UNIVERSITI SAINS MALAYSIA

PEJABAT PENGURUSAN & KREATIVITI PENYELIDIKAN
RESEARCH CREATIVITY AND MANAGEMENT OFFICE [RCMO]

LAPORAN AKHIR PROJEK PENYELIDIKAN JANGKA *PENDEK*
FINAL REPORT OF SHORT TERM RESEARCH PROJECTS

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1) **Nama Ketua Penyelidik** :
Name of Research Leader :

Ketua Penyelidik *Research Leader*	PTJ *School/Centre*
Dr. Mohd Nazri Bin Shafei	**School of Medical Sciences**

Nama Penyelidik Bersama
(Jika berkaitan) :
Name/s of Co-Researcher/s
(if applicable)

Penyelidik Bersama *Co-Researcher*	PTJ *School/Centre*
Assoc. Prof. (Dr.) Tg. Mohd Ariff Bin Raja Husin	**School of Medical Sciences**
Dr. Sohel Redza Choudhury	**School of Medical Sciences**
Dr. Than Winn	**School of Medical Sciences**

2) Tajuk Projek : **The Association of Shift Work And Coronary Heart Disease Risk Factors Among Male Factory Workers In Kota Bharu, Kelantan.**

3) **Abstrak untuk penyelidikan anda**

(Perlu disediakan di antara 100 – 200 perkataan di dalam **Bahasa Malaysia dan Bahasa Inggeris**. Ini kemudiannya akan dimuatkan ke dalam Laporan Tahunan Bahagian Penyelidikan & Inovasi sebagai satu cara untuk menyampaikan dapatan projek tuan/puan kepada pihak Universiti & luar).

Abstract of Research

(Must be prepared in 100 – 200 words in Bahasa Malaysia as well as in English. This abstract will later be included in the Annual Report of the Research and Innovation Section as a means of presenting the project findings of the researcher/s to the university and the outside community)

ABSTRAK (Bahasa Malaysia):

Kemodenan telah banyak merubah pelbagai aspek kehidupan dengan cepat termasuklah aspek ekonomi, sosial dan tingkah-laku manusia. Ini telah menyumbang kepada penggunaan berbagai-bagai jadual kerja oleh organisasi-organisasi. Masa bekerja telah dilanjutkan kepada petang, malam dan juga pada hujung minggu. Kerja syif merupakan satu cara bekerja di mana pekerja-pekerja akan bertukar ganti melebihi waktu bekerja biasa. Ia berpotensi untuk mengganggu ritma biologikal yang normal atau keperluan sosial atau kedua-duanya sekali. Ramai penyelidik mendapati bahawa pekerja syif lebih berisiko untuk mendapat pelbagai penyakit dan juga mendapat faktor risiko bagi panyakit jantung koronari (CHD) seperti hipertensi, hiperkolesterolemia, obesiti dan diabetes mellitus (DM). Kajian ini dijalankan untuk menentukan hubungkait antara kerja syif dan faktor-faktor risiko CHD. Faktor-faktor risiko tersebut adalah tekanan darah tinggi, dislipidemia (samada hiperkolesterolemia, hiper-lipoprotin berketumpatan rendah-kolesterolemia, hipo-lipoprotin berketumpatan tinggi-kolesterolemia atau hipertrigliseridemia), indeks jisim badan (BMI) tinggi, diabetes mellitus dan gaya hidup tidak aktif dalam kalangan pekerja kilang lelaki di Kota Bharu, Kelantan. Kajian irisan-lintang ini melibatkan 76 orang pekerja shif dan 72 orang pekerja harian daripada sebuah kilang yang terletak di Kota Bharu, Kelantan. Data diperolehi menggunakan borang soal-selidik berkenaan psikososial dan gaya hidup. Ukuran antropometri dan tekanan darah, analisa glukosa darah dan profail lipid ketika berpuasa dijalankan. Ujian 'Chi-square' dilakukan untuk menentukan perbezaan disegi prevalens setiap faktor risiko CHD di antara dua kumpulan pekerja berkenaan. Regresi logistik multipel (MLR) pula digunakan untuk menentukan nilai nisbah odds (OR) bagi setiap faktor risiko penyakit jantung yang dikaitkan dengan kerja syif. Prevalens bagi tekanan darah tinggi, hiperkolesterolemia, hipertrigliseridemia dan BMI yang sama dengan atau melebihi 25 kg/m^2 adalah lebih tinggi dalam kalangan pekerja syif berbanding pekerja harian. Prevalens bagi diabetes mellitus, hipo-lipoprotin berketumpatan tinggi-kolesterolemia, hiper-lipoprotin berketumpatan rendah-kolesterolemia serta tahap aktiviti fizikal yang rendah tidak berbeza secara signifikan bagi kedua-dua kumpulan kerja berkenaan. Bila dibandingkan pekerja syif dan bukan syif, nilai 'adjusted' OR bagi tekanan darah tinggi, BMI yang tinggi dan tidak aktif masing-masing adalah 9.1 (95% CI 1.4-56.8), 2.9 (95% CI 1.3-6.1) dan 7.7 (95% CI 2.1-27.5). Sebaliknya, tidak terdapat hubungan antara kerja syif dan risiko mendapat dislipidemia ataupun diabetes mellitus (DM). Didapati bahawa terdapat hubungkait positif antara kerja syif dan tekanan darah tinggi, BMI yang sama dengan atau melebihi 25 kg/m^2 serta gaya hidup tidak aktif. Ini menunjukkan kemungkinan bahawa risiko untuk mendapat faktor-faktor risiko CHD adalah tinggi dalam kalangan pekerja syif berbanding pekerja harian.

ABSTRACT (English):

Modern society is changing quite rapidly in terms of economic, social and human behaviour. Consequently, various types of work schedules have been applied by organizations and companies. Working hours are extended to evenings and nights, as well as on weekends. Shift work is one of the work hour systems in which a relay of employees extends the period of production beyond the conventional 8-hour working day. It potentially disrupts workers' normal biological or social diurnal rhythms or both. Shift work has been found to be associated with various health problems and there is a concern that shift workers are at higher risk to develop risk factors for coronary heart disease (CHD) such as hypertension, hypercholesterolaemia, obesity and diabetes mellitus (DM). The study was undertaken to examine relationships between shift work and CHD risk factors, namely high blood pressure (BP), dyslipidaemia (either hypercholesterolaemia, hyper-low density lipoprotein-cholesterolaemia, hypo-high density lipoprotein-cholesterolaemia or hypertriglyceridaemia), high body mass index (BMI), diabetes mellitus and physical inactivity among male factory workers in a factory in Kota Bharu, Kelantan. This study was a cross-sectional study of 76 shift and 72 day workers from a factory in Kota Bharu, Kelantan. Data was collected through a questionnaire on psychosocial and life-style factors. Anthropometric and blood pressure measurement, fasting blood sugar and fasting lipid profiles analyses were obtained. Chi-square test was used to determine the significant difference in the prevalence for each CHD risk factors between the two worker groups. Multiple logistic regression was used to evaluate the odds ratio for each CHD risk factors associated with shift work. The prevalence of high BP, hypercholesterolaemia, hypertriglyceridaemia and body mass index (BMI) of equal to or more than 25 kg/m^2 were significantly higher among shift workers compared to day workers. There was no difference in the prevalence of diabetes mellitus, hypo-high-density lipoprotein-cholesterolaemia, hyper-high-density lipoprotein-cholesterolaemia and physical inactivity. When the shift workers were compared with the day workers, the adjusted odds ratio (OR) for high BP, BMI of equal to or more than 25 kg/m^2 and physical inactivity were 9.1 (95% CI 1.4-56.8), 2.9 (95% CI 1.3-6.1) and 7.7 (95% CI 2.1-27.5) respectively. There was neither association of shift work with dyslipidaemia, nor with diabetes mellitus. There were positive association between shift work and high BP, BMI of equal to or more than 25 kg/m^2 and physical inactivity which denotes a higher risk of CHD risk factors among shift workers compared to day workers.

4) Sila sediakan Laporan teknikal lengkap yang menerangkan keseluruhan projek ini. [Sila gunakan kertas berasingan]
Kindly prepare a comprehensive technical report explaining the project (Prepare report separately as attachment)

Senaraikan Kata Kunci yang boleh menggambarkan penyelidikan anda :
List a glosssary that explains or reflects your research:

Bahasa Malaysia	Bahasa Inggeris
kerja syif	**shift work**
faktor-faktor risiko	**risk factors**
penyakit jantung koronari	**coronary heart disease**
prevalens	**prevalence**
nisbah odds	**odds ratio**

5) **Output Dan Faedah Projek**
Output and Benefits of Project

(a) * Penerbitan *(termasuk laporan/kertas seminar)*
Publications (including reports/seminar papers)
(Sila nyatakan jenis, tajuk, pengarang, tahun terbitan dan di mana telah diterbit/dibentangkan).
(Kindly state each type, title, author/editor, publication year and journal/s containing publication)

1. Mohd Nazri S., *et al.* (2004). The association of shift work and coronary heart disease risk factors among male factory workers in Kota Bharu, Kelantan. *Jurnal Kesihatan Masyarakat.* 72.
2. The association of shift work and hypertension among male factory workers in Kota Bharu, Kelantan. *Dibentangkan dalam 4th National Public Health Conference 2005 di Hotel Marriot Putrajaya.*
3. Mohd Nazri S., *et al.* (2005). The association of shift work and hypertension among male factory workers in Kota Bharu, Kelantan. *MJPHM.* 5 (Supp 1), 45.
4. Mohd Nazri S., *et al.* (2005). Lipid disorders among male factory workers in Kota Bharu, Kelantan: are they prone to? *MJPHM.* 5 (Supp 3), 58.
5. The comparison of markers for metabolic syndrome in day and shift male factory workers in kota bharu, Kelantan: *Dibentangkan dalam 2nd Regional Conference on Occupational Health 2006 di Hotel Crowne Plaza, KL.*

(b) **Faedah-Faedah Lain Seperti Perkembangan Produk, Prospek Komersialisasi Dan Pendaftaran Paten atau impak kepada dasar dan masyakarat.**
Other benefits such as product development, product commercialisation/patent registration or impact on source and society

There was no documented such study done previously in Malaysia as well as there was lack of data pool on effect of shift work particularly on CHD risk factors, hence the results of the study will hopefully provide useful information for the prevention of CHD among the shift workers.

Many researchers worldwide have investigated the risks to CHD among shift workers. Many of them have reported that there is an association between shift work and risk of developing CHD as compared to day workers. On the other hand, there is limited data on such study in Malaysia. This study provides scientific data pertaining to the effect of shift work on cardiovascular system especially among Kelantanese factory workers.

There are almost 10 million of manual workers in our country among whom, most of them do shift work and they tend to be exposed to various health problems. Those workers contribute a great deal in supporting our economic growth. Hence, the risks of CHD among them should be studied and efforts should be administered to minimize such risks.

* Sila berikan salinan
* *Kindly provide copies*

(c) **Latihan Gunatenaga Manusia**
Training in Human Resources

i) Pelajar Siswazah : .....**tiada**.....
Postgraduate students:
(perincikan nama, ijazah dan status)
(Provide names, degrees and status)
.....

.....

.....

ii) Pelajar Prasiswazah *:* .....**tiada**.....
Undergraduate students:
(Nyatakan bilangan)
(Provide number)
.....

.....

.....

iii) Lain-Lain : ..... **tiada** .....
Others:
.....

.....

.....

6. **Peralatan Yang Telah Dibeli :**
Equipment that has been purchased:

1. **One unit of laptop**
2. **Cool box for transportation of blood collected**
3. **Handy drive for data storing**
4. **Syringes and needles**

KOMEN JAWATANKUASA PENYELIDIKAN PUSAT PENGAJIAN
Comments of the Research Committees of Schools/Centres

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TANDATANGAN PENGERUSI
JAWATANKUASA PENYELIDIKAN PUSAT PENGAJIAN
Signature of Chairman
[Research Committee of School/Centre]

TARIKH
Date

Updated 16MAC2006

BORANG LAPORAN HASIL PENYELIDIKAN
PPSP

Tajuk geran: **304/PPSP/6131331**
Penyelidik: **Dr. Mohd Nazri Bin Shafei**
Jenis geran: **Jangka Pendek**
Tempoh geran: **1.6.2004-31.5.2006**

Jenis laporan: Laporan Kemajuan ☐

Laporan Akhir*: X

OBJEKTIF SPESIFIK KAJIAN (sama spt dalam proposal)	**SECARA RINGKAS TERANGKAN PENCAPAIAN/HASIL**	**OBJEKTIF TERCAPAI ATAU TIDAK**
1. To compare the CHD risk factors between male population of shift and daytime workers	The prevalence of high BP, hypercholesterolaemia, hypertriglyceridaemia and body mass index (BMI) of equal to or more than 25 kg/m^2 were significantly higher among shift workers compared to day workers. There was no difference in the prevalence of diabetes mellitus, hypo-high-density lipoprotein-cholesterolaemia, hyper-high-density lipoprotein-cholesterolaemia and physical inactivity.	tercapai
2. To determine associations between shift work and each CHD risk factor among those male factory workers	When the shift workers were compared with the day workers, the adjusted odds ratio (OR) for high BP, BMI of equal to or more than 25 kg/m^2 and physical inactivity were 9.1 (95% CI 1.4-56.8), 2.9 (95% CI 1.3-6.1) and 7.7 (95% CI 2.1-27.5) respectively. There was neither association of shift work with dyslipidaemia, nor with diabetes mellitus.	tercapai
3. -		

