obesity, as well as very high prevalence of abdominal obesity among all the studied drivers (shift and day workers). In addition, general and abdominal obesity was more frequent among shift workers than day workers. These results are consistent with the results of several studies (Chen *et al.*, 2010, Kim *et al.*, 2013, Peplonska *et al.*, 2015). The mechanism of the relationship between shift work and weight gain has not been fully explained. Despite this, several factors such as unhealthy food habits, sleep deprivation, circadian rhythm disorder and low level of physical activity have been suggested as potential causes (Lowden *et al.*, 2010). Sleep deprivation and circadian rhythm disorder affect the mechanisms of metabolism and hunger, leading to unhealthy nutritional behaviors, which include irregular meals, high caloric and low fiber food consumption, along with frequent sweets during the night. On the other hand, studies have shown that lack of sleep leads to a reduction in the concentration of leptin and an increase in the concentration of ghrelin, which likely leads to an increase in appetite and overweight (Chen *et al.*, 2010, Lemke *et al.*, 2015). Furthermore, shift working may lead to stress. Chronic activation of stress system including secretion of glucocorticoids and catecholamine from the adrenal gland may result in abdominal adiposity and other metabolic disorders (Wang *et al.*, 2011).

Several studies have reported that workers with more working hours have higher BMI (Bray and Young, 2007, Magee *et al.*, 2011), confirming our study results; where the prevalence of general and abdominal obesity in those who worked more than 8 hours per day was higher, compared with drivers who worked 8 hours and less. Long working hours can lead to sleep and circadian rhythms disorders, both of which play an important role in metabolic problems such as obesity (Scott *et al.*, 2008). Studies have shown that those who have long working hours are less likely to exercise, eat faster and spend more time watching television, which can lead to weight gain (Basner *et al.*, 2007, Lemke *et al.*, 2015). Driving is one of the most stressful occupations (Scott *et al.*, 2008). Moreover, since stress can lead to some undesired behaviors, it plays an important role in the relationship between working hours and obesity. On the other hand, those who have long working hours are more likely to be exposed to stress and exhibit undesired behaviors such as smoking, alcohol consumption as well as overeating as a way to manage their stress (Ishizaki *et al.*, 2004). Stress also causes cortisol secretion, which leads to weight gain (Gu *et al.*, 2012).

In this study, a positive and significant correlation was seen between age and WHR and between work experience and WHR. Also, this can be justified given the fact that those with higher work experience will have a cumulative effect of disorders in the body's circadian rhythm, inappropriate nutrition, inactivity, and other factors. Also, aging can justify a positive correlation with abdominal obesity by this mechanism.

Given that the present study is a cross-sectional study, it is impossible to establish a causal relationship between shift work and overweight or obesity. Other limitations of this study include lack of control group, non-participation of female drivers and the lack of control of some confounding variables, for example, it has not been determined whether the subjects were overweight and obese after entering the job, or were also obese before entering. Furthermore, individuals with

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certain obesity related diseases, such as depression, Hypothyroidism, were not excluded. Studies on examining the relationship between shift work and obesity of taxi drivers in our country are a handful. For this reason, conducting the present study is one of its strengths; in addition, it is suggested to conduct more comprehensive studies with a larger sample size and considering female drivers as well as the control group.

Conclusion

According to the results of this study, shift work can be considered as an effective factor on overweight and obesity. Regular measurement of anthropometric indices such as body mass index, modification of individual habits such as following a balanced nutrition program and having sufficient physical activity among drivers, especially shift work drivers, is strongly recommended.

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Author's contribution

The study was designed by Rezaei Hachesu V and statistical analysis was performed by Naderyan Feli S. Data collection and writing manuscript were performed by both authors. Both authors reviewed the paper and confirmed it.

Conflict of interest

The authors have no conflicts of interest to report.

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