Advances in Nursing and Midwifery Original Article
Summer 2021, Volume 30, Issue 2 (8-14)

The Relationship between Metabolic Syndrome and Shift Work in Midwives: A Cross Sectional Study

Azadeh Karami [1], **Sedigheh Amir Ali Akbari** [2,*], **Maliheh Nasiri** [3], **Farzad Hadaegh** [4]

[1] MSc, Department of Midwifery & Reproductive Health, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[2] Associate Professor, Midwifery and Reproductive Health Research Center, Department of Midwifery and Reproductive Health, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[3] Associate Professor, Department of Basic sciences, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[4] Professor of Endocrinology & Metabolism, Prevention of Metabolic Disorders Research Center, Research Institute for Endocrine Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran

** Corresponding author: Sedigheh Amir Ali Akbari, Associate Professor, Midwifery and Reproductive Health Research Center, Department of Midwifery and Reproductive Health, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran. E-mail: akbarisedd@sbmu.ac.ir*

DOI: 10.22037/jnm.v30i2.34288

Submitted: 05 Dec 2020
Accepted: 17 Mar 2021
Published: 15 Apr 2021

Keywords:
Midwives
Shift Work
Metabolic Syndrome

How to cite:
Karami A, Amir Ali Akbari S, Nasiri M, Hadaegh F. The Relationship between Metabolic Syndrome and Shift Work in Midwives: A Cross Sectional Study. *Adv Nurs Midwifery*. 2021;30(**2**):8-14. doi: 10.22037/jnm.v30i2.34288

Abstract

Introduction: Recent studies suggest that shift work can be associated with the incidence of metabolic syndrome. The present study was conducted in 2019 to investigate the relationship between metabolic syndrome and shift work in midwives working in hospitals affiliated to universities of medical sciences in Tehran, Iran.

Methods: The present analytical cross-sectional study recruited 216 midwives who satisfied the inclusion criteria. Questionnaires were first used to collect demographic information and job records. Waist circumference and blood pressure of the subjects were then measured. A 12-hour fasting blood test was performed to determine fasting blood sugar (FBS), triglyceride and HDL levels. The frequency of metabolic syndrome was ultimately evaluated based on the Harmonized criteria. Data were analyzed in SPSS using the Chi-square and Fisher's exact tests.

Results: The prevalence of metabolic syndrome was found to be 6.9% in the midwives using the Harmonized criteria. Although the prevalence of metabolic syndrome was higher in the night-shift workers (11.5%) compared to that in the other two groups, but the difference was not significant. Low HDL cholesterol and abdominal obesity were respectively the most frequent metabolic syndrome criteria. Significant relationships were observed between low HDL cholesterol and night shift (P<0.001), and also between abdominal obesity and rotational shift work (P<0.001).

Conclusions: According to the present findings, a higher prevalence of metabolic syndrome was observed in the night-shift workers, and rotational shift work was found to be significantly associated with two of the metabolic syndrome criteria, namely low HDL levels and abdominal obesity.

INTRODUCTION

Metabolic syndrome encompasses a collection of risk factors that increase the risk of cardiovascular diseases and type II diabetes, including abdominal obesity, high cholesterol levels, hypertension, and diabetes and elevated FBS [1]. This condition is also referred to as dysmetabolic syndrome, cardiometabolic syndrome, syndrome X:"the deadly quarter" and insulin resistance syndrome. The relationships and categories of these risk

factors have long been known [2]. Metabolic syndrome is the risk factor for progressive diabetes and cardiovascular diseases [3].