** Laporan Akhir perlu disertakan salinan manuskrip dan surat yang dihantar kepada mana-mana jurnal untuk penerbitan. Senarai peralatan yang dibeli di bawah geran juga perlu diserahkan.*

t.t.:

Nama Penyelidik Utama (PI): **Dr. Mohd Nazri Bin Shafei**

Tarikh: **23 Januari 2007**

THE ASSOCIATION OF SHIFT WORK AND CORONARY HEART DISEASE RISK FACTORS AMONG MALE FACTORY WORKERS IN KOTA BHARU, KELANTAN

*Mohd Nazri S., Tengku M.A., Winn T., Choudhury S.R.**

ABSTRACT

INTRODUCTION: *Shift work is one of the work hour systems in which a relay of employees extends the period of production beyond the conventional 8-hour working day. It has been found to be associated with various health problems and there is concern that shift workers are at higher risk to develop risk factors for coronary heart disease (CHD). The study was undertaken to examine relationships between shift work and CHD risk factors, namely hypertension, dyslipidaemia (either hypercholesterolaemia, hyper-low density lipoprotein-cholesterolaemia, hypo-high density lipoprotein-cholesterolaemia or hypertriglyceridaemia), high body mass index (BMI), hyperglycemia and physical inactivity among male factory workers in a factory in Kota Bharu, Kelantan.* ***METHODS:*** *This study was a contrived cross-sectional study of 76 shift and 72 day workers from one of the factories in Kota Bharu, Kelantan. Data was collected through a questionnaire on psychosocial and life-style factors, anthropometric and blood pressure measurement, fasting blood sugar and fasting lipid profiles analyses.* ***RESULTS:*** *The prevalence of hypertension, hypercholesterolaemia, hypertriglyceridaemia and high body mass index (BMI) were significantly higher among shift workers compared to day workers. There was no difference in the prevalence of hyperglycemia, hypo-high-density lipoprotein-cholesterolaemia, hyper-high-density lipoprotein-cholesterolaemia and physical inactivity. When the shift workers were compared with the day workers, the adjusted odds ratio (OR) for hypertension, high BMI and physical inactivity were 9.1 (95% CI 1.4-56.8), 2.9 (95% CI 1.3-6.1) and 7.7 (95% CI 2.1-27.5) respectively. There was neither association of shift work with dyslipidaemia, nor with hyperglycemia.* ***CONCLUSIONS:*** *There were positive association between shift work and hypertension, high BMI and physical inactivity which denotes a higher risk of CHD risk factors among shift workers compared to day workers.*

Keywords: *shift work, risk factors, coronary heart disease, prevalence, odds ratio*

INTRODUCTION

Shift work is one of the work hour systems in which a relay of employees extends the period of production beyond the conventional 8-hour working day and that potentially disrupts workers' normal biological or social diurnal rhythms or both (Akerstedt, T. *et al.*, 1984, Harrington, J.M., 2001). Today, about one in five workers in Europe (Harrington, J.M., 2001) and in the United States (U.S. Congress, 1991, Scott, A.J. and LaDou, J., 1994) are employed on shift work. Some sectors have a considerably higher percentage of employees on shift work. For example, capital-intensive industries and continuous-process operations may have 50% of employees working on shift and over 38% of those in service occupations are shift workers (U.S. Congress, 1991). Although the shift workers of fifty years ago were likely to be factory-based workers, increasing demand for services (both business and pleasure) has extended to those employed in traditionally known as "white collar" occupations like doctors and nurses (Harrington, J.M., 2001).

Shift work has been found to be associated with various health problems which do not only affect the workers but also the economic and industrial sectors. Health problems of shift workers are caused by disturbance of the biologic rhythms. It is well-established that most human functions have a rhythm, the peaks and troughs of which occur in approximately a 24-hour period, known as circadian rhythms. They are determined partly by endogenous factors, the internal body clock and partly by environmental cues such as daylight, noise and the social habits of the individual. These circadian rhythms, which are geared towards activities during the day and rest at night, are persistent and rigid and therefore do not adapt immediately to new working patterns (Taylor, E. *et al.*, 1997).

As association of risk of coronary heart disease (CHD) and shift work is concerned, most of the studies on cardiovascular disease (CVD) among shift workers were supported by the hypothesis

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that they were at increased risk of developing the disease (Akerstedt, T. *et al.*, 1984, Kawachi, I. *et al.*, 1995, Nakamura, K. *et al.*, 1997, Karlsson, B. *et al.*, 2001). Few studies have reported that shift work might have an impact on metabolic variables and also be a risk factor for diabetes, although the evidence is not conclusive (Knutsson, A., 2003). A recent study by Nagaya, T. *et al.* (2002) found that all markers of insulin resistance (IR) which include hypertension, hyperglycemia, hypertriglyceridemia and hypo-High Density Lipoprotein-cholesterolemia were more common in shift workers than in day workers in the age group less than 50 years. A higher prevalence of obesity, hypertension, high triglyceride and low High Density Lipoprotein (HDL) but not hyperglycemia in shift workers than in day workers was also found in a population study (Karlsson, B. *et al.*, 2001). In Malaysia, shift work system is receiving priority attention as it has been practiced in United States and Europe. There are about 8.6 million labor forces in Malaysia which represents approximately 38.7% of the total population (Rampal, K.G. *et al.*, 2002). It is estimated that one-third of the present Malaysian workforce work abnormal hours of some type such as shift work, some form of regulated scheme and staggered working hours (Chee, H.L. and Rampal, K.G., 2003). This study is designed to determine whether there are relationships between shift work and risk factors to coronary heart disease which are dyslipidaemia (either hypercholesterolaemia, hyper-low density lipoprotein-cholesterolaemia, hypo-high density lipoprotein-cholesterolaemia or hypertriglyceridaemia), high body mass index (BMI), hypertension, impaired fasting glycemia (labeled as "hyperglycemia") and physical inactivity among male shift workers as compared to male day workers in a factory in Kota Bharu, Kelantan.

METHODOLOGY

A contrived cross-sectional study was carried out in a factory located in Pengkalan Chepa, Kota Bharu, Kelantan. The factory specializes in the manufacturing of semiconductors and related components. It has a total of 980 employees, running 24-hours with two shifts. The shift system is as follows: first shift workers work from 0800H to 2000H whereas the second shift workers from 2000H to 0800H. Shift rotation was as follows: MMMM-OO-NNNN-OO- and so on (M= morning, N= night, O= off from working). Subjects for each group of workers were selected through a simple random sampling method. We could not run a screening to exclude those who do not fulfill the inclusion criteria due to the factory's rules and regulations. In view of the possibilities of having those who do not fulfill the criteria, we over-sampled the workers. The over-sampling was based on the overall prevalence of hypertension in Kelantan which was 14%. Those who did not fulfill the inclusion criteria were not included in the analysis. The sample size was calculated for each objective and the largest sample size for each group including 20% non-response and 14% over-sampling was 80. A worker was selected as a study subject when he fulfilled the following criteria: Malaysian with age ranges from 19 to 50 years and has been working for more than a year. On the other hand, a subject was excluded to be a sample if he has changing working schedules, for example from shift work to day work or vice versa or having any known chronic illnesses such as diabetes mellitus, hypertension, dyslipidaemia or any cardiovascular diseases (to minimize healthy worker effect since employer tend to put those 'unhealthy' workers into day work). The study was conducted from 1st December 2003 to 31st May 2004.

Research instruments used during the study were:

1. Self-administered questionnaire

Each subject answered a questionnaire which consisted of demographic data, smoking habit and physical activity. Shift workers were determined if he answered his type of work as "shift work" in the questionnaire. Physical activity was graded as active if a subject engaged himself in a sporting activity for at least three times a week; and each activity should be lasting for at least 15 minutes. Otherwise, physical activity was graded as inactive. It was based on one of our local studies (Lim, T.O. *et al.*, 2000).

2. WHO Standard Physical Examination

Height and weight of the subjects were measured with the participants wearing light clothing and their shoes removed. Their weight was measured using a validated and calibrated bathroom spring balance. Their height was measured using a measuring tape which was attached to a rigid wall. High body mass index was defined by BMI $\geq$ 25 kg/m^2. Systolic and diastolic blood pressures were measured twice on the day of interview using an 8 X 14 cm cuff of a standard mercury sphygmomanometer. The average of the two readings for both systolic and diastolic pressures was recorded for data analysis. The measurement was taken with each subject sitting on a chair after at least five minutes of rest. Hypertension was defined as mean systolic blood

pressure (SBP) ≥ 140 mmHg or mean diastolic blood pressure (DBP) ≥ 90 mmHg.

3. Blood collection

For each subject, a ten hours overnight-fasting blood specimen was drawn from antecubital vein between 0800-0900H. Blood for fasting lipid profile (FLP) was analyzed using chemistry analyzer (Hitachi 912) at USM laboratory. Fasting blood sugar was obtained through a capillary puncture using a glucometer (Accutrend). Hypercholesterolaemia was defined by a fasting serum total cholesterol level ≥ 6.22 mmol/l, hypertriglyceridaemia if fasting serum triglyceride level ≥ 1.70 mmol/l, hypo-HDL-cholesterolaemia if fasting serum HDL level ≤ 1.04 mmol/l and hyper-LDL-cholesterolaemia if fasting serum LDL level ≥ 4.14 mmol/l. All the cut-off point levels were based on the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults. Hyperglycemia determination was based on WHO criteria. The capillary fasting blood sugar level of more than 6.10 mmol/l was regarded as abnormal (hyperglycemia). All data was analyzed using Statistical Package for Social Science version 11.0 and Statistics/Data analysis version 7. Independent t-test was performed to compare the mean differences of each numerical risk factor which had normal distribution between shift and non-shift workers. Chi square test or Fisher Exact test were used to determine the differences of the categorical variables between the two groups of workers. In multivariable analysis, multiple logistic regression was used to detect an association between shift work and each CHD risk factor after adjustment for other variables such as age, education levels, duration of employment, income, smoking status and nature of job. The adjusted odds ratio was estimated with 95% confidence interval (95% CI) and a p-value of less than 0.05 was judged to be statistically significant. Each CHD risk factor was tested separately.

RESULTS

The total subject in this study was 148. Table 1 shows the main characteristics of shift and day workers in the factory studied. Their ages ranged from 20.1 to 49.2 years and their working duration was from one to fourteen years. The income of shift workers was significantly lower than that of day workers. There was no worker who did not have any formal education nor had only finished primary education. Many of the day workers (66.7%) had tertiary education, while only about 12% of the shift workers had. Majority of the workers in both worker groups were currently married. Majority of them were among ex-smokers or non-smokers which comprise about 63% and 61% for the shift and day workers respectively. Most of the shift workers were doing machine assisted jobs while on the other hand, more than half of day workers were doing supervisory jobs. The proportion of workers who did manual jobs were almost equal (15%) for both groups. Crude prevalence (*n* and %) for each risk factor by worker group is presented in Table 2 below. Shift workers had a significantly higher prevalent of hypertension, hypercholesterolaemia, hyper-LDL-cholesterolaemia and hypertriglyceridaemia as compared to day workers. On the other hand, the prevalence of hypo-HDL-cholesterolaemia, diabetes mellitus, obesity and physical inactivity were not significantly different between the two worker groups. To exclude the effects of other controlling variables, we calculated both crude and adjusted odds ratios (ORs) for each CHD risk factor. Simple and multiple logistic regression analyses were conducted separately for each risk factor parameter with each risk factor as a dependent variable and type of work (shift work or day work) and other controlling variables as independent variables. Variable selection was done with type of work remained in the model in each analysis. There was no multicollinearity detected since result showed that all the variables have VIF of less than 10. All possible two-way or first order interactions, between type of work and other independent variables were checked by LR test and none was significant. All models were reasonably fit, proven by Hosmer-Lemeshow test. The model fitness was also supported by the Classification table and ROC curve. The identified outliers were not omitted as there was no obvious justification for them when the individual data was checked. Table 3 shows a summary of the final model for each CHD risk factor with their independent and/or important variable/s. There were a significant association between shift work and hypertension, high BMI and being physically inactive. The risk of shift workers having hypertension was 9.1 times, high BMI 2.9 times and being physically inactive 7.7 times more compared to day workers.

