Journal of Public Health and Epidemiology Vol. 3(9), pp. 394-400,12 September, 2011
Available online at http://www.academicjournals.org/jphe
ISSN 2141-2316 ©2011 Academic Journals

Full Length Research Paper

Prevalence of metabolic syndrome and its associated factors among female nurses in a teaching hospital in North-Eastern state of Malaysia

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Accepted 18 July, 2011

Nurses who are mostly shift workers were found to be at risk for coronary heart disease (CHD). This study was designed to determine the prevalence of metabolic syndrome and its associated factors among female nurses working in a teaching hospital. A cross sectional study was conducted among 404 female nurses working in a teaching hospital in North-Eastern state of Malaysia. Data were collected using a proforma on sociodemographic and occupational characteristics, physical activity and depression anxiety and stress scale (DASS) 42 questionnaire (validated Malay version). Anthropometric, blood pressure measurement and fasting venous blood for fasting lipid profile and blood sugar were taken from each respondent. Majority of the respondents were Malay nurses with the mean age of 42.1 (SD 7.19) years old. Out of 404 respondents, 56.2% of them do shift work. The prevalence of metabolic syndrome was 24.3% (95% CI: 20.1, 28.4). The significant factors associated with metabolic syndrome were total duration of employment (years) and one way commuting time to work (minutes). There was a high prevalence of metabolic syndrome among nurses working in a teaching hospital in North-eastern state of Malaysia. Occupational factors such as total duration of employment and one way commuting time to work are associated with metabolic syndrome.

Key words: Prevalence, metabolic syndrome, nurses, shift work, self-perceived stress.

INTRODUCTION

Healthcare workers including nurses practice shift work in order to provide 24 hours health care services. Although shift work is widely practiced, it is known to cause many adverse health effects such as reduction in quality and quantity of sleep, fatigue, anxiety, depression and neuroticism, gastrointestinal disorders, increased risk of spontaneous abortion and prematurity as well as increasing evidence of adverse cardiovascular effects (Harrington, 2001, Learthart, 2000). Many studies have been conducted to determine relationships between shift work and coronary heart diseases (CHD). It has been concluded that there is a strong evidence of an association between shift work and heart diseases (Knutsson, 2003). A recent study found that compared with day workers, shift workers had a significantly higher risk of death due to ischemic heart disease (relative risk (RR) = 2.32) (Fujino et al., 2006). In addition, a study involving 5517 people revealed that shift workers had a higher risk for all circulatory diseases as compared to day workers (Tuchsen et al., 2006). A cohort study among nurses in the United States found that there is a relationship between duration of shift working (year) and coronary heart disease (Kawachi et al., 1996).

Since shift work has been associated with increased risk of CHD, this study is designed to find potential association between shift work and having a metabolic syndrome. Metabolic syndrome is a medical disorder that increases the risk of CHD and type 2 diabetes (Tarani et al., 2006). The risk for CHD among those with metabolic syndrome is approximately doubled as compared to those without the syndrome as found in a recent meta-analysis. In addition, the relative risk for cardio-vascular (CVD) events and death was higher among women

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(RR 2.63) (Grundy, 2008).

At present, studies to determine the presence of association between shift work and metabolic syndrome in Malaysia were limited. Based on the result from this study, we will be able to provide a valuable data or information to the health care organization that might be useful for future reference in term of designing intervention package or preventive measures regarding safety and health at workplace for shift workers. Hence, this study was designed to determine the prevalence of metabolic syndrome using the definition by the National Institutes of Health in the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) and to determine the associated factors for metabolic syndrome among female nurses in a teaching hospital in north-eastern state of Malaysia. Selection of one occupational group for this study (female nurses) was aimed to minimize the confounding effect of socioeconomic status.

METHODOLOGY

Study design and subjects

A cross sectional study was conducted from January to April 2009 among 404 female nurses in a teaching hospital located in Kelantan, Malaysia. The sampling frame was the list of all eligible female nurses who fulfilled the study criteria which were age ranged from 30 to 55 years old; those who have been working for more than a year in either shift or day work (Ludovic et al., 2004) and those employed under Grade 29 (junior nurses) and 32 (senior nurses). We excluded nurses with higher grade due to difference in nature of their job as they do more administrative than clinical work. Those who were known to have cushing syndrome and pregnant beyond first trimester as well as having psychiatric illness were also excluded from the study. Those with psychiatric illness were excluded to remove the influence of the illness on self-perceived stress.

Sample size was estimated using PS software (Dupont and Plummer, 1997) to compare two independent proportions using odds ratio of 2.5 for smoking variable (LaMonte et al., 2005), 80% power and alpha set at 0.05. With the anticipation of 20% non-response rate, the total sample size required for the study was 434 respondents. From a total of 901 eligible female nurses, 477 of them fulfilled the study criteria. However, only 404 of them consented to be recruited in the study.