Research suggests a coincidence in metabolic factors in different individuals, and that a combination of these factors is more harmful than each factor individually. Mortality from cardiovascular diseases is specifically higher in patients with metabolic syndrome [4]. The prevalence of metabolic syndrome has been increasing in recent years in both developed and developing countries [1]. Metabolic syndrome is believed to be associated with lifestyle, including nutrition, physical activity, smoking and drinking alcohol [3, 5]. Research shows that shift work is associated with metabolic syndrome [3, 6]. Shift work is a work schedule that includes irregular and uncommon working hours compared to those with regular daytime working hours. Different work schedules can be defined as shift work, including night shift and rotational shift work [7]. In the world, 20% -50% of the workforce deals with shift work [8]. Endogenous fluctuations in living creatures are associated with time, day and seasons of the year. These fluctuations referred to as the biological cycle or circadian cycle regularly repeat over 24±4-hour periods. The circadian cycle is adjusted by periodical environmental changes, including light-dark cycles. The living creatures' health is affected by the potential imbalance between the biological rhythm and environmental cycles. These endogenous cycles are adjusted by neuro-humoral factors such as glucocorticoid and melatonin as well as social cycles such as nutrition and working time. Human is the only creature that has voluntarily changed his time of activity to unusual times. This change modifies sleeping patterns and food habits and therefore affects the circadian cycle, which in turn affects the endocrine system and can cause serious consequences such as metabolic diseases [9, 10]. Shift work is associated with negative outcomes for the physical and mental health of employees, including family-work conflicts, unhealthy eating habits, affect sleep and contribute to sedentarism, increased fatigueand stress, night shift adjustment problems, increased risks of cardiovascular problems, gastrointestinal problems, cancer, other metabolic disorders, such as insulin resistance, dyslipidemias [10-12]. Although the mechanism of the relationship between shift work and health problems is unclear, changes in the circadian cycle, sleep problems, stress, lifestyle and behavioral changes such as diet and smoking may be the potential mediators [13]. Individuals' health and survival depend on the services provided by medical teams and required by the community round-the-clock. As healthcare providers, hospital employees are obliged to work at all hours of the day to meet patient needs [14]. Research suggests that dealing with patients, performing clinical processes, facing dying patients, inadequate or defective equipment, facing emergencies and unpredictable situations, high levels of workplace noise, rotational shift work and the location of service delivery, i.e. hospital or clinic, are stressful professional factors for hospital personnel, especially in the maternity ward [15]. Although working hours have been well studied in nurses and physicians, little information is available about other health workers [16]. A prospective study conducted on nurses' health showed that the risk of developing cardiovascular diseases is higher in nurses with rotational shift work for over six months compared to those who had never experienced rotational shift work or experienced it for fewer years; nevertheless [17], a systematic study did not suggest compelling evidence for the relationship between metabolic syndrome and shift work [18]. Another study conducted on health workers reported a significant relationship between metabolic syndrome and shift work [19]. Given the absence of studies in literature on metabolic syndrome in midwives in Iran, the present study was conducted in 2019 to determine the relationship between metabolic syndrome and shift work in midwives working in hospitals affiliated to universities of medical sciences in the city of Tehran.

METHODS

After receiving the approval of the Ethics Committee of Shahid Beheshti University of Medical Sciences (Code: IR.SBMU.PHNM.1395.481) and a letter of introduction from the Deputy of Research of this university, a list of hospitals affiliated to Shahid Beheshti University of Medical Sciences, Tehran University of Medical Sciences and Iran University of Medical Sciences was prepared, permission was received from the authorities of the hospitals and the number of midwives working in each center was determined. The present analytical cross-sectional study used convenience sampling to select the subjects. The objectives of the research were explained to all samples. Written consent was obtained from them to participate in the research. The inclusion criteria comprised an age of below 40 years, the absence of a history of diseases such as diabetes, dyslipidemia, hypertension, cardiovascular diseases and heart attack in family members under the age of 65, the absence of chronic diseases that are potentially associated with metabolic syndrome components, including polycystic ovary syndrome, infectious diseases, fatty liver and gout, avoiding the consumption of herbal medicines in the

course of the study, not being pregnant, no breastfeeding, no history of gestational diabetes and no intense to moderate physical activities for more than 120 minutes a week. Moreover, the eligible midwives should not have made any changes in their working schedule over the previous year based on their own self-report. The following formula was used to determine the sample size.

$$n = p(1-p)z^2/d^2$$

P=0.3, z=1.96, d=0.06

The data collection tools consisted of:

1-Demographic-shift work questionnaires that validated using the content validity method,

2-Non-elastic tape measure with a precision of 1 mm (Seca Company, Germany) for measuring waist circumference. The reliability of the tape measure was confirmed by comparing it with a standard inelastic tape measure that is not affected by weather conditions and the concurrent validation method was used.