Table 1: Characteristics of 76 shift workers and 72 day workers

Variable	Shift workers $n = 76$		Day workers $n = 72$		P value*
	Mean (sd)	No. (%)	Mean (sd)	No. (%)	
Age	31.6 (4.73)		32.32 (4.61)		0.369†
Working duration	8.8 (4.00)		8.12 (4.38)		0.350†
Income	982 (394.15)		1753 (624.82)		<0.001
Level of education:					
Secondary		67 (88.16)		24 (33.33)	<0.001
Tertiary		9 (11.84)		48 (66.67)	
Marital status:					
Married		59 (77.63)		64 (88.89)	0.068
Unmarried		17 (22.37)		8 (11.11)	
Nature of job:					
Machine assisted		61 (80.26)		11 (15.28)	<0.001
Manual		12 (15.79)		11 (15.28)	
Supervisory		3 (3.95)		50 (69.44)	
Working hour:					
≤48 hours/week		47 (61.84)		47 (65.28)	0.664
>48 hours/week		29 (38.16)		25 (34.72)	
Smoking habit:					
Current smoker		28 (36.84)		28 (38.89)	0.613
Ex-smoker		12 (15.79)		15 (20.83)	
Never smoked		36 (47.37)		29 (40.28)	
Smoking duration among smokers (year)	12.1 (4.86)		10.6 (4.23)		0.234
Tobacco smoked per day among smokers	8.21 (3.28)		9.2 (4.68)		0.376

(sd) : standard deviation
*Chi-square test (Pearson)
†Independent t test

Table 2:Prevalence of risk factors for CHD in shift and day workers (using chi-square test)

Risk factor	Shift workers $n = 76$	Day workers $n = 72$	P value
	No. (%)	No. (%)	
Hypertension[a]	17 (22.37)	3 (4.17)	0.001
Hypercholesterolaemia[b]	36 (47.37)	20 (27.78)	0.014
Hyper-LDL-cholesterolaemia[c]	29 (38.16)	22 (30.56)	0.331
Hypo-HDL-cholesterolaemia[d]	7 (9.21)	10 (13.89)	0.372
Hypertriglyceridaemia[e]	32 (42.10)	19 (26.39)	0.044
Hyperglycemia[f]	7 (9.21)	5 (6.94)	0.610
Obesity[g]	32 (42.10)	16 (22.22)	0.010
Physical inactivity[h]	64 (84.21)	55 (76.39)	0.231

[a]Systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg
[b]Fasting serum total cholesterol ≥ 6.22 mmol/l
[c]Fasting serum LDL cholesterol ≥ 4.14 mmol/l
[d]Fasting serum HDL cholesterol ≤ 1.04 mmol/l
[e]Fasting serum triglyceride ≥ 1.70 mmol/l
[f]Fasting blood sugar ≥ 6.10 mmol/l
[g]BMI ≥ 25 kg/m^2
[h]Not engaging in a sporting activity of at least three times a week and each lasting at least 15 minutes

Table 3: Summary of final model for each CHD risk factor (from multiple logistic regression analysis)

CHD risk factor	Significant / important independent variable/s	Adjusted ORs	95% CI
Hypertension	Type of work		
	Shift work	9.07	1.45-56.75
	Day work	1.00	
	Nature of job		
	Manual	6.55	1.43-30.08
	Supervisory	3.00	0.45-20.18
	Machine assisted	1.00	
	Body mass index		
	High	11.90	3.21-44.08
	Normal	1.00	
Dyslipidaemia	Type of work		
	Shift work	1.27	0.63-2.57
	Day work	1.00	
	Age	1.10	1.01-1.19
	Body mass index		
	High	2.41	1.08-5.34
	Normal	1.00	
Hyperglycemia	Type of work		
	Shift work	1.36	0.41-4.49
	Day work	1.00	
High body mass index	Type of work		
	Shift work	2.86	1.34-6.10
	Day work	1.00	
	Physical activity		
	Inactive	1.42	0.53-3.82
	Active	1.00	
	Age	1.13	1.04-1.23
Physical inactivity	Type of work		
	Shift work	7.67	2.14-27.47
	Day work	1.00	
	Working duration	1.25	1.07-1.46
	Level of education		
	Tertiary	16.53	2.63-103.94
	Secondary	1.00	
	Nature of job		
	Manual	0.88	0.26-2.98
	Supervisory	5.66	1.18-27.11
	Machine assisted	1.00	
	Income	0.99	0.99-1.00

DISCUSSION

Many studies on the prevalence of CHD risk factors have been published in the occupational health literature over the last 30 years, with correspondingly wide range of results. Some of the discrepancies could be attributed to the methods of studies used. In our study, we found that the prevalence of all risk factors is generally higher among shift workers except for the prevalence of hyper-HDL-cholesterolaemia. However, the significant or possible positive relationships between shift work and CHD risk factors were in term of hypertension, hypercholesterolaemia, hypertriglyceridaemia and high body mass index. Our finding was similar to the study by Karlsson, B. *et al.* (2001) who reported a higher prevalence of hypertension, hypertriglyceridaemia and high body mass index (but not hypercholesterolaemia) among shift workers than day workers.

Among shift workers, we had found a higher prevalence of hypertension which was 22.37% (95% CI 13.6-33.4%) compared to studies by Karlsson, B. *et al.* (2001) and Nagaya, T. *et al.* (2002) which was reported as 17.8% and 18.6%

respectively. For the prevalence of hypercholesterolaemia, it was higher among the shift workers (47.7%) than day workers (27.8%). Our finding was in contrast with a prospective study by Kawachi, I. *et al.* (1995) who showed that the prevalence of hypercholesterolaemia between the two groups is almost similar which was about 23%. In our study, there was a higher prevalence of hypertriglyceridaemia among shift workers than in day workers. This finding was in line with two previous cross-sectional studies (Karlsson, B. *et al.*, 2001, Nagaya, T. *et al.*, 2002). However, the prevalence of hypertriglyceridaemia (42.1%) among shift workers in our study was higher compared to those previous studies which were 30.8% and 31.3% respectively. There was no adverse health effect of shift work found on the prevalence of hypo-HDL-cholesterolemia in our study. This finding was consistent with the result from the studies by Romon, M. *et al.* (1992), Nakamura, K. *et al.* (1997) and Nagaya, T. *et al.* (2002). On the other hand, in a population study by Karlsson, B. *et al.* (2001), shift workers had a higher prevalence of hypo-HDL-cholesterolaemia than day workers which was significant among workers in 30-39 years and 50-59 years old. However, the results were not adjusted either for nature of jobs or for lifestyle such as smoking. Effects of shift work on serum HDL-cholesterol should be reanalyzed, with more detail being used to take account of lifestyle and the nature of their jobs. We did not also find any significant difference in its prevalence of hyper-LDL-cholesterolaemia between the two workers group. In the present study, we found no difference in the prevalence of hyperglycemia when comparing shift workers and day workers. This result is consistent with a previous study by Karlsson, B. *et al.* (2001). However, Kawachi, I. *et al.* (1995) found a clear relation between duration of shift work and diabetes in a cohort study of 79,109 female nurses. Nagaya, T. *et al.* (2002) also reported a significantly higher prevalence of hyperglycemia among people age 30-39 years old working in shift than among day workers of the same age group. A recent review article summarizing previous studies have yielded inconsistent results on BMI in day and shift workers (Knutsson, A., 2003). We had classified BMI into either high or normal with a cut-off BMI value of 25 kg/m^2. In our study, we found a significant difference in the prevalence of high BMI between the two groups. The prevalence was higher among shift workers (42.1%) than day workers (22.2%). This finding was consistent with a previous study by Karlsson, B. *et al.* (2001). The prevalence of high BMI among shift workers in our study was higher compared to that found in the previous study.

From our analysis, there was no difference in the prevalence of physical inactivity between the two groups. The result is consistent with a study by Johansson, G. *et al.* (1991) who explored the possible influences of work organization, work-related stress and work-related adult socialization on level of physical activity. They found that shift work was entirely unrelated to sedentary behaviour. In view of confounders' effect, we calculated both crude and adjusted odds ratio (ORs) for each of the CHD risk factor. There was about 36% change in odds ratio of shift work in association with hypertension after we adjusted for significant possible confounders which are BMI and nature of their jobs. The risk of having hypertension is 9.07 times more among shift workers compared to day workers. In their prospective study, Kawachi, I. *et al.* (1995) had proven that longer durations of shift work were associated with higher age-adjusted prevalence of hypertension. In our study, there was no association between type of work and dyslipidaemia. As the prevalences of hyperglycemia were similar between the two groups, there was also no association between shift work and risk of having hyperglycemia after adjusting for all possible confounders in the multivariable analysis. Study design could be one of the reasons why we found no difference in association of type of work with dyslipidemia, nor with hyperglycemia. This is because cross-sectional study will underestimate chronic diseases due to selection effects. Usually managers will tend to transfer those shift workers with any chronic illnesses to day work (Karlsson, B. *et al.*, 2001). This observation could also be due to no effects on lipid profile and glucose level at the current exposure, very minimal or subtle change in their profiles or due to inadequate sample size to produce enough study power. For the association between shift work and high BMI, we found that the risk was higher among shift workers which were 2.86 times more compared to day workers. Our finding was in line with a cohort study of 377 shift workers and day workers as controls (Amelsvoort, L.G.P.M.v. *et al.*, 1999). In contrast to no difference in the prevalence of low physical activity, we found that there was an association between shift work and risk of being physically inactive after adjusting for all possible confounders. The risk of being physically inactive among shift workers was 7.67 times more compared to day workers.

The results from our study suggest that in the present factory male workers population, shift work may affect the workers health that may induce development of CHD in the future. It is characterized by a higher prevalence of

hypercholesterolaemia, hypertriglyceridaemia and high body mass index that seems to cluster together more often in shift workers than in day workers. However after adjustment, shift work is persistently highly associated with higher risk of having hypertension and high body mass index. Our study also proved that shift workers may be associated with a higher risk of being physically inactive. On the other hand, there are no adverse health effects of shift work on serum LDL, HDL and glucose. No matter what advances there are in high-technology medicine, the fundamental message is that any major reduction in deaths and disability from CHD will come from prevention, not cure. This must involve robust reduction of risk factors.

ACKNOWLEDGEMENTS

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ABSTACT FOR KELANTAN PUBLIC HEALTH CONFERENCE 2005

TITLE: THE ASSOCIATION OF SHIFT WORK AND HYPERTENSION AMONG MALE FACTORY WORKERS IN KOTA BHARU, KELANTAN

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INTRODUCTION: Shift work is one of the work hour systems in which a relay of employees extends the period of production beyond the conventional 8-hour working day. Shift work has been found to be associated with various health problems and there is concern that shift workers are at higher risk to develop risk factors for coronary heart disease (CHD). The study was undertaken to examine relationship between shift work and hypertension as one of the CHD risk factors among male factory workers in a factory in Kota Bharu, Kelantan.

METHODS: This study was a contrived cross-sectional study of 76 shift and 72 day workers from one of the factories in Kota Bharu, Kelantan. Data was collected through a Malay language questionnaire on psychosocial and life-style factors, anthropometric and blood pressure measurement, fasting blood sugar and fasting lipid profiles analyses. The study was conducted between December 2003 and May 2004.

RESULTS: The prevalence of hypertension was significantly higher among shift workers (22.4%) compared to day workers (4.2%). Shift work (adjusted OR 9.1; 95 percent CI 1.4-56.7), manual job (adjusted OR 6.5; 96 percent CI 1.4-30.1) and high body mass index (adjusted OR 11.9; 95 percent CI 3.2-44.1) were significantly associated with hypertension.

CONCLUSIONS: There was positive association between shift work and hypertension which posed a higher risk of hypertension among shift workers compared to day workers.

Keywords: shift work, risk factors, hypertension, prevalence, odds ratio

P28

RELIABILITY AND CONCURRENT VALIDITY OF THE MALAY VERSION OF DEPRESSION ANXIETY STRESS SCALE (DASS) IN AUTOMOTIVE ASSEMBLY WORKERS IN MALAYSIA

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Introduction
Increasing awareness of mental health problem such as depression, anxiety and stress amongst employees presents practical demands for employers and occupational health practitioners to screening the status of depression, anxiety and stress in workers with reliable and validate instrument in the workforce.

Aim
The aim of the present study was to assess the reliability and concurrent validity of the Malay version of Depression, Anxiety and Stress Scale (DASS) questionnaire in automotive assembly workers in Malaysia.

Methods
This cross-sectional study was self-administered among 224 men workers during working hours at the premises of the industry in 12 to 14 April 2005. All workers were provided written informed consent before participating in the study. Translation and back translation was made. The internal consistency and concurrent validity of the Malay version of DASS was evaluated by Cronbach's alpha and Pearson correlation analysis using SPSS 11.01. RESULTS: The Cronbach's alpha coefficients for depression, anxiety and stress were 0.87, 0.82 and 0.87, which indicated that these subscales had good internal consistency. The concurrent validity analysis was found satisfactory which demonstrated DASS-Depression had moderately strong and positive correlation with Beck Depression Inventory (BDI) questionnaire (r = 454) and had poor and positive correlation between DASS-Anxiety scale with Beck Anxiety Inventory (BAI) questionnaire (r = 293).

Conclusions
The results indicate that the Malay version of DASS questionnaire is valid and reliable to measure occupational screening for depression, anxiety and stress problem at automotive assembly working population in Malaysia.

Key words: *DASS, Reliability, Concurrent Validity*

P29

LIPID DISORDERS AMONG MALE FACTORY SHIFT WORKERS IN KOTA BHARU, KELANTAN: ARE THEY PRONE TO?

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Introduction
Modern society is changing rapidly in terms of economic, social and human behaviour. Consequently, various types of work schedules have been applied by organizations and companies. Working hours are extended to evenings and nights, as well as on weekends. Shift work, one of the work hour systems has been found to be associated with various health problems and there is concern that shift workers are at higher risk to develop lipid disorders.

Objectives
The study was undertaken to compare the prevalence of lipid disorders (hypercholesterolaemia, hypertriglyceridaemia, hyper-LDL and hypo-HDL-cholesterolaemia) and to examine relationship between shift work and dyslipidaemia among 76 shift and 72 day male workers from one of the factories in Kota Bharu, Kelantan.

Methods
A cross-sectional study using data from a Malay language questionnaire on psychosocial and life-style factors, anthropometric and blood pressure measurement, fasting blood sugar and lipid profiles analyses from 148 workers who were randomly selected. In multiple variable analysis, the presence of any abnormalities in the lipid profiles was regarded as having dyslipidaemia. The study was conducted between December 2003 and May 2004.