Ethical approval

This study was approved by the Research Ethics Committee of School of Medical Sciences, Universiti Sains Malaysia (Ref.: USMKK/PP/JEPeM[205.4(1.5)]). A detailed explanation about the study was given to the respondents and enough time was allocated for them to make a decision. After been agreed upon, a written informed consent form was given to them for signature. Confidentiality of data was strictly maintained in which only researchers have access to the data.

Research tools

Data were collected using a proforma which consists of sociodemographic data, occupational history and physical activity. For smoking status, respondents were classified as non-smokers, ex-smokers or current smokers. A respondent was considered to be physically inactive when she answered 'No' to the question "Do you exercise or have any physical activity?", or when she answered yes but the amount of exercise was less than 30 minutes per session and less than 3 days in a week (MOH, 2004a, 2004b). Total duration of employment was the total years of employment as a nurse including either in current setting or in other previous hospitals or health clinics. On the other hand, duration of job experience refers to the length (in years) of a nurse engaged in current job experience, either as shift or day worker. Meanwhile, duration of one way commuting time refers to the average duration of time usually taken by respondents either to work or from work to home.

The depression anxiety and stress scale (DASS)-42 questionnaire which was translated into Malay version and validated by Edimansyah et al. (2005) was used to determine self-perceived stress. The DASS-42 is a set of three self-report scales designed to measure the negative emotional states of depression, anxiety and stress. In order to determine stress (self-perceived), raw scores for the DASS stress scale were summed and converted into z scores. Based on the z scores, nurses scored less than 0.5 are considered normal; 0.5 to 1.0, mild stress; 1.0 to 2.0, moderate stress; 2.0 to 3.0, severe stress; and more than 3.0, extremely severe stress (Lovibond and Lovibond, 2002). A respondent was classified as having self-perceived stress when they fall in any of the four categories from mild to extremely severe (Edimansyah et al., 2005).

Waist circumference measurement was done by a trained female research assistant following the WHO recommended methods (MOH, 2004a). Systolic and diastolic blood pressures were measured three times following a standardized protocol. The highest reading was taken as the recorded systemic blood pressure (MOH, 2008). A 10-hour overnight fasting (MOH, 2004b) venous blood was taken from antecubital vein amounting to 6 ml. Four milliters blood for fasting lipid profile was collected in a plain container with a clot activator (BD Vacutainer) and the remaining 2 ml blood for fasting blood sugar was collected in a container with potassium oxalate, 4 mg and sodium fluoride 5 mg and then softly shaken for 8 times. Samples were stored and transported at a temperature between 4 and 25°C and sent to laboratory on the same day of blood sampling. Blood for fasting lipid profile and fasting blood sugar were analyzed at Pathlab Chemical-Pathology laboratory (SAMM No. 406) (ISO 9001:2000 No. 136588).

A respondent was defined as having metabolic syndrome when there was presence of three or more of the following criteria, based on the adult treatment panel III (ATP III) criteria (NCEP, 2002):

1. Central obesity (waist circumference greater than 80 cm for Asian women);
2. Blood pressure of ≥ 130/85 mm Hg
3. Fasting blood sugar of ≥100 mg/dl (5.6 mmol/L) or previously diagnosed type 2 diabetes
4. Triglycerides level of 150 mg/dl (1.7 mmol/L)
5. High-density lipoprotein (HDL) cholesterol of less than 50 mg/dl (1.29 mmol/L)

We applied the above definition for metabolic syndrome as it is commonly used by other studies worldwide. In addition, a study in Malaysia has reported that there was a good concordance between the International Diabetes Federation (IDF) and NCEP ATP III definitions (Tan et al., 2008).

Statistical analysis

Data were entered and analyzed using PASW statistics 18. Prevalence of metabolic syndrome was calculated as the percentage

of respondents diagnosed to have metabolic syndrome with all study respondents as the denominator. Multiple logistic regression analysis was applied to identify potential risk factors associated with metabolic syndrome. Meaningful combination of categories was done when small cell of categories were noted (ethnic, marital status and nursing education). Ethnicity was recategorized into Malays and non-Malay, marital status was recategorized into married and unmarried (combination of single, widowed and divorced) and nursing education was recategorized into certificate or diploma in nursing (3 years course) and degree in nursing (4 years course). All variables with *P*-value of <0.25 were included in multiple logistic regression during variable selection process. Variables with *P*- value ≥0.25 required additional evidence of importance, for instance known clinical importance, before inclusion in the multivariable analysis.