3-Blood pressure was also measured using the German-made Richter sphygmomanometer with a ±10 mmHg error, whose reliability was assessed by comparing it with a reference sphygmomanometer after performing ten measurements.

4-A glucose oxidase kit was used to measure FBS, an enzymatic colorimetric method with glycerol-phosphate oxidase to measure serum triglyceride and an enzymatic colorimetric method with cholesterol oxidase (Pars-Azmon Company, Iran, approved by the Institute of Standards and Industrial Research of Iran) to measure total serum cholesterol using the COBAS MIRA device. To confirm the reliability of the device and laboratory kits, one of the subject's blood samples was assessed five times with the device. The reliability of the checklist for observations was assessed using the concurrent validity method. All the measurements were performed by only one person and all the tests by a laboratory scientist.

The participants were divided into three groups according to their type of shift work, including the permanent night-shift with only night-shifts in the previous year, the day-shift working from 7 a.m. to 7 p.m. in the previous year and the rotational shift with at least four night shifts per month in the previous year. Metabolic syndrome was confirmed in the present study if at least three out of the following five criteria, known also as the harmonic criteria, were met: (1): A waist circumference of at least 90 cm in men and women, (2): Triglyceride≥150 mg/dl or its specific treatment, (3): HDL cholesterol below 40 mg/dl in men and below 50 mg/dl in women or its specific treatment, (4): Hypertension (a diastolic blood pressure of at least 85 mmHg and a systolic blood pressure of at least 130 mmHg) or taking antihypertensive medications and (5): Fasting blood sugar≥100 mg/dl or using anti diabetic drugs [2, 20]. The demographic-shift work questionnaire was completed by all participants. Waist circumference was measured after a normal exhalation in a private setting at the level of the umbilicus with no clothing using a tape measure accurate to 1 mm, and blood pressure was measured and recorded twice using a sphygmomanometer after sitting for 15 minutes. One ml of 12-hour fasting blood samples was collected from all the participants between 7 a.m. and 9 a.m., and the samples were immediately centrifuged and the isolated serum was kept at -20 °C until all the samples were collected. All the samples were analyzed by a laboratory sciences expert. FBS was measured using a glucose kit made by Pars Azmon Company. Serum triglyceride was measured using an enzymatic colorimetric method and glycerol-phosphate oxidase. Total serum cholesterol was measured using an enzymatic colorimetric method and cholesterol oxidase. High-density lipoprotein-cholesterol levels were measured after depositing APO-containing lipoproteins using a phosphotungstic acid solution. The prevalence of metabolic syndrome was ultimately determined in each of the groups. The data collected using the questionnaires were statistically analyzed in SPSS-18. The descriptive statistics used to describe the demographic information and the study variables comprised measures of central tendency and measures of dispersion, including mean and standard deviation. The data were analyzed, the study hypotheses were tested, the three groups were compared with one another and the relationship between metabolic syndrome and shift work was ultimately evaluated in the midwives using inferential statistical methods, i.e. The Chi-square and Fisher's exact test. P<0.05 was set as the level of statistical significance.

RESULTS

The present study was conducted on 216 midwives working in hospitals affiliated to universities in Tehran. The mean age of the participants was a 30.97±6.16 year, with the highest frequency of age being associated with the 25-30 year olds (34.7%). A total of 57.4% of the participants worked 50-100 hours' overtime, a mere 4.2% had a second job, and 10.2% exercised professionally. The mean daytime sleep duration was 1.06 ±0.93 hours, and the mean nighttime sleep duration 6.80±1.29 hours, other finding are shown in Table 1.

Significant relationships were observed between low HDL cholesterol and night shift (P<0.001), and also

between abdominal obesity and rotational shift work (P<0.001) (Table2).

The results showed that the rate of metabolic syndrome was higher among midwives with rotational shift but was not statistically significant (Table 3).