Results
The prevalence of hypercholesterolaemia and hypertriglyceridaemia were significantly higher among shift workers compared to day workers with p-value of 0.014 and 0.044 respectively. However, there was no significant different in the prevalence of hyper-LDL and hypo-HDL-cholesterolaemia. After adjusted, shift work (adjusted odds ratio 1.27; 95 percent CI 0.63-2.57) was not significantly associated with dyslipidaemia.

Conclusions
Although the prevalence of hypercholesterolaemia and hypertriglyceridaemia were higher among shift workers, shift work was found not to be associated with dyslipidaemia.

Key words: *shift work, dyslipidaemia, prevalence, odds ratio*

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LIPID DISORDERS AMONG MALE FACTORY SHIFT WORKERS IN KOTA BHARU, KELANTAN

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Summary

Shift work has been found to be associated with various health problems and there is concern that shift workers are at higher risk to develop lipid disorders. A cross-sectional study was conducted to compare the prevalence of lipid disorders (hypercholesterolaemia, hypertriglyceridaemia, hyper-LDL and hypo-HDL-cholesterolaemia) and to examine relationship between shift work and dyslipidaemia among 148 male workers from one of the factories in Kota Bharu, Kelantan. Data was gathered from a Malay language questionnaire on psychosocial and life-style factors, anthropometric and blood pressure measurement, fasting blood sugar and lipid profiles analyses from those workers who were randomly selected. In multiple variable analysis, the presence of any abnormalities in the lipid profiles was regarded as having dyslipidaemia. The study was conducted between December 2003 and May 2004. The prevalence of hypercholesterolaemia and hypertriglyceridaemia were significantly higher among shift workers compared to day workers with p-value of 0.014 and 0.044 respectively. However, there was no significant different in the prevalence of hyper-LDL and hypo-HDL-cholesterolaemia. After adjusted, shift work (adjusted odds ratio 1.27; 95 percent CI 0.63-2.57) was not significantly associated with dyslipidaemia.

***Key Words**: shift work, dyslipidaemia, prevalence, odds ratio*

Introduction

Shift work is one of the work hour systems in which a relay of employees extends the period of production beyond the conventional 8-hour working day and that potentially disrupts workers' normal biological or social diurnal rhythms or both [1,2]. Today, about one in five workers in Europe [2] and in the United States [3,4] are employed on shift work. Although the shift workers of fifty years ago were likely to be factory-based workers, increasing demand for services (both business and pleasure) has extended to those employed in traditionally known as "white collar" occupations like doctors and nurses [2].

In Malaysia, shift work system is receiving priority attention as it has been practiced in United States and Europe. It is because of the concerns of productivity, health and safety. Rapid industrialization has introduced various types of working schedules and working hours as opposed to the conventional dawn-to-dusk practice. It is estimated that one-third of the present Malaysian workforce work abnormal hours of some type such as shift work, some form of regulated scheme and staggered working hours [5].

Shift work has been found to be associated with various health problems which do not only affect the workers but also the economic and industrial sectors. Health problems of shift workers are caused by disturbance of the biologic rhythms [6]. It is well-established that most human functions have a rhythm, the peaks and troughs of which occur in approximately a 24-hour period, known as

circadian rhythms. They are determined partly by endogenous factors, the internal body clock and partly by environmental cues such as daylight, noise and the social habits of the individual [7]. These circadian rhythms, which are geared towards activities during the day and rest at night, are persistent and rigid and therefore do not adapt immediately to new working patterns [8].

A recent study found that all markers of insulin resistance (IR) which include hypertension, hyperglycemia, hypertriglyceridemia and hypo-High Density Lipoprotein-cholesterolemia were more common in shift workers than in day workers in the age group less than 50 years [9]. A higher prevalence of hypertriglyceridaemia among shift workers than day workers was also found in a population study [10]. Causal mechanisms are not well defined but contributing factors include disruption of circadian rhythm, disturbed sociotemporal patterns and social support, stress, smoking, poor diet, and lack of exercise [2].

This study was designed to determine the lipid disorders prevalence (hypercholesterolaemia, hyper-LDL-cholesterolaemia, hypo-HDL-cholesterolaemia and hypertriglyceridaemia) and relationship between dyslipidaemia and shift work among male factory workers. We hypothesized that the prevalence of those lipid disorders were higher among shift workers as compared to day workers and also there was a positive relationship between shift work and dyslipidaemia.

Materials and Methods

A cross-sectional study was designed to investigate the effect of shift work on blood pressure of male factory workers. The study was carried out in a factory located in Pengkalan Chepa, Kota Bharu, Kelantan. It specializes in the manufacturing of semiconductors and related components. The total number of employees was 980. The factory runs 24-hours with two shifts. The shift system is as follows: first shift workers work from 8.00 am to 8.00 pm (considered as daytime) whereas the second shift workers work from 8.00 pm to 8.00 am (considered as nighttime). Shift rotation was as follows: DD-NN-OOO-DD-NN-OOO- and so on (D= daytime, N= nighttime, O= off from working). The study was conducted from 1st December 2003 to 31st May 2004.

Subjects for each group of workers were selected through a simple random sampling. We could not run a screening to exclude those who do not fulfill the inclusion criteria due to the factory's rules and regulations. In view of the possibilities of having those who do not fulfill the criteria, we over-sampled the workers. The over-sampling was based on the overall prevalence of hypertension in Kelantan which was 14% [11]. Those who did not fulfill the inclusion criteria were not included in the analysis. A total of a hundred and sixty subjects were selected.

A worker was selected as a study subject when he fulfilled the following criteria: Malaysian with age ranged from 19 to 50 years and had been working for more

than a year. A subject was excluded if he had changing working schedules, for example from shift work to day work or vice versa or having any known chronic illnesses such as diabetes mellitus, hypertension, dyslipidaemia or any cardiovascular diseases (to minimize healthy worker effect since employers tend to put those 'unhealthy' workers into day work). Seven of the selected subjects were dropped from the study because of not fulfilling the inclusion criteria and five of them did not finish the study.

The study protocol was reviewed and presented to the Research Ethics Committee, School of Medical Sciences, Universiti Sains Malaysia on 24th September 2003 and was approved on 5th November 2003 (Ref. No.: USM/PPSP®/Ethics Com./2003(113.3[1]).

Research instruments used during the study were:

1. Self-administered questionnaire

Each subject answered a Malay language questionnaire which consisted of three parts which were demographic data, smoking habit and physical activity. Shift workers were determined if he answered his type of work as "shift work" in the questionnaire. Physical activity was graded as active if a subject engaged himself in a sporting activity for at least three times a week; and each activity should be lasting for at least 15 minutes. Otherwise, physical activity was graded as inactive. It was based on one of our local studies [12].

2. WHO Standard Physical Examination

Height and weight of the subjects were measured to the nearest tenth of a centimeter and nearest tenth of a kilogram respectively. These were done with the participants wearing light clothing and their shoes removed. Their weight was measured using a validated and calibrated bathroom spring balance. Their height was measured using a measuring tape which was attached to a rigid wall. During height measurement, their heels were close together and the subjects were asked to look horizontally ahead. High body mass index was defined by BMI ≥ 25 kg/m^2.

Systolic and diastolic blood pressures were measured twice using an 8 X 14 cm cuff of a standard mercury sphygmomanometer. The average of the two readings for both systolic and diastolic pressures was recorded for data analysis. The measurement was taken with each subject sitting on a chair after at least five minutes of rest. Hypertension was defined as mean systolic blood pressure (SBP) ≥ 140 mmHg or mean diastolic blood pressure (DBP) ≥ 90 mmHg [13].

3. Blood collection

For each subject, a ten hours overnight-fasting blood specimen was drawn from antecubital vein between 0800-0900H. Blood for fasting lipid profile (FLP) was analyzed using chemistry analyzer (Hitachi 912) at USM laboratory. Fasting blood sugar was obtained using a glucometer (Accutrend).

Hypercholesterolaemia was defined by a fasting serum total cholesterol level ≥ 6.22 mmol/l, hypertriglyceridaemia if fasting serum triglyceride level ≥ 1.70 mmol/l, hypo-HDL-cholesterolaemia if fasting serum HDL level ≤ 1.04 mmol/l and hyper-LDL-cholesterolaemia if fasting serum LDL level ≥ 4.14 mmol/l. All the cut-off point levels were based on the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults. The presence of any abnormality was regarded as having dyslipidaemia.

Hyperglycemia determination was based on WHO criteria. Fasting blood sugar level of more than 6.10 mmol/l was regarded as abnormal (hyperglycemia).

Statistical Analysis

All data was analyzed using SPSS version 11.0 and STATA version 7. Descriptive analysis was done to check the comparability between the two groups. In multivariable analysis, multiple logistic regression was used to detect an association between shift work and dyslipidaemia after adjusting for other variables. Fitness of the model was tested using Hosmer-Lemeshow goodness-of-fit test, classification table and Receiver Operating Characteristics (ROC) curve. The model was further checked for model diagnostics by influential statistics. These were plotted against predicted probability. The adjusted odds

ratio was estimated with 95% confidence interval (95% CI). A p-value of less than 0.05 was judged to be statistically significant.

Results

Total number of the subjects selected to be in our statistical analysis was 148. Seventy six (51.4%) of the subjects were among shift workers, whereas 72 (48.6%) of them were day workers.

Table I shows the main characteristics of shift and day workers in the factory studied. The age of the workers participated in the study ranged from 20.1 to 49.2 years and their working duration was from one to fourteen years. There were no significant difference in the mean age and duration of employment between the two worker groups ($p = 0.369$). Majority of the workers were among ex-smokers or non-smokers which comprise about 63% and 61% for the shift and day workers respectively. There was no significant difference in the proportion of smokers among shift workers (36.8%) as compared to among day workers (38.9%).

Table I: Characteristics of 76 shift workers and 72 day workers

Variable	Shift workers $n = 76$		Day workers $n = 72$		p value*
	Mean (sd)	No. (%)	Mean (sd)	No. (%)	
Age	31.6 (4.73)		32.32 (4.61)		0.369†
Working duration	8.8 (4.00)		8.12 (4.38)		0.350†
Income	982 (394.15)		1753 (624.82)		<0.001
Level of education:					
Secondary		67 (88.16)		24 (33.33)	<0.001
Tertiary		9 (11.84)		48 (66.67)	
Marital status:					
Married		59 (77.63)		64 (88.89)	0.068
Unmarried		17 (22.37)		8 (11.11)	
Nature of job:					
Machine assisted		61 (80.26)		11 (15.28)	<0.001
Manual		12 (15.79)		11 (15.28)	
Supervisory		3 (3.95)		50 (69.44)	
Smoking habit:					
Current smoker		28 (36.84)		28 (38.89)	0.613
Ex-smoker		12 (15.79)		15 (20.83)	
Never smoked		36 (47.37)		29 (40.28)	
Smoking duration among smokers (year)	12.1 (4.86)		10.6 (4.23)		0.234
Tobacco smoked per day among smokers	8.21 (3.28)		9.2 (4.68)		0.376

(sd) : standard deviation
*Chi-square test (Pearson)
†Independent t test

Table II shows that shift workers had a significantly higher prevalence of hypercholesterolaemia and hypertriglyceridaemia as compared to day workers. To exclude the effects of other controlling variables, we calculated both crude and adjusted odds ratio (OR) for dyslipidaemia. Simple and multiple logistic regression analysis were conducted with presence/absence of dyslipidaemia as a dependent variable and type of work (shift work or day work) and other controlling variables as independent variables.

Table II: Prevalence of risk factors for CHD in shift and day workers (using chi-square test)

Risk factor	Shift workers $n = 76$	Day workers $n = 72$	P value
	No. (%)	No. (%)	
Hypercholesterolaemia[a]	36 (47.37)	20 (27.78)	0.014
Hyper-LDL-cholesterolaemia[b]	29 (38.16)	22 (30.56)	0.331
Hypo-HDL-cholesterolaemia[c]	7 (9.21)	10 (13.89)	0.372
Hypertriglyceridaemia[d]	32 (42.10)	19 (26.39)	0.044

[a]Fasting serum total cholesterol ≥ 6.22 mmol/l
[b]Fasting serum LDL cholesterol ≥ 4.14 mmol/l
[c]Fasting serum HDL cholesterol ≤ 1.04 mmol/l
[d]Fasting serum triglyceride ≥ 1.70 mmol/l

Table III shows a final model for dyslipidaemia with the independent variables. We examined all the possible confounders in the model during variable selection

process. Those variables were age, working duration, education level, marital status, nature of job, working hour (either 48 hours in a week or less or more than 48 hours in a week), smoking habit, BMI (either high or normal), presence of high blood pressure and physical activity (either active or inactive). In this study, after controlling for possible confounders, we found that there was no association between shift work and dyslipidaemia. There was no multicollinearity detected. All possible two-way or first order interactions, between type of work and other independent variables were checked.