Two methods of variable selection were used which were forward and backward stepwise variable selection methods to obtain preliminary model and the highest number of variables was included in the further analyses. However, if the selected variable *P*-value was >0.05, the respective variable was removed manually and excluded from the model. The removal of that variable was based on the decision of *P*-value from the Wald statistics. With all significant and important variables, the preliminary main-effect model was obtained. In the analysis, we checked for multicolinearity and interaction term problems. Multicolinearity problem was checked using correlation matrix and standard error. Then, preliminary final model was obtained.

To assess the fitness of model, Hosmer Lemeshow goodness of fit test, classification table and receiver operating characteristics (ROC) curve were used. The model was fit if the *P*-value approached to one for Hosmer Lemeshow test. The high overall percentage in the classification table and area under the curve towards 1 in ROC curve showed that the model was fit. Sensitivity and specificity tests were calculated manually from the classification table. The final model was determined by enter method. The adjusted odds ratio was estimated with 95% confidence interval. Findings were presented with crude and adjusted OR, 95% CI and *P*-value. The level of significant for all analysis was set at 0.05.

RESULTS

Majority of the respondents were Malay nurses with the mean age of 42.1 (SD 7.19) and ranged from 30 to 57 years old. All of the respondents were non-smokers. Meanwhile, the duration of employment ranged from 2 to 33 years. Among respondents, one way commuting time ranged from 5 to 60 minutes. Out of 404 respondents, 56.2% of them are doing shift work. There were 14.1% of the respondents who had self-perceived stress. Table 1 shows characteristics of the respondents.

The prevalence of metabolic syndrome among the respondents was 24.3% (95% CI: 20.1, 28.4). Table 2 shows the factors that were analyzed to determine their association with metabolic syndrome among the respondents using simple and multiple logistic regression. It was found that shift work was not significantly associated with metabolic syndrome. In addition, inactive involvement in physical activity and self-perceived stress were also not significantly associated with metabolic syndrome.

DISCUSSION

This study documented a high prevalence of metabolic syndrome among nurses working in the teaching hospital which was about 24%. The finding was higher as compared to the prevalence of metabolic syndrome among general population of Malaysia which was 16.5% (Tan et al., 2008). It was also higher than that among municipal workers in Turkey which was 17.8% (Demiral et al., 2006). Differences in study population might contribute to this finding. As in Turkey, only male municipal workers were selected in the study. Their nature of work which is more labor intensive might produce a lower prevalence as compared to the recent study.

In contrast to all the aforementioned, the prevalence of metabolic syndrome among female population in Thailand and Singapore were much less which were 11.7 and 12.3%, respectively (Grundy, 2008). As those countries are more developed, preventive measures towards metabolic syndrome are relatively more advanced. On the other hand, the study population (general female population) might also lower the prevalence of metabolic syndrome.

In this study, the factors which are significantly associated with metabolic syndrome were total duration of employment (years) and one way commuting time to work (minutes). In multivariable analysis, one way commuting time to work was one of the independent variables that could predict the outcome of metabolic syndrome. Nurses who spend more than 10 min commuting to work compared to others, were 1.21 more likely to have metabolic syndrome. This finding was supported by a prospective study in Finland that suggested not only leisure-time physical activity but also commuting physical activities as an important component that determine involvement into a healthy lifestyle (Hu et al., 2004).

Another occupational factor which significantly associated with metabolic syndrome in this study was total duration of employment. Nurses who worked 10 years more than others were more than two times more likely to have metabolic syndrome. This finding was similar to a study in Turkey which found metabolic syndrome was significantly higher among workers who had been working for more than 10 years (Demiral et al., 2006). This result implies that nurses who had longer duration of employment were more senior and they had a longer duration of exposure to physical inactivity thus increased their risk towards metabolic syndrome.

The finding of no association between shift work and metabolic syndrome was consistent with a study among male workers with rotating three shift works (Karlsson et al., 2003). The finding could be explained by the positive values that the respondents have such as did not smoke, had good education and income as well as fast forward rotation shift schedule practice among shift workers. Fast forward rotation is currently considered the best in reducing sleep debt among shift workers (Katriina et al., 2008), thus reducing other health effects associated with circadian rhythm disruption. The finding could also be

Table 1. Characteristics of the respondents (n = 404).

Variable	Frequency (%)	Mean (SD)
Age (years)		42.2 (7.19)
Number of children		3.6 (1.70)
Income per month (RM)		2879.1 (585.73)
Ethnic		
Malay	379 (93.8)	
Chinese	21 (5.2)	
Indian	2 (0.5)	
Others	2 (0.5)	
Nursing education		
Certificate of nursing	127 (31.4)	
Diploma of nursing	248 (61.4)	
Degree	29 (7.2)	
Marital status		
Single	13 (3.2)	
Married	376 (93.1)	
Divorced	2 (0.5)	
Widowed	13 (3.2)	
Total duration of employment (years)		17.8 (6.33)
Duration of job experience (years)		11.9 (6.43)
One way commuting time (min)		20.8 (11.38)
Employment grade		
Junior (Grade U29)	367 (90.8)	
Senior (Grade U32)	37 (9.2)	
Type of work		
Day work	177 (43.8)	
Shift work	227 (56.2)	
Family history of *CHD		
No	289 (71.5)	
Yes	115 (28.5)	
Consume oral contraceptive pill		
No	346 (85.6)	
Yes	58 (14.4)	
Physically inactive		
No	35 (8.7)	
Yes	369 (91.3)	

SD, Standard deviation; * CHD, coronary heart disease.