Table 1. Details of the Midwives in Three Groups, Namely the Day-Shift, the Night-Shift and the Rotational Shift, Working in Hospitals Affiliated to Universities of Medical Sciences in Tehran

Groups Variables	Day Shift	Night Shift	Rotational Shift
Age(year)			
25≤	2(3.8%)	6(23.1%)	37(27%)
26-30	11(20.8%)	7(26.9%)	57(41.6%)
31-35	16(30.2%)	9(34.6%)	22(16.1%)
36-40	24(45.3%)	4(15.4%)	21(15.3%)
Education			
Graduate of Midwifery (Associate degree)	0(0%)	0(0%)	2(1.5%)
Bachelor of Midwifery	51(96.2)	23(88.5%)	124(90.5%)
Master of Midwifery	2(3.8)	3(11.5%)	11(8%)
Marital statues			
Single	20(30.7%)	13(50%)	55(40.1%)
Married	33(62.3%)	13(50%)	82(59.9%)
Work experience(year)			
5≤	5(15.2%)	11(42.3%)	82(59.9%)
5-10	9(27.3%)	13(50%)	30(21.9%)
11-15	6(18.2%)	2(7.7%)	12(8.8)
≤15	13(39.3%)	0(0%)	13(9.5%)
Type of employment			
Official employment	36(67.9%)	8(30.8%)	25(18.2%)
Contractual employment	17(31. %)	18(69.2%)	112(81.8%)
Service location			
Labor Ward	11(20.8%)	6(23.1%)	63(46%)
Postpartum Ward &clinic	42(79.2%)	20(76.9%)	74(54%)

Table 2. Comparison of Harmonized Criteria in Midwives in Three Groups, Namely the Day-Shift, the Night-Shift and the Rotational Shift, Working in Hospitals Affiliated to Universities of Medical Sciences in Tehran

Groups Variables	Night Shift	Day Shift	Rotational Shift	Result
Abdominal circumference(cm)				P=0.001 χ2=14.73
<90	22(84.6%)	48(90.6%)	89(65%)	
90≤	4(15.4%)	5(9.4%)	45(35%)	
Triglyceride (mg/dl)				F=3.1 P=0.24
150>	23(88.5%)	51(96/2%)	132(96.4%)	
150≤	3(11.5%)	2(6.8%)	5(3.6%)	
Fasting blood sugar (mg/dl)				3.23, F= P=0.19
100>	23(88.5%)	52(98.1%)	127(92.7%)	
100≤	3(11.5%)	1(1.9%)	10(7.3%)	
Systolic blood pressure (mmHg)				10.49, F= P=0.003
130>	25(96.2%)	48(90.6%)	136(99.3%)	
130≤	1(3.8%)	5(9.4%)	1(0.7%)	
Diastolic blood pressure (mmHg)				14.08, F= P=0.001
85>	26(100%)	47(88.7%)	137(100%)	
85≤	0(0%)	6(11.3%)	0(0%)	
Cholesterol HDL (mg/dl)				42.47, F= p<0.001
50>	25(96.2%)	30(56.6%)	131(95.6%)	
50≤	1(3.8%)	23(43.4%)	6(4.4%)	

Table 3. Frequency Distribution of Midwives Working in 3 Groups: Day, Night and Rotation According to Metabolic Syndrome

Groups Metabolic Syndrome	Night Shift	Day Shift	Rotational Shift	Total	Result
+	3(11/5%)	3(5.7%)	9(6.6%)	15(6.9%)	χ2=0.11, P=0.95
-	23(88.5%)	50(94.3%)	128(93.4%)	201(93.1%)	χ2=0.11, P=0.95