Table III: Association of shift work and dyslipidaemia among 148 factory workers, using multiple logistic regression models

Variables (*n*)	Cru. OR (95% CI)	p value	Adj. OR (95% CI)[a]	LR Stat.	p value
Type of work					
Shift work (76)	1.37 (0.71-2.64)	0.345	1.27 (0.63-2.57)	0.46	0.498
Day work (72)	1.00	-	1.00		
Age	1.11 (1.03-1.20)	0.007	1.10 (1.01-1.19)	5.36	0.024
Body mass index					
High (48)	3.00 (1.40-6.43)	0.005	2.41 (1.08-5.34)	4.86	0.031
Normal (100)	1.00		1.00		

Cru. OR: Crude Odds Ratio
Adj. OR: Adjusted Odds Ratio
LR Stat.: Likelihood Ratio Statistic

The model was reasonably fit, proven by Hosmer-Lemeshow test which gave an insignificant p-value (Chi square = 147.44, df = 142, p-value = 0.360). Fitness of the model was also supported by the ROC curve (Figure I).

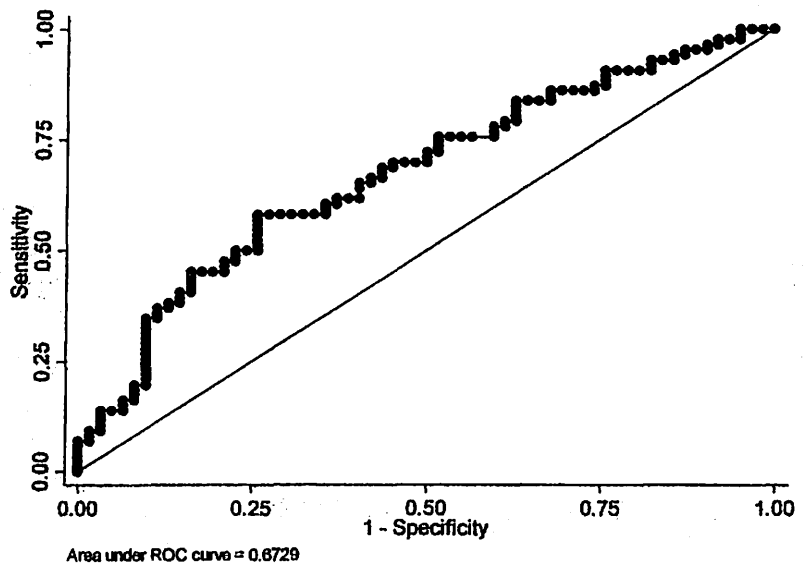

Fig. 1: ROC curve of model for dyslipidaemia

Discussion

This study attempts to determine the relationship between doing shift work and odds of having dyslipidaemia. This study may not be a representative of factory workers in other companies in Malaysia as well as in other parts of the world. It should be noted that among our subjects, there were no differences in their mean age, working duration and marital status between shift and day workers.

In our study we used level of education as a proxy for the socioeconomic situation. Low socioeconomic status is a potential confounder when studying the association between shift work and dyslipidaemia. From our study, we found that day workers were more educated as compared to shift workers in which many of them had undergone until at least tertiary education level. This could be explained by the selection of the subjects into the study. Day workers were selected from operators as well as from white collar and administrative work. Hence, we admit that this may influence the interpretation of our study findings.

Many studies on the prevalence of lipid disorders have been published in the occupational health literature over the last 30 years, with correspondingly wide range of results. Some of the discrepancies could be attributed to the methods of studies used. In our study, we found that the prevalence of hypercholesterolaemia and hypertrigliceridaemia were higher among shift workers compared to among day workers. On the other hand, the prevalence of

hyper-LDL and hypo-HDL-cholesterolaemia were not differed between the two worker groups.

We had found a higher prevalence of hypercholesterolaemia among shift workers compared to studies by Kawachi *et al.* [14] which were almost 48% and 23% respectively. However, in their study the prevalence was similar between the two groups of workers. A higher prevalence of hypertriglyceridaemia among shift workers than in day workers in our study was in line with two previous cross-sectional studies [9,10]. However, the prevalence of hypertriglyceridaemia (42.1%) among shift workers in our study was higher compared to those previous studies which were 30.8% and 31.3% respectively. The difference in the finding could be due to the fact that the prevalence of hypertriglyceridaemia in their general population is much lower than that in our country.

As far as hypo-HDL-cholesterolaemia is concerned, there was no adverse health effect of shift work found in our study. This finding was consistent with the result from a study by Nagaya, *et al.* [9]. Serum HDL may be more stable in shift working than other lipid markers. On the other hand, in a population study by Karlsson, *et al.* [10], shift workers had a higher prevalence of hypo-HDL-cholesterolaemia than day workers which was significant among workers in 30-39 years and 50-59 years old. However, the results were not adjusted either for nature of jobs or for lifestyle such as smoking. Moreover, both shift work and smoking habit were generally more frequent in blue-collar workers than in office or white-collar

workers. So, their results may be confounded by factors such as smoking habit related to job and the nature of their jobs. Effects of shift work on serum HDL-cholesterol should be reanalyzed, with more detail being used to take account of lifestyle and the nature of their jobs. Our finding of a slightly higher prevalence of hypo-HDL-cholesterolemia among day workers as compared to shift workers might be explained by a higher prevalence of current smoking among them.

For the odds of having dyslipidaemia, we found that the crude and adjusted odds ratios for the type of work were not different. In the study, there was no association between type of work and dyslipidaemia. The significant controlling variables in the model of association were age and BMI. Study design could be one of the reasons why we found no difference in association of type of work with dyslipidemia. This is because cross-sectional study will underestimate chronic diseases due to selection effects. Usually managers will tend to transfer those shift workers with any chronic illnesses to day work. This observation could also be due to no effects on lipid profiles at the current exposure, very minimal or subtle change in their profiles or due to inadequate sample size to produce enough study power.

The results from our study, suggest that in the present factory male workers population, although the prevalence of hypercholesterolaemia and hypertriglyceridaemia were higher among shift workers, shift work was found not to be associated with dyslipidaemia. Despite the finding of no association

between shift work and dyslipidaemia, our study does show that the important metabolic risk variables which are raised cholesterol and triglyceride concentrations are more common in shift workers than in day workers. These may indicate that further researches along these lines with a better study design and larger sample size are needed.

Conclusions

Acknowledgements

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ABSTRACT FOR REGIONAL CONFERENCE ON OCCUPATIONAL HEALTH 2006

THE COMPARISON OF MARKERS FOR METABOLIC SYNDROME IN DAY AND SHIFT MALE FACTORY WORKERS IN KOTA BHARU, KELANTAN

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ABSTRACT

INTRODUCTION: Modern society is changing quite rapidly in terms of economic, social and human behaviour. Working hours are extended to evenings and night hours, as well as to weekends. There is concern that shift workers are at higher risk to develop risk factors for metabolic syndrome (MS). The study was undertaken to examine relationships between shift work and MS risk factors among male factory workers in a factory in Kota Bharu, Kelantan.

METHODS: This study was a cross-sectional study of 148 workers from one of the factories in Kota Bharu, Kelantan. Data was collected through a questionnaire on psychosocial and life-style factors, anthropometric and blood pressure measurement, fasting blood sugar and fasting lipid profiles analyses. ATP-III guidelines was used in determining the presence of risk factors for the metabolic syndrome.

RESULTS: The crude prevalence of high blood pressure, hypertriglyceridaemia and high body mass index (BMI) were significantly higher among shift workers compared to day workers. There was no difference in the crude prevalence of hyperglycemia and hypo-HDL-cholesterolaemia. When the shift workers were compared with the day workers, the proportion of workers having three or more risk factors for the syndrome was higher among shift workers which were 15.8% and 5.6% respectively.

CONCLUSIONS: There were positive association between shift work and risk factors for developing metabolic syndrome. It denotes a higher risk of metabolic syndrome among shift workers compared to day workers.

Keywords: shift work, risk factors, metabolic syndrome, crude prevalence

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Tuan,

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Artikel tuan akan diwasit oleh dua orang pewasit bebas dan tuan akan dimaklumkan keputusannya dengan secepat yang mungkin.

Sila berhubung dengan pihak kami melalui e-mail mjphm@kck.usm.my sekiranya terdapat sebarang pertanyaan atau masalah.

Sekian, terima kasih.

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THE COMPARISON OF MARKERS FOR METABOLIC SYNDROME IN DAY AND SHIFT MALE FACTORY WORKERS IN KOTA BHARU, KELANTAN

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ABSTRACT

Modern society is changing quite rapidly in terms of economic, social and human behaviour. Working hours are extended to evenings and night hours, as well as to weekends. There is concern that shift workers are at higher risk to develop risk factors for metabolic syndrome (MS). A cross-sectional study of 148 workers from one of the factories in Kota Bharu, Kelantan was conducted to examine relationships between shift work and MS risk factors. Data was collected through a questionnaire on psychosocial and life-style factors, anthropometric and blood pressure measurement, fasting blood sugar and fasting lipid profiles analyses. ATP-III guidelines was used in determining the presence of risk factors for the metabolic syndrome. The crude prevalence of high blood pressure, hypertriglyceridaemia and high body mass index (BMI) were significantly higher among shift workers compared to day workers. There was no difference in the crude prevalence of hyperglycemia and hypo-HDL-cholesterolaemia. When the shift workers were compared with the day workers, the proportion of workers having three or more risk factors for the syndrome was higher among shift workers which were 15.8% and 5.6% respectively.

Key words: shift work, risk factors, metabolic syndrome, crude prevalence

INTRODUCTION

Modern society is changing rapidly both in terms of economic and productive strategies such as new technologies, market globalization and information processes. Hence, time constraints no longer limit human activities. As a result, the arrangement of working hours has become a crucial factor in work organization and acquires different values according to economic and social consequences that can arise at different periods of the company and worker's life [1]. In order to fulfill human needs, shift work has been introduced.

Shift work is one of the work hour systems in which a relay of employees extends the period of production beyond the conventional 8-hour working day and that potentially disrupts workers' normal biological or social diurnal rhythms or both [2,3]. Today, about one in five workers in Europe [3] and in the United States [4,5] are employed on shift work. In Malaysia, shift work system is also receiving priority attention as it has been practiced in United States and Europe. It is because of the concerns of productivity, health and safety. Rapid industrialization has introduced various types of working schedules and working hours as opposed to the conventional dawn-to-dusk practice. It is estimated that one-third of the present Malaysian workforce work abnormal hours of some type such as shift work, some form of regulated scheme and staggered working hours [6].

Shift work has been found to be associated with various health problems which do not only affect the workers but also the economic and industrial sectors.

Health problems of shift workers are caused by disturbance of the biologic rhythms [7]. It is well-established that most human functions have a rhythm, the peaks and troughs of which occur in approximately a 24-hour period, known as circadian rhythms. They are determined partly by endogenous factors, the internal body clock and partly by environmental cues such as daylight, noise and the social habits of the individual [8]. These circadian rhythms, which are geared towards activities during the day and rest at night, are persistent and rigid and therefore do not adapt immediately to new working patterns [9].

It is found that quality and duration of sleep could impact on metabolic and endocrine function [10]. Karlsson, et al. [11] proved that obesity, hypertension, high triglyceride and low High Density Lipoprotein (HDL)-cholesterol are clustered together more often among shift workers than day workers. The result raises the question whether shift work could induce metabolic syndrome. Few studies have reported that shift work might have an impact on metabolic variables and also be a risk factor for diabetes, although the evidence is not conclusive [12]. Kawachi, I. *et al.* [13] conducted a prospective study of shift work and risk of CHD in female nurses found that the age-standardized prevalence of diabetes increased with increasing exposure to shift work. A study by Nagaya, T. *et al.* [14] found that all markers of insulin resistance (IR) which include hypertension, hyperglycemia, hypertriglyceridemia and hypo-HDL-cholesterolemia were more common in shift workers than in day workers in the age group less than 50 years. Causal mechanisms are not well defined but contributing factors include disruption of circadian rhythm, disturbed sociotemporal patterns and social support, stress, smoking, poor diet and lack of exercise [3].

Metabolic syndrome (MS) has multiple, inter-related factors that raise risk and is characterized by a constellation of metabolic risk factors in one individual. The root causes of the syndrome are overweight or obesity, physical inactivity and genetic factors. The MS is closely associated with a generalized metabolic disorder known as insulin resistance (IR). The mechanistic connections between IR and metabolic risk factors are not fully understood and appear to be complex [15]. Until now, there are no well-accepted criteria for the diagnosis of the MS. The MS defined by ATP-III guidelines consists of three or more of the following: fasting plasma glucose [greater than or equal to] 6.10 mmol/l, serum triglycerides [greater than or equal to] 1.70 mmol/l, serum HDL cholesterol <1.04 mmol/l, blood pressure [greater than or equal to] 130/85 mmHg or on BP medication, or waist girth >102 cm.

This study is designed to determine the characteristic of the MS and examine the extent of the risk factors for the syndrome. We compared the prevalence of each MS marker between male shift workers and day workers in a factory in Kota Bharu, Kelantan.

MATERIALS AND METHODS

Design and respondents

This was a cross-sectional study which was designed to investigate the effect of shift work on the markers for the MS. This study was carried out in a factory located in Pengkalan Chepa, Kota Bharu, Kelantan. It specializes in the manufacturing of semiconductors and related components. It has a total of 980 employees, running 24-hours with two shifts. The shift system is as follows: first shift workers work from 8.00 am to 8.00 pm (considered as 'Daytime') whereas the second shift workers work from 8.00 pm to 8.00 am (considered as 'Nighttime'). Shift rotation was as follows: DDDD-OO-NNNN-OO- and so on (D= Daytime, N= Nighttime, O= off from working). The study was conducted from 1st December 2003 to 31st May 2004.