Table 2. Factors associated with metabolic syndrome among respondents using simple and multiple logistic regressions (n = 404).

Factor	Crude OR	95% CI		*p* value	Adjusted OR	95% CI		Wald stat	*p* value
		Lower	Upper			Lower	Upper		
Age	1.07	1.03	1.10	<0.001					
No. of children	1.12	0.98	1.27	0.089					
Income per month (RM)	1.00	1.00	1.00	0.100					
Ethnic									
Non-malay	1								
Malay	1.30	0.48	3.56	0.609					
Nursing education									
Certificate or diploma	1								
Degree	0.99	0.41	2.40	0.988					
Employment grade									
Junior (U 29)	1								
Senior (U 32)	1.57	0.76	3.25	0.227					
Marital status									
Unmarried	1								
Married	2.82	0.83	9.54	0.096					
Total duration of employment (10 years)	2.12	1.48	3.10	<0.001	2.12	1.48	3.12	13.68	<0.001
One way commuting time (10 minutes)	1.21	1.11	1.48	0.054	1.21	1.11	1.48	4.25	0.039
Duration of job experience (years)	1.01	0.97	1.04	0.777					
Type of work									
Day work	1								
Shift work	0.68	0.43	1.08	0.099					
Family history of CHD*									
Negative	1								
Positive	1.22	0.75	2.01	0.425					
Consume oral contraceptive pill									
No	1								
Yes	0.89	0.46	1.72	0.723					
Physical activity									
Active	1								
Inactive	0.78	0.36	1.69	0.534					
Self-perceived stress									
No	1								
Yes	1.17	0.62	2.22	0.635					

* **CHD,** Coronary heart disease; Hosmer and Lemeshow test P-value = 0.157; Receiver operating characteristics (ROC) curve = 0.662. No outlier by Cook's test and Leverage value.

explained by our study design. Cross sectional study had a tendency to underestimate chronic diseases such as cardiovascular disease and diabetes. This was due to selection bias (healthy workers effect). Shift workers who had chronic diseases were often transferred to day work (Karlsson et al., 2001). Hence, many workers with chronic

chronic disease would be appointed as day workers. However, to minimize the bias we have excluded any workers who had been transferred to day work or even to shift work within the past one year.

In contrast to the recent study, a population-based prospective study in Belgium which sampled 1529 employees found that metabolic syndrome incidence rate among shift workers was almost two times higher as compared to day workers (De Bacquer et al., 2009). Differences in study design and study population might contribute to the contradiction.

Other occupational factors such as employment grade (seniority), duration of current job experience and self-perceived stress were found to be not associated with metabolic syndrome. No association of self-perceived stress with metabolic syndrome was in agreement with a study among workers in Turkey (Demiral et al., 2006). However, it contradict the finding from a cohort study in London which reported a double risk of metabolic syndrome among workers with chronic work stress compared to those without work stress (Tarani et al., 2006). The difference could be attributed by the research tool used by researchers. In the recent study, DASS questionnaire (Stress Scale) was used to determine stress level which was more confined to stress perception in their daily life and not specifically on job stress.

An effective intervention program should be implemented by the hospital management in view of high prevalence of metabolic syndrome found among the nurses. As duration of employment and commuting time to work are non-modifiable factors, prevention and control strategies at the work place are needed to change unhealthy lifestyle such as lack of physical activity which might reduce obesity problem and metabolic syndrome among the nurses. A prospective cohort study would be a better design to determine associations between job factors such as shift work and job stress with metabolic syndrome. A multi-centre approach will also be able to provide a better picture on metabolic syndrome among occupational risk groups in Malaysia.

Conclusion

There was a high prevalence of metabolic syndrome among nurses working in a teaching hospital in north-eastern state of Malaysia. Occupational factors such as total duration of employment and one way commuting time to work are associated with metabolic syndrome. As those factors are not modifiable, prevention and control strategies at workplace are recommended to change unhealthy lifestyle such as lack of physical activity which might reduce obesity problem and metabolic syndrome among the nurses.

ACKNOWLEDGEMENTS

The authors are most grateful to all respondents of the survey who provided us with their valuable responses in this study and to the teaching hospital administrators for their assistance and cooperation. The study was funded by the USM short-term grant (304/PPSP/6139001).

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