DISCUSSION

The present study was performed to investigate the relationship between metabolic syndrome and shift work in midwives working in hospitals in Tehran, Iran. The results showed that the rate of metabolic syndrome was higher among midwives with rotational shift but was not statistically significant. The present study showed that the prevalence of metabolic syndrome was 6.9%, which was higher in the rotational shift compared to the other two groups, but this difference was not statistically significant. In a study conducted on nurses in Bandar Abbas city in south of Iran, the rate of metabolic syndrome was higher in night shift workers. There was no statistically significant difference with other groups [21]. Dalvand et al. also found the prevalence of metabolic syndrome to be 38% among Iranian women. This high prevalence was found to be due to the high

prevalence of abdominal obesity among these women [22]. Nikpour et al reported 6.3% the prevalence of metabolic syndrome in shift worker women [3]. The prevalence of metabolic syndrome was found to be 7.9% in medical personnel in Istanbul, Turkey, 7% in female medical staff in Taiwan, and 5.6% in nurses in Korea,which is consistent with the present study [23-25], The prevalence of metabolic syndrome has been reported differently in literature owing to the differences in lifestyle, food habits, environmental and genetic factors in different regions, the definitions used for metabolic syndrome and the cut-off points for abdominal circumference. The low prevalence of metabolic syndrome found in the present study can be explained by excluding subjects over the age of 40 years. The most frequent findings obtained in the present study in the patients with metabolic syndrome respectively comprised low HDL (100%), abdominal obesity (86%) and high FBS (60%). Nikpour et al.(2019) achieve similar results in our study [3]. Given that the mean serum HDL is low in the Iranian population, low serum HDL to be the most common risk factor for metabolic syndrome based on both IDF and ATP III definitions [26].

The present study found differences in systolic and diastolic blood pressures between the three groups, and observed a greater risk in the day-shift workers potentially due to the fact that the morning shift was mostly assigned to the more experienced and older subjects. Kawabe et al. (2014) observed differences in systolic and diastolic blood pressures between the day-shift and night-shift groups in a way that higher blood pressures were reported in the night-shift workers [6]. Lu et al. (2017) reported a higher blood pressure in shift-workers compared to in day-shift workers, and this difference was statistically significant [27]. Riegel et al. (2019), and Niazi et al (2019) also demonstrated the relationship between blood pressure and shift work [28, 29], but Nikpour et al.(2019) observed a higher blood pressure in shift workers compared to day workers, although the difference was insignificant [3].

Although the present study found a higher frequency of patients with high triglyceride in the group of midwives working rotational shifts, the difference was statistically insignificant. Lu et al. (2017) also found that high triglyceride was more prevalent in shift workers compared to in day-shift workers, and that the difference was statistically significant [27]. Moreover, Kawabe et al. (2014) observed higher levels of triglyceride in night-shift workers compared to in day-shift workers [6]. Guo et al. (2015) reported that no significant association was observed between shift work and Low HDL cholesterol and raised triglyceride levels. [30]. Food consumption appearing to be more in night-shift workers and shift workers compared to in day-shift workers might have increased the absorption of carbohydrates, fats and triglyceride.

In present study significant differences were observed between the three groups in terms of HDL cholesterol<50 mg/dl (P<0.001). Mohebbi et al. (2012) found the prevalence of low HDL levels to be 34.6% in shift workers, including night shift and rotational shift, and 21.2% in day-shift workers, suggesting a significant difference, which is consistent with the present study [31]. Given that the prevalence of HDL levels below the reference threshold increases with age, particularly in women [18], higher-than-50 HDL levels in the day-shift workers may be explained by healthier nutrition in the older subjects compared to in the younger ones. Jung et al. (2020) found significant relationships between shift work and dyslipidemia, i.e. low HDL and high triglyceride levels, which is consistent with the present study in terms of the relationship between low HDL and shift work [25]. The present study found a statistically-insignificant higher prevalence of triglyceride levels over 150 in the night shift. In line with the present study, Ye et al. (2013) found triglyceride>150 to be more prevalent in shift workers compared to in day-shift workers, although the difference was insignificant; however, in contrast to the present study, they observed no relationships between low HDL cholesterol and shift work [32]. Given that the cited study was conducted in Korea, this discrepancy of results can be explained by the differences in nutrition of the subjects.