There were 620 male workers in the factory with 450 of them did shift work and 170 did day work. Subjects for each group of workers were selected through a simple random sampling method. We could not run a screening to exclude those who do not fulfill the inclusion criteria due to the factory's rules and regulations. In view of the possibilities of having those who do not fulfill the criteria, we over-sampled the workers. Those who did not fulfill the inclusion criteria were not included in the analysis.

Our inclusion criteria were: Malaysian with age ranges from 19 to 50 years and has been working for more than a year. On the other hand, a subject was

excluded to be a sample if he has changing working schedules, for example from shift work to day work or vice versa or having any known chronic illnesses such as diabetes mellitus, hypertension, dyslipidaemia or any cardiovascular diseases (to minimize healthy worker effect since employer tend to put those 'unhealthy' workers into day work)

Data Collection and Research Instruments

Research instruments used during the study were:

1. Self-administered questionnaire

Each subject answered a questionnaire which consisted of three parts which were demographic data, smoking habit and physical activity. Shift workers were determined if he answered his type of work as "shift work" in the questionnaire. Physical activity was graded as active if a subject engaged himself in a sporting activity for at least three times a week; and each activity should be lasting for at least 15 minutes. Otherwise, physical activity was graded as inactive. It was based on one of our local studies [16].

2. WHO Standard Physical Examination

Height and weight of the subjects were measured to the nearest tenth of a centimeter and nearest tenth of a kilogram respectively. These were done with the participants wearing light clothing and their shoes removed. Their weight was measured using a validated and calibrated bathroom spring balance. Their height was measured using a measuring tape which was attached to a rigid wall. During height measurement, their heels were close together and the

subjects were asked to look horizontally ahead. High body mass index was defined by BMI ≥ 25 kg/m^2.

Systolic and diastolic blood pressures were measured twice on the day of interview using an 8 X 14 cm cuff of a standard mercury sphygmomanometer. The average of the two readings for both systolic and diastolic pressures was recorded for data analysis. The measurement was taken with each subject sitting on a chair after at least five minutes of rest. High blood pressure was defined as mean systolic blood pressure (SBP) ≥ 130 mmHg or mean diastolic blood pressure (DBP) ≥ 85 mmHg.

3. Blood collection

For each subject, a ten hours overnight-fasting blood specimen was drawn from antecubital vein between 0800-0900H. Blood for fasting lipid profile (FLP) was analyzed using chemistry analyzer (Hitachi 912) at USM laboratory. Fasting blood sugar was obtained using a glucometer (Accutrend).

Hypertriglyceridaemia was defined by a fasting serum triglyceride level ≥ 1.70 mmol/l, hypo-HDL-cholesterolaemia if fasting serum HDL level < 1.04 mmol/l. The capillary fasting blood sugar level of more than 6.10 mmol/l was regarded as abnormal (hyperglycemia). All the cut-off point levels were based on the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults.

The study protocol was reviewed and presented to the Research Ethics Committee, School of Medical Sciences, Universiti Sains Malaysia on 24th September 2003 and was approved on 5th November 2003.

Statistical Analysis

All data was analyzed using Statistical Package for Social Science version 11.0 and Statistics/Data analysis version 7. Descriptive analysis was done to check the comparability between the two groups. Independent t-test was performed to compare the mean differences of each numerical risk factor which had normal distribution between shift and non-shift workers. Chi square test or Fisher Exact test were used to determine the differences of the categorical variables between the two groups of workers. We also examine the proportion of the workers in each group at risk for MS using ATP-III guidelines but with some modification in which, unlike the criteria from the guideline, we used body mass index instead of waist girth. Finally, we presented the proportion of workers with the number of MS markers present.

RESULTS

There were 148 respondents with 76 (51.4%) of the respondents were among shift workers, whereas 72 (48.6%) of them were day workers. Table 1 shows the main characteristics of shift and day workers in the factory studied. The age of the workers participated in the study ranged from 20.1 to 49.2 years and their working duration was from one to fourteen years. There were no significant difference in the mean age and duration of employment between the two worker groups ($p = 0.369$). There was no worker who did not have any formal education nor had only finished primary education. Many of the day workers (66.7%) had tertiary education, while only about 12% of the shift workers had.

Majority of the workers in both worker groups were married and there was no significant difference in the marital status between the two groups. Most of the shift workers were doing machine assisted jobs while on the other hand, more than half of day workers were doing supervisory jobs. The proportion of workers who did manual jobs were almost equal (15%) for both groups.

Table 1. Characteristics of 76 shift workers and 72 day workers

Variable	Shift workers $n = 76$		Day workers $n = 72$		p value*
	Mean (sd)	No. (%)	Mean (sd)	No. (%)	
Age	31.6 (4.73)		32.32 (4.61)		0.369†
Working duration	8.8 (4.00)		8.12 (4.38)		0.350†
Level of education:					
Secondary		67 (88.16)		24 (33.33)	<0.001
Tertiary		9 (11.84)		48 (66.67)	
Marital status:					
Married		59 (77.63)		64 (88.89)	0.068
Unmarried		17 (22.37)		8 (11.11)	
Nature of job:					
Machine assisted		61 (80.26)		11 (15.28)	<0.001
Manual		12 (15.79)		11 (15.28)	
Supervisory		3 (3.95)		50 (69.44)	
Working hour:					
≤48 hours/week		47 (61.84)		47 (65.28)	0.664
>48 hours/week		29 (38.16)		25 (34.72)	

(sd) : standard deviation

*Chi-square test (Pearson)

†Independent t test

Table 2. Smoking Characteristics of 76 shift workers and 72 day workers

Measurement	Shift workers $n = 76$		Day workers $n = 72$		p value
	Mean (sd)	No. (%)	Mean (sd)	No (%)	
Smoking habit:					
Current smoker		28 (36.84)		28 (38.89)	0.613*
Ex-smoker		12 (15.79)		15 (20.83)	
Never smoked		36 (47.37)		29 (40.28)	
Smoking duration among smokers (year)	12.1 (4.86)		10.6 (4.23)		0.234
Tobacco smoked per day among smokers	8.21 (3.28)		9.2 (4.68)		0.376

(sd): standard deviation

* Chi-square test

Table 2 shows that majority of them were among ex-smokers or non-smokers which comprise about 63% and 61% for the shift and day workers respectively. There was no significant difference in the proportion of smokers among shift workers (36.8%) as compared to among day workers (38.9%).

Crude prevalence (*n* and %) for each marker by worker group is presented in Table 3. Among the shift workers, high BMI (42.10%) was the most prevalent. Meanwhile, hyperglycemia and hypo-HDL-cholesterolaemia was the least prevalent (9.21%). Hypo-HDL-cholesterolaemia showed an equivocal result in which it was more prevalent among day workers. However, the difference was not statistically significant.

Shift workers had a significantly higher prevalent of high BP, hypertriglyceridaemia and high BMI as compared to day workers. On the other hand, the prevalence of hypo-HDL-cholesterolaemia and hyperglycemia were not significantly different between the two worker groups. Having three or more of the markers for the metabolic syndrome were significantly more common among shift workers compared to day workers as shown in Table 3.

Table 3. Prevalence of risk factors for metabolic syndrome in shift and day workers (using chi-square test)

Risk factor	Shift workers $n = 76$	Day workers $n = 72$	p value
	No. (%)	No. (%)	
High BP[a]	17 (22.37)	3 (4.17)	0.001
Hypo-HDL-cholesterolaemia[b]	7 (9.21)	10 (13.89)	0.372
Hypertriglyceridaemia[c]	32 (42.10)	19 (26.39)	0.044
Hyperglycemia[d]	7 (9.21)	5 (6.94)	0.614
High BMI[e]	32 (42.10)	16 (22.22)	0.010

[a]Systolic blood pressure ≥ 130 mmHg or diastolic blood pressure ≥ 85 mmHg

[b]Fasting serum HDL cholesterol ≤ 1.04 mmol/l

[c]Fasting serum triglyceride ≥ 1.70 mmol/l

[d]Fasting blood sugar ≥ 6.10 mmol/l

[e]BMI ≥ 25 kg/m^2

Table 4. Comparison of number of markers for metabolic syndrome in shift and day workers (using chi-square test)

Number of marker(s)	Shift workers $n = 76$	Day workers $n = 72$	P value
	No. (%)	No. (%)	
0	29 (38.16)	38 (52.78)	0.074
1	18 (23.68)	19 (26.39)	0.704
2	17 (22.37)	11 (15.28)	0.271
≥ 3	12 (15.79)	4 (5.55)	0.045

DISCUSSION

In our study, the significant positive relationships between shift work and metabolic syndrome risk factors were high BP, hypertriglyceridaemia and high body mass index. Our finding was similar to the study by Karlsson, B. *et al.* [11] who reported a higher prevalence of hypertension, hypertriglyceridaemia and high body mass index among shift workers than day workers. Among shift workers, we found a higher prevalence of hypertension which was 22.4% (95% CI 13.6-33.4%) compared to studies by Karlsson, B. *et al.* [11] and Nagaya, T. *et al.* [14] which was reported as 17.8% and 18.6% respectively. The difference in the finding could be due to the fact that the prevalence of hypertension in their general population is much lower than that in our country. The prevalence of hypertriglyceridaemia (42.1%) among shift workers in our study was also higher compared to those previous studies which were 30.8% and 31.3% respectively.

A recent review article summarizing previous studies have yielded inconsistent results on BMI in day and shift workers [12]. The inconsistency in the findings might be attributed to the different categorization of BMI. We had classified BMI into either high or normal with a cut-off BMI value of 25 kg/m^2. In our study, we found a significant difference in the prevalence of high BMI between the two groups. The prevalence was higher among shift workers (42.1%) than day workers (22.2%). However, Karlsson, B. *et al.* [11] considered a BMI of 30 kg/m^2 or more as cut-off values. Hence, the prevalence of high BMI among shift workers in our study was higher compared to that found in his study.

There was no adverse health effect of shift work found on the prevalence of hypo-HDL-cholesterolemia in our study. This finding was consistent with the result from the studies by Romon, M. *et al.* [17], Nakamura, K. *et al.* [18] and Nagaya, T. *et al.* [14]. Serum HDL may be more stable in shift working than other lipid markers. On the other hand, in a population study by Karlsson, B. *et al.* [11], shift workers had a higher prevalence of hypo-HDL-cholesterolaemia than day workers which was significant among workers in 30-39 years and 50-59 years old.

In the present study, we found no difference in the prevalence of hyperglycemia when comparing shift workers and day workers. This result is consistent with a previous study by Karlsson, B. *et al.* [11]. However, Kawachi, I. *et al.* [13] found a clear relation between duration of shift work and diabetes in a cohort study of 79,109 female nurses. Nagaya, T. *et al.* [14] also reported a significantly higher prevalence of hyperglycemia among people age 30-39 years old working in shift than among day workers of the same age group.

When comparing those with three or more risk factors, we found that shift workers have a higher proportion as compared to day workers. It suggests that shift workers are more at risk to have MS. The mechanism on how shift work leads to developing of MS is not well-understood. However, many researchers relate health effects due to circadian disruption. Sleep debt, which is experienced by many shift workers, is clearly associated with metabolic and endocrine alteration.

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We would like to recommend a proper health assessment among shift workers. This is because it can detect any health disorder related to shift work at an early or presymptomatic stage. Thus, intervention might arrest progression of the disease. Those who practice unhealthy lifestyles can be counseled appropriately. A proper health assessment should include specific items such as questionnaire on lifestyle, waist hip ratio measurement, BMI, mental status examination and blood investigation for lipid profiles and glucose level.

CONCLUSION

The prevalence of high BP, hypertriglyceridaemia and high BMI are clustered together more common among male shift workers compared to day workers. Significantly, the proportions of those having three or more risk factors are higher among shift workers than day workers. This finding suggests the importance of proper risk management for the shift workers. Occupational health doctors should maximize the pharmacological modification of the metabolic risk factors. However, the prevention of the risk factors through behavioural and lifestyle modification is equally important.