The present study found the prevalence of FBS>100 mg/dl to be 6.5%, which was respectively higher in the night-shift workers compared to in the rotational-shift and day-shift workers, although the difference was insignificant. Mohebbi et al. found that this level was higher in shift workers compared to in day-shift workers, and that the difference was significant [31]. The present results are consistent with those obtained by Canotto et al. (2015), and Jung et al (2020) [18, 25].

Our study showed that abdominal obesity was higher among midwives working in rotating shifts. This result is consistent with the research of Najimi-Varzaneh et al (2019) [32].The reason why shift workers are fatter is due to excessive consumption of food while working. Another reason for shift workers to be obese is sleep disorders.

The present study found the prevalence of metabolic syndrome to be higher in the rotational-shift workers, although this difference was statistically insignificant. Ye et al. (2013) demonstrated the relationship between metabolic syndrome and shift work, and showed that shift workers are at a greater risk for developing metabolic syndrome by a factor of 2.26 [33]. Studying Taiwanese women showed that rotational-shift work is associated with an increased risk of metabolic syndrome, and that this risk increases by 4.6 times compared to day-shift workers after 5 years [34]. Jung et al (2020) as well as Uve and Yim (2018) also observed

a higher frequency of metabolic syndrome in night-shift workers compared to in day-shift workers [25, 35]. Moreover, Nikpour et al 2019 demonstrated the relationship between metabolic syndrome and shift work [3].

One of the limitations of the study was that the number of midwives working in day and night shifts was less than the rotational shift.

One of the strengths of this research is that so far no research has been done on midwives about metabolic syndrome in Iran.

It is recommended that the study of metabolic syndrome among midwives and other medical groups be done prospectively with a large number of samples.

CONCLUSIONS

Many prospective studies have shown the clinical importance of metabolic syndrome. Preventing and treating metabolic syndrome is therefore crucial before developing cardiovascular diseases and diabetes. The present study results showed that shift workers are vulnerable to developing metabolic syndrome, and that their prevalence of the components of metabolic syndrome is high, especially abdominal obesity and low HDL. Shift workers are therefore in dire need for more attention and training in terms of nutrition and regular physical activity.

ETHICAL CONSIDERATION

This study was published on IR.SBMU.PHNM.1395.481 by the ethics committee of Shahid Beheshti University of Medical Sciences.

AUTHOR CONTRIBUTION

This article is taken from a Master's thesis.

ACKNOWLEDGEMENT

The present article was extracted from Azadeh Karami MSc thesis in midwifery, and supervised by Dr, S.A. Akbari , and approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences (Code: IR.SBMU.PHNM.1395.481). The authors would like to express their gratitude to all the midwives participating in the present research.

FUNDING

This study was supported by Shahid Beheshti University of Medical Sciences.

CONFLICT OF INTEREST

The authors had no conflicts of interest to report.

REFERENCES

1. Bartosiewicz A, Luszczki E, Nagorska M, Oleksy L, Stolarczyk A, Deren K. Risk Factors of Metabolic Syndrome among Polish Nurses. Metabolites. 2021;11(5). doi: 10.3390/metabo11050267 pmid: 33922860
2. Saklayen MG. The Global Epidemic of the Metabolic Syndrome. Curr Hypertens Rep. 2018;20(2):12. doi: 10.1007/s11906-018-0812-z pmid: 29480368
3. Nikpour M, Tirgar A, Hajiahmadi M, Hosseini A, Heidari B, Ghaffari F, et al. Shift work and metabolic syndrome: A multi-center cross-sectional study on females of reproductive age. Biomed Rep. 2019;10(5):311-7. doi: 10.3892/br.2019.1205
4. Maleki F, Sayehmiri C, Sayehmiri F, Kiani F, Nasiri S, Mohammadi H, et al. Metabolic syndrome prevalence in Iran: a systematic review. (Persian). Bimonthly J kermanshah univ med sci. 2014;18(4):242-50.
5. Kawabe Y, Nakamura Y, Kikuchi S, Murakami Y, Tanaka T, Takebayashi T, et al. Relationship between shift work and clustering of the metabolic syndrome diagnostic components. J Atheroscler Thromb. 2014;21(7):703-11. doi: 10.5551/jat.19380 pmid: 24599169
6. Brum MC, Filho FF, Schnorr CC, Bottega GB, Rodrigues TC. Shift work and its association with metabolic disorders. Diabetol Metab Syndr. 2015;7:45. doi: 10.1186/s13098-015-0041-4 pmid: 25991926
7. Wang XS, Armstrong ME, Cairns BJ, Key TJ, Travis RC. Shift work and chronic disease: the epidemiological evidence. Occup Med (Lond). 2011;61(2):78-89. doi: 10.1093/occmed/kqr001 pmid: 21355031
8. Assadi SN. Comparison the frequency of symptoms of acute shift work maladaption syndrome between two groups of shift workers (Persian). Iran Occupational Health J. 2013;10 (5):70-7.
9. Dijk DJ, Duffy JF. Novel Approaches for Assessing Circadian Rhythmicity in Humans: A Review. J Biol Rhythms. 2020;35(5):421-38. doi: 10.1177/0748730420940483 pmid: 32700634
10. Ulhoa MA, Marqueze EC, Burgos LG, Moreno CR. Shift work and endocrine disorders. Int J Endocrinol. 2015;2015:826249. doi: 10.1155/2015/826249 pmid: 25892993
11. Merkus SL, van Drongelen A, Holte KA, Labriola M, Lund T, van Mechelen W, et al. The association between shift work and sick leave: a systematic review. Occup Environ Med. 2012;69(10):701-12. doi: 10.1136/oemed-2011-100488 pmid: 22767871
12. Torquati L, Mielke GI, Brown WJ, Burton NW, Kolbe-Alexander TL. Shift Work and Poor Mental Health: A Meta-Analysis of Longitudinal Studies. Am J Public Health. 2019;109(11):e13-e20. doi: 10.2105/AJPH.2019.305278 pmid: 31536404
13. Kim MJ, Son KH, Park HY, Choi DJ, Yoon CH, Lee HY, et al. Association between shift work and obesity among female nurses: Korean Nurses' Survey. BMC Public Health. 2013;13:1204. doi: 10.1186/1471-2458-13-1204 pmid: 24354395
14. Arghami S, Ghanbari H, Zahirian G. Health status of city staff shiftwork in a hospital Razan. (Persian). J Ergonom. 2014;2(1):64-9.
15. Mohammadian M, Hashemi Nejad N, Rahimi Moghadam S, Amiri F. The survey of musculoskeletal disorders of midwives and its relationship with job stress. (Persian). J Fundamental Mental Health. 2013;15(59):171-83.
16. Oliveira MD, Luiza A. Brazil: Case study on working time organization and its effects in the health services sector. ILO pub. 2015;2(130083):978-92.
17. Moradi S, Farahnaki Z, Akbarzadef A, Gharagozlou F, Pournajaf A, Abbasi AM, et al. Relationship between shift work and Job satisfaction among nurses: a Cross-sectional study. Int J Hospital Res. 2014;3(2):63-8.
18. Canuto R, Garcez AS, Olinto MT. Metabolic syndrome and shift work: a systematic review. Sleep Med Rev. 2013;17(6):425-31. doi: 10.1016/j.smrv.2012.10.004 pmid: 23531362