ACKNOWLEDGEMENTS

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UNIVERSITI SAINS MALAYSIA
JABATAN BENDAHARI
KUMPULAN WANG PENYELIDIKAN GERAN USM(304)
PENYATA PERBELANJAAN SEHINGGA 31 DISEMBER 2006

Jumlah Geran:	RM	15,045.00	Ketua Projek:	DR. MOHD NAZRI BIN SHAFEI
Peruntukan 2004 (Tahun 1)	RM	6,000.00	Tajuk Projek:	The Association of Shift and Coronary Heart Disease Risk factors Among Male Factory Workers in Kota Bharu, Kelantan
Peruntukan 2005 (Tahun 2)	RM	9,045.00		
Peruntukan 2006 (Tahun 3)	RM	0.00	Tempoh:	01 Jun 04-31 Mei 06
			No.Akaun:	304/PPSP/6131331

*1500 of brg Q

Kwg	Akaun	PTJ	Projek	Donor	Peruntukan Projek	Perbelanjaan T'kumpul Hingga Tahun Lalu	Peruntukan Semasa	Tanggungan Semasa	Bayaran Tahun Semasa	Belanja Tahun Semasa	Baki Projek
304	11000	PPSP	6131331		-	-	-	-	-	-	-
304	14000	PPSP	6131331		-	-	-	-	-	-	-
304	15000	PPSP	6131331		-	-	-	-	-	-	-
304	21000	PPSP	6131331		3,500.00	1,442.90	2,057.10	-		868.00	2,057.10
304	22000	PPSP	6131331		-	-	-	-	-	-	-
304	23000	PPSP	6131331		400.00	-	400.00	-	38.05	-	361.95
304	24000	PPSP	6131331		-	-	-	-	-	-	-
304	25000	PPSP	6131331		-	144.50	(144.50)	-		52.30	(144.50)
304	26000	PPSP	6131331		-	-	-	-	-	-	-
304	27000	PPSP	6131331		1,500.00	908.15	591.85	300.00	2,229.55	878.40	(1,937.70)
304	28000	PPSP	6131331		-	-	-	-	-	-	-
304	29000	PPSP	6131331		9,645.00	4,470.45	5,174.55	-	1,690.80	1,073.05	3,483.75
304	32000	PPSP	6131331		-	-	-	-	-	-	-
304	35000	PPSP	6131331		-	5,250.00	(5,250.00)	-		5,250.00	(5,250.00)
					15,045.00	12,216.00	2,829.00	300.00	3,958.40	8,121.75	(1,429.40)

THE ASSOCIATION OF SHIFT WORK AND CORONARY HEART DISEASE RISK FACTORS AMONG MALE FACTORY WORKERS IN KOTA BHARU, KELANTAN

by

Dr. MOHD NAZRI BIN SHAFEI

Dissertation Submitted In Partial Fulfillment Of The Requirements For The Degree Of Master Of Community Medicine (Occupational Health)

UNIVERSITI SAINS MALAYSIA

This manuscript is dedicated to:

My wife

Puan Shaharuni Binti Mat Nawi

My daughter

Nurul Qistina Binti Mohd Nazri

My parent

En. Shafei Bin Abd. Rahman

Puan Zaidah Binti Daud

My parent in-law

Tn. Hj. Mat Nawi Bin Muhammad

Pn. Hjh. Raizam Binti Muhamad

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May Allah bless you always.

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LIST OF ABBREVIATIONS

BMI	- Body Mass Index
BP	- Blood Pressure
CAD	- Coronary Artery Disease
CHD	- Coronary Heart Disease
CVD	- Cardiovascular Disease
DALYs	- Disability-adjusted Life Years
FBS	- Fasting Blood Sugar
FLP	- Fasting Lipid Profile
HDL	- High Density Lipoprotein
IC	- Integrated Circuits
IHD	- Ischemic Heart Disease
IR	- Insulin Resistance
LCD	- Liquid Crystal Displays
LDL	- Low Density Lipoprotein
LED	- Light Emitting Diodes
MOH	- Ministry of Health
NCEP	- National Cholesterol Education Program
OR	- Odds Ratio
REM	- Rapid Eye Movement
SMS	- Shift work Maladaption Syndrome
TC	- Total Cholesterol
USM	- Universiti Sains Malaysia
VIF	- Variance-Inflation Factor
WHO	- World Health Organization

LIST OF APPENDICES

ABSTRAK

TAJUK: HUBUNGAN ANTARA KERJA SYIF DAN FAKTOR-FAKTOR RISIKO BAGI PENYAKIT JANTUNG KORONARI DALAM KALANGAN PEKERJA KILANG LELAKI DI KOTA BHARU

PENGENALAN: Kemodenan telah banyak merubah pelbagai aspek kehidupan dengan cepat termasuklah aspek ekonomi, sosial dan tingkah-laku manusia. Ini telah menyumbang kepada penggunaan berbagai-bagai jadual kerja oleh organisasi-organisasi. Masa bekerja telah dilanjutkan kepada petang, malam dan juga pada hujung minggu. Kerja syif merupakan satu cara bekerja di mana pekerja-pekerja akan bertukar ganti melebihi waktu bekerja biasa. Ia berpotensi untuk mengganggu ritma biologikal yang normal atau keperluan sosial atau kedua-duanya sekali. Ramai penyelidik mendapati bahawa pekerja syif lebih berisiko untuk mendapat pelbagai penyakit dan juga mendapat faktor risiko bagi panyakit jantung koronari (CHD) seperti hipertensi, hiperkolesterolemia, obesiti dan diabetes mellitus (DM).

OBJEKTIF KAJIAN: Kajian ini dijalankan untuk menentukan hubungkait antara kerja syif dan faktor-faktor risiko CHD. Faktor-faktor risiko tersebut adalah tekanan darah tinggi, dislipidemia (samada hiperkolesterolemia, hiper-lipoprotin berketumpatan rendah-kolesterolemia, hipo-lipoprotin berketumpatan tinggi-kolesterolemia atau hipertrigliseridemia), indeks jisim badan (BMI) tinggi, diabetes mellitus dan gaya hidup tidak aktif dalam kalangan pekerja kilang lelaki di Kota Bharu, Kelantan.

METODOLOGI: Kajian irisan-lintang ini melibatkan 76 orang pekerja shif dan 72 orang pekerja harian daripada sebuah kilang yang terletak di Kota Bharu, Kelantan. Data diperolehi menggunakan borang soal-selidik berkenaan psikososial dan gaya

hidup. Ukuran antropometri dan tekanan darah, analisa glukosa darah dan profail lipid ketika berpuasa dijalankan. Ujian 'Chi-square' dilakukan untuk menentukan perbezaan disegi prevalens setiap faktor risiko CHD di antara dua kumpulan pekerja berkenaan. Regresi logistik multipel (MLR) pula digunakan untuk menentukan nilai nisbah odds (OR) bagi setiap faktor risiko penyakit jantung yang dikaitkan dengan kerja syif.

KEPUTUSAN: Prevalens bagi tekanan darah tinggi, hiperkolesterolemia, hipertrigliseridemia dan BMI yang sama dengan atau melebihi 25 kg/m^2 adalah lebih tinggi dalam kalangan pekerja syif berbanding pekerja harian. Prevalens bagi diabetes mellitus, hipo-lipoprotin berketumpatan tinggi-kolesterolemia, hiper-lipoprotin berketumpatan rendah-kolesterolemia serta tahap aktiviti fizikal yang rendah tidak berbeza secara signifikan bagi kedua-dua kumpulan kerja berkenaan. Bila dibandingkan pekerja syif dan bukan syif, nilai 'adjusted' OR bagi tekanan darah tinggi, BMI yang tinggi dan tidak aktif masing-masing adalah 9.1 (95% CI 1.4-56.8), 2.9 (95% CI 1.3-6.1) dan 7.7 (95% CI 2.1-27.5). Sebaliknya, tidak terdapat hubungan antara kerja syif dan risiko mendapat dislipidemia ataupun diabetes mellitus (DM).

KESIMPULAN: Didapati bahawa terdapat hubungkait positif antara kerja syif dan tekanan darah tinggi, BMI yang sama dengan atau melebihi 25 kg/m^2 serta gaya hidup tidak aktif. Ini menunjukkan kemungkinan bahawa risiko untuk mendapat faktor-faktor risiko CHD adalah tinggi dalam kalangan pekerja syif berbanding pekerja harian.

Kata-kunci: kerja syif, faktor-faktor risiko, penyakit jantung koronari, prevalens, nisbah odds

ABSTRACT

TITLE: THE ASSOCIATION OF SHIFT WORK AND CORONARY HEART DISEASE RISK FACTORS AMONG MALE FACTORY WORKERS IN KOTA BHARU, KELANTAN

INTRODUCTION: Modern society is changing quite rapidly in terms of economic, social and human behaviour. Consequently, various types of work schedules have been applied by organizations and companies. Working hours are extended to evenings and nights, as well as on weekends. Shift work is one of the work hour systems in which a relay of employees extends the period of production beyond the conventional 8-hour working day. It potentially disrupts workers' normal biological or social diurnal rhythms or both. Shift work has been found to be associated with various health problems and there is a concern that shift workers are at higher risk to develop risk factors for coronary heart disease (CHD) such as hypertension, hypercholesterolaemia, obesity and diabetes mellitus (DM).

OBJECTIVES: The study was undertaken to examine relationships between shift work and CHD risk factors, namely high blood pressure (BP), dyslipidaemia (either hypercholesterolaemia, hyper-low density lipoprotein-cholesterolaemia, hypo-high density lipoprotein-cholesterolaemia or hypertriglyceridaemia), high body mass index (BMI), diabetes mellitus and physical inactivity among male factory workers in a factory in Kota Bharu, Kelantan.

METHODS: This study was a cross-sectional study of 76 shift and 72 day workers from a factory in Kota Bharu, Kelantan. Data was collected through a questionnaire on psychosocial and life-style factors. Anthropometric and blood pressure measurement,

fasting blood sugar and fasting lipid profiles analyses were obtained. Chi-square test was used to determine the significant difference in the prevalence for each CHD risk factors between the two worker groups. Multiple logistic regression was used to evaluate the odds ratio for each CHD risk factors associated with shift work.

RESULTS: The prevalence of high BP, hypercholesterolaemia, hypertriglyceridaemia and body mass index (BMI) of equal to or more than 25 kg/m^2 were significantly higher among shift workers compared to day workers. There was no difference in the prevalence of diabetes mellitus, hypo-high-density lipoprotein-cholesterolaemia, hyper-high-density lipoprotein-cholesterolaemia and physical inactivity. When the shift workers were compared with the day workers, the adjusted odds ratio (OR) for high BP, BMI of equal to or more than 25 kg/m^2 and physical inactivity were 9.1 (95% CI 1.4-56.8), 2.9 (95% CI 1.3-6.1) and 7.7 (95% CI 2.1-27.5) respectively. There was neither association of shift work with dyslipidaemia, nor with diabetes mellitus.

CONCLUSIONS: There were positive association between shift work and high BP, BMI of equal to or more than 25 kg/m^2 and physical inactivity which denotes a higher risk of CHD risk factors among shift workers compared to day workers.

Keywords: shift work, risk factors, coronary heart disease, prevalence, odds ratio

CHAPTER ONE

INTRODUCTION

1.1. Global Perspective of Shift Work

Modern society is changing rapidly both in terms of economic and productive strategies such as new technologies, market globalization and information processes. The changes also occur in terms of the social organization and individual behaviours. Time constraints no longer limit human activities. People want and are able to do everything at any hour of the day or night. Therefore, the arrangement of working hours has become a crucial factor in work organization and acquires different values according to economic and social consequences that can arise at different periods of the company and worker's life (Costa, 2003). There are various types of work schedules applied by organizations and companies in which working hours are extended to evenings and night hours, as well as to weekends. Hours of duty have become more and more variable. A previous cross-sectional study that used the public access data from the Canadian National Longitudinal Survey of Children and Youth, had broadly classified work schedules into standard and non-standard (Strazdins, *et al.*, 2004). A standard work schedule refers to those who work on weekdays and do daytime work. Whereas, non-standard work schedules refer to those who are on-call or who do any shift work and/or working during weekends.

Shift work is one of the work hour systems in which a relay of employees extends the period of production beyond the conventional 8-hour working day and that potentially disrupts workers' normal biological or social diurnal rhythms or both (Akerstedt, *et al.*,

1984, Harrington, 2001). There are thousands of shift systems used and they differ widely with respect to their structure, and in particular: the presence or absence of night work; the duration of the duty period such as from 6 to 12 hours; the number of workers or crews who cover the whole working time; the interruption of the weekend; if workers stay on a given shift, or alternate between the different shifts; the speed either fast or slow and the direction of the shifts rotation either clockwise or counter-clockwise; the start and finish times of the duty periods; and the regularity or irregularity and length of the shift cycle (Costa, 2003).

Shift work systems have been broadly classified into four which are permanently displaced workhours, rotating shift work, roster work, and unscheduled workhours (Akerstedt, *et al.*, 1984). For permanently displaced workhours, the workers are doing morning, evening or night work. Rotating shift work means that there is an alternation between thirds of the 24-hour cycle. Roster work is less regularly used by industries to assign their workers as compared to the rotating shift work. Workers who are working when they are needed refer to a class known as unscheduled work hours. This is often done by self-employed individuals.

Shift work is not a modern phenomenon. Ramazzini (1633-1714) noted that bakers, innkeepers and soldiers worked as such. Historically, bakers have worked through the night to ensure fresh bread in the morning, and in ancient Rome, deliveries were restricted to the night hours in order to relieve traffic congestion. With the initiation of the Industrial Revolution, more and more work processes required full-time operations (U.S. Congress, 1991). Today, about one in five workers in Europe (Harrington, 2001) and in the United States (U.S. Congress, 1991, Scott and LaDou, 1994) are employed on

shift work. Some sectors have a considerably higher percentage of employees on shift work. For example, capital-intensive industries and continuous-process operations may have 50% of employees working on shift and over 38% of those in service occupations are shift workers (U.S. Congress, 1991). Although the shift workers of fifty years ago were likely to be factory-based workers, increasing demand for services (both business and pleasure) has extended to those employed in traditionally known as "white collar" occupations like doctors and nurses (Harrington, 2001).

Among specific reasons for adopting shift work schedules are an extended period of time required to complete a particular job or process and a constant need or extended demand for services. Other reasons include economic factors (for example, the expense of capital investment and the need for maximum competitiveness) and technological advances (U.S. Congress, 1991).