19. Pietroiusti A, Neri A, Somma G, Coppeta L, Iavicoli I, Bergamaschi A, et al. Incidence of metabolic syndrome among night-shift healthcare workers. Occup Environ Med. 2010;67(1):54-7. doi: 10.1136/oem.2009.046797 pmid: 19737731
20. Azizi F, Khalili D, Aghajani HM, Esteghamati AM, Hosseinpanah FM, Delavari AM. Appropriate waist circumference cut-off points among Iranian adults: the first report of the Iranian National Committee of Obesity. Archive Iran Med. 2010;13(3):243.
21. Amiri A, Hakimi A. The study of prevalence of metabolic syndrome among nurses of Shahid Mohammadi Hospital of Bandar Abbas city, Iran. (Persian). J Clinic Nurs Midwife. 2017;6(1):1-8.
22. Dalvand S, Niksima SH, Meshkani R, Ghanei Geshlagh R, Nejadi S, Kooti W, et al. Prevalence of Metabolic Syndrome among Iranian Population: A Systematic Review and Meta-analysis. (Persian). Iran J Pub Health. 2017;46(4):45667.
23. Oğuz A, Sağun G, Uzunlulu M, Alpaslan B, Yorulmaz E, Tekiner E, et al. Frequency of abdominal obesity and metabolic syndrome in healthcare workers and their awareness levels about these entities. Turk Kardiyol Dern Ars. 2008;36(5):302-9.
24. Ho HH, Tsai TY, Lin CL, Wu SY, Li CY. Prevalence and associated factors for metabolic syndrome in Taiwanese hospital employees. Asia Pac J Public Health. 2011;23(3):307-14. doi: 10.1177/1010539509340911 pmid: 19625323
25. Jung H, Dan H, Pang Y, Kim B, Jeong H, Lee JE, et al. Association between Dietary Habits, Shift Work, and the Metabolic Syndrome: The Korea Nurses' Health Study. Int J Environ Res Public Health. 2020;17(20). doi: 10.3390/ijerph17207697 pmid: 33096883
26. Mazloomzadeh S, Rashidi Khazaghi Z, Mousavinasab N. The Prevalence of Metabolic Syndrome in Iran: A Systematic Review and Meta-analysis. Iran J Public Health. 2018 47(4):473-80.
27. Lu YC, Wang CP, Yu TH, Tsai IT, Hung WC, Lu IC, et al. Shift work is associated with metabolic syndrome in male steel workers-the role of resistin and WBC count-related metabolic derangements. Diabetol Metab Syndr. 2017;9:83. doi: 10.1186/s13098-017-0283-4 pmid: 29075331
28. Riegel B, Daus M, Lozano AJ, Malone SK, Patterson F, Hanlon AL. Shift Workers Have Higher Blood Pressure Medicine Use, But Only When They Are Short Sleepers: A Longitudinal UK Biobank Study. J Am Heart Assoc. 2019;8(20):e013269. doi: 10.1161/JAHA.119.013269 pmid: 31581870
29. Niazi E, Saraei M, Aminian O, Izadi N. Frequency of metabolic syndrome and its associated factors in health care workers. Diabetes Metab Syndr. 2019;13(1):338-42. doi: 10.1016/j.dsx.2018.10.013 pmid: 30641722
30. Guo Y, Rong Y, Huang X, Lai H, Luo X, Zhang Z, et al. Shift work and the relationship with metabolic syndrome in Chinese aged workers. PLoS One. 2015;10(3):e0120632. doi: 10.1371/journal.pone.0120632 pmid: 25761114
31. Mohebbi I, Shateri K, Seyedmohammadzad M. The relationship between working schedule patterns and the markers of the metabolic syndrome: comparison of shift workers with day workers. Int J Occup Med Environ Health. 2012;25(4):383-91. doi: 10.2478/S13382-012-0051-5 pmid: 23055229
32. Najimi-Varzaneh A, Gholami-Fesharaki M, Rowzati M. The relationship between shift work and metabolic syndrome: a prospective cohort study. Tehran Univ Med J. 2019;77(8):520-5.
33. Ye HH, Jeong JU, Jeon MJ, Sakong J. The Association between Shift Work and the Metabolic Syndrome in Female Workers. Ann Occup Environ Med. 2013;25(1):33. doi: 10.1186/2052-4374-25-33 pmid: 24472469
34. Lin YC, Hsiao TJ, Chen PC. Persistent rotating shift-work exposure accelerates development of metabolic syndrome among middle-aged female employees: a five-year follow-up. Chronobiol Int. 2009;26(4):740-55. doi: 10.1080/07420520902929029 pmid: 19444753
35. Oh JI, Yim HW. Association between rotating night shift work and metabolic syndrome in Korean workers: differences between 8-hour and 12-hour rotating shift work. Ind Health. 2018;56(1):40-8. doi: 10.2486/indhealth.2017-0072 pmid: 29046489