1.2. Shift Work and Health

Shift work has been found to be associated with various health problems which do not only affect the workers but also the economic and industrial sectors. Health problems of shift workers are caused by disturbance of the biologic rhythms (Akerstedt, 2003). It is well-established that most human functions have a rhythm, the peaks and troughs of which occur in approximately a 24-hour period, known as circadian rhythms. The word "circadian" was derived from Latin "circa dies" which means "about a day". The source of the rhythms in the brain appears to be the suprachiasmatic nucleus of the hypothalamus. The nucleus receives projections from the retina (Anders, 1996). They

are determined partly by endogenous factors, the internal body clock and partly by environmental cues such as daylight, noise and the social habits of the individual (Spurgeon, 2003). Multiple physiologic, psychologic and behavioural parameters such as body temperature, serum and urinary corticosteroids and electrolytes, cardiovascular functions, gastric enzyme secretion, blood leucocyte count, muscle strength, alertness, mood and immediate and long-term memory have been observed to follow circadian rhythms (Scott and LaDou, 1994). These circadian rhythms, which are geared towards activities during the day and rest at night, are persistent and rigid and therefore do not adapt immediately to new working patterns (Taylor, *et al.*, 1997).

The change from day to late evening and night work compels the worker to modify his normal 'activity-rest' cycle, forcing him to adjust his body functions to the duty periods. This involves a progressive phase shift of circadian rhythms across the successive night shifts, but a complete inversion is never reached, except in the very rare cases of permanent night workers who maintain an inverted sleep-wake cycle on their days off. In most cases, the human body is exposed to continuous stress from attempts to adjust as quickly as possible to the varying working hours, while at the same time being invariably frustrated by the continuous shift rotations. Consequently, people suffer from a so-called 'shift lag' syndrome (Costa, 2003). The syndrome is characterized by feelings of fatigue, sleepiness, insomnia, disorientation, digestive troubles, irritability, poor mental agility and reduced performance efficiency.

There is a general agreement that the effect of shift work has a deleterious effect on sleep. The most authoritative review concludes that despite considerable variation between people, sleep loss is a major effect of shift work. These problems are mainly

due to disruption of the normal sleep-wake rhythm, of the normal circadian rapid eye movement (REM) sleep rhythm and of the rhythm of REM or non-REM sleep patterns. Thus, the sleep problems of shift workers are partly a circadian one (Ohayon, *et al.*, 2002). Four recent studies confirm sleep disturbances among shift workers including frequent insomnia, frequent use of hypnotics, sleep deprivation and daytime sleepiness (Khaleque, 1999, Nicholson and D'Auria, 1999, Garbarino, *et al.*, 2002, Ohayon, *et al.*, 2002). This is most noticeable after the night shift. The quantity of sleep may be reduced by up to two hours a day but there is also an effect on the quality of sleep. REM sleep and Stage 2 sleep have been shown to be reduced (Akerstedt, 1990). Such sleep deficits can lead to sleepiness and inadvertent napping at work which consequently might result in errors and accident occurrence at work. However, it should be noted that other factors are also involved in the deterioration of sleep quality such as fatigue, noisy surroundings, stress, daylight, health and age of workers (Khaleque, 1999, Ohayon, *et al.*, 2002).

Although gastrointestinal symptoms are very common in the general population, it was more common in shift workers than in day workers (Segawa, *et al.*, 1987, Scott and LaDou, 1994). In the long term, many shift workers may suffer serious diseases such as chronic gastritis, gastroduodenitis, colitis and peptic ulcer. The prevalence of peptic ulcer has been estimated to be two to five times higher among shift workers with night shifts, compared to day workers or shift workers without night shifts (Costa, 1996). Meal times are important synchronizers of the human life. They have both physiological and social contents; therefore they represent a crucial point of the worker's life. The work schedule and schedule-related changes in eating can interfere with gastrointestinal function because of inadequate timing of food intake with respect to the optimal

circadian phases of gastric secretion and enzyme activity. Food quality, which is poor during some shift and increased use of caffeine, nicotine or alcohol may result in additional interference (Costa, 1996, Garbarino, *et al.*, 2002).

As association of risk of coronary heart disease (CHD) and shift work is concerned, most of the studies on cardiovascular disease (CVD) among shift workers found that they were at increased risk of developing the disease (Akerstedt, *et al.*, 1984, Knutsson, *et al.*, 1986, Kawachi, *et al.*, 1995, McNamee, *et al.*, 1996, Nakamura, *et al.*, 1997, Boggild, *et al.*, 1999, Knutsson, *et al.*, 1999, Murata, *et al.*, 1999, Amelsvoort, *et al.*, 2001, Karlsson, *et al.*, 2001).

Table 1.1 shows a summary of a number of studies on shift work and cardiovascular disorders. The relative risk for ischaemic heart disease (IHD) in shift workers was accepted to be around 1.4 (Nicholson and D'Auria, 1999). Causal mechanisms are not well defined but contributing factors include disruption of circadian rhythm, disturbed sociotemporal patterns and social support, stress, smoking, poor diet, and lack of exercise (Harrington, 2001). Some researchers have postulated that the increased risk of developing the disease is the result of shift work inducing increased secretion of stress hormones while changing the factors such as blood pressure, heart rate, coagulation and lipid and glucose metabolism (Garbarino, *et al.*, 2002).

Table 1.1 Summary of studies on shift work and cardiovascular disorders

Author	Year	Number of sample	Ass	Study	RR/OR	Method
Thiis-Evensen	1958	14,308	No	Morbidity, manual workers		ce-in-q
Aanonsen	1959	1,106	No	Morbidity, manual workers		ce-is
Leuliet	1963	564	No	Morbidity, 12-yr follow-up		ce
Taylor & Pocock	1972	8,603	No	Mortality, 13 years		dc
Koller *et al.*	1978	270	Yes	White/blue collar complaints		q-in
Angersbach *et al.*	1980	640	No	Morbidity, retrosp., cohort		mr-is
Michel-Briand *et al.*	1981	200	Yes	In transferred shiftworkers		ce
Alfredsson *et al.*	1982	14,500	Yes	Myoc. infarction, national stats	1.26	db-is
Koller	1983	301	Yes	with increasing age		ce-in
Frees & Semmer	1986	3,446	Yes	In drop-outs		q
Knutsson *et al.*	1986	504	Yes	IHD, history prospect, 14 years	1.4	mr
Knutsson *et al.*	1988	601	Yes	Blue collars, risk factors		q-ce
Kawachi *et al.*	1995	79,109	Yes	CHD, women, 4-yr follow-up	1.38	mr-q-in
mc-Namee *et al.*	1996	934	No	Mortality, case-control, 42 yr	0.90	mr-db
Tenkanen *et al.*	1998	1,806	Yes	CHD, 6-yr cohort follow-up	1.30	ce-q
Knutsson *et al.*	1999	4,648	Yes	Men-women, case-control	1.3-3.0	mr-dc-q
Boggild *et al.*	1999	5,249	No	Men, prospect cohort, 22 years	0.96	ce-q

Legend (Methods):
ce = clinical examination; dc = death certificates; db = data banks; in = interviews;
is = insurance records; mr = medical records; q = questionnaires; RR = Relative Risk;
OR = Odds Ratio; Ass = Association
Adapted from a manuscript by Wedderburn (2000).

Few studies have reported that shift work might have an impact on metabolic variables and also be a risk factor for diabetes, although the evidence is not conclusive (Knutsson, 2003). Orth-Gomer (1983) studied the effects of a new rotation schedule on coronary risk factors on 45 volunteer policemen, demonstrated that the direction of shift rotation

could affect metabolic variables in which during clockwise shift rotation, serum triglycerides, glucose and uric acid were lower as compared to during counterclockwise rotation. Kawachi, *et al.* (1995) conducted a prospective study of shift work and risk of CHD in female nurses found that the age-standardized prevalence of diabetes increased with increasing exposure to shift work. A recent study by Nagaya, *et al.* (2002) examined the relationship between shift work and markers of insulin resistance (IR). They found that all markers of insulin resistance which include hypertension, diabetes mellitus, hypertriglyceridemia and hypo-high density lipoprotein-cholesterolemia which are collectively known as IR syndrome, were more common in shift workers than in day workers in the age group less than 50 years. A higher prevalence of obesity, hypertension, high triglyceride and low high density lipoprotein (HDL) but not hyperglycemia in shift workers than in day workers was also found in a population study (Karlsson, *et al.*, 2001). In addition, Romon, *et al.* (1992) reported that shift workers had significantly higher levels of triglycerides independent of dietary intake. Those results suggest that shift work may affect IR and may induce IR syndrome.

Irregular sleep schedules practiced by rotating shift workers may be of particular concern for workers with affective disorders (Scott and LaDou, 1994). Anxiety and depression indices point to the likelihood of an adverse effect on mental health from shift work and long working hours. Nevertheless, it must be remembered that shift workers are a self selected population. Thus, the question of whether shift work causes psychiatric morbidity or shift workers have pre-existent psychiatric problems is not entirely resolved (Harrington, 2001).

It should be recognized that the health impact of shift work depends to some extent on individual differences. There is a high inter-individual variability in tolerance to shift work. Aging may be associated with a progressive intolerance to shift work due to reduced psycho-physical fitness, the decreased restorative properties of sleep and a higher proneness to the internal desyncronization of circadian rhythms. On the other hand, younger people can find it difficult to adapt to night work either because they are more sensitive to acute sleep loss or because it hampers their possibility of participating and integrating with social groups (Costa, 2003). The ability to sleep at unusual times or known as flexibility and the ability to overcome drowsiness or vigor are two other examples of personality variables that predict shift work tolerance (Costa, *et al.*, 1989). In addition, it was shown that less favourable living and social conditions, which are often connected with both poor working conditions and long working hours, may aggravate the impact of shift work on health (Ong and Kogi, 1990).

The term shift work maladaption syndrome (SMS) has been used to describe the typical constellation of signs and symptoms seen in shift work intolerant workers. The symptoms and signs of SMS include sleepiness or sleeping at work, decreased vigilance, irritability and depression. In SMS, the symptoms are pronounced and worsen with continued exposure to shift work. The longer the worker stays on shift work, the worse the symptoms become, and eventually, the worker may be fired, quit his job or be involved in an accident (Scott, 2001).

To minimize ill-health that may result from shift work, periodic checks are important tools. They aimed at detecting early signs of difficulty in adjustment or intolerance that may require prompt intervention both at the organizational and the individual level. The

periodicity of the health checks should be set in relation to the various factors related to both working conditions such as shift work and individual characteristics such as age. As a general guideline, it is advisable to plan a second health check during the first year of shift or night work which is crucial for adaptation and coping, and successive health checks at least every three years for those under 45 years of age and every two years for those over 45 years old (Costa, 2003).

It is found that health problems due to the work schedule is a common reaction for workers to give up shift work (Scott and LaDou, 1994). Although there is a link between shift work and ill health, understanding of this association, including its direction and strength, is weak (Taylor, *et al.*, 1997).

1.3. Overview of Shift Work and Health in Malaysia

There are about 8.6 million workers in Malaysia which represents approximately 38.7% of the total population. The largest employers are the manufacturing sector (22.2%), followed by community, social, and personal services (20.1%), and wholesale, retail trade, hotel and restaurants (18.9%) (Rampal, *et al.*, 2002).

Shift work system is receiving priority attention in Malaysia as it has been practiced in United States and Europe. It is because of the concerns of productivity, health and safety. Rapid industrialization has introduced various types of working schedules and working hours as opposed to the conventional dawn-to-dusk practice. It is estimated that one-third of the present Malaysian workforce work abnormal hours of some type such

as shift work, some form of regulated scheme and staggered working hours (Chee and Rampal, 2003).

Shift work is common in the manufacturing sectors including electronics and textile industries, while the three-shift system is a rule in essential services and service industries. One local study which examined on the relationship between selected health problems and exposures among women semiconductor workers, found that majority of the workers in Malaysia were on rotating eight-hour shift (60.6%), whereas 30.1% were on a rotating 12-hour shift and others were on fixed shift (Chee and Rampal, 2003). Most Malaysian shift workers are men, but with rapid industrialization more women are being employed in shift work. Majority of these women are young, school leavers or dropouts, usually coming from rural areas attracted to work in urban areas (Mahathevan, 1982).

As far as Malaysian legislation is concerned, although it does not contain any provisions on the scheduling of working hours, Malaysian Employment Ordinance 1955 specifically states that women and workers below the age of 16 years should not work after 10.00 p.m. or before 7.00 a.m. In other words, night work is in principle forbidden in these two groups except with special and expressed permission of the Minister of Labour.

A preliminary study was done by the Occupational Health Unit of Ministry of Health (MOH) in a textile industry situated about 60 kilometres from Kuala Lumpur. The total workforce in the factory was 356 with 301 females and 55 males. Two hundred and eighty eight of the females did shift work when compared to only 33 of the males doing

shift work. The medical complaints from shift workers are shown in Table 1.2 below. Fatigue (95.8%) was the most frequent complaint followed by indigestion (92.0%) (Mahathevan, 1982).

Table 1.2 Medical complaints of workers interviewed

Complaints	Number of workers	Percentage
Fatigue	276	95.8
Indigestion	265	92.0
Leg and foot cramps	176	61.1
Menstrual irregularities	167	58.0
Insomnia	126	43.8
Chest pain	35	12.2
Nervousness	173	60.1
Fever off and on	90	31.3

Adapted from Mahathevan (1982)

1.4. Definition and Epidemiology of Cardiovascular Disease

CHD, also called coronary artery disease (CAD), is a condition that affects arterial blood vessels responsible for delivering blood, oxygen, and other nutrients to the heart muscle itself. CHD is the end-product of a pathogenic process associated with development of atherosclerotic plaque in the coronary vasculature, which is known as atherosclerosis (Samar, 1999). CHD covers a group of clinical syndromes which include angina pectoris, myocardial infarction and sudden cardiac death. It is one of the lifestyle-related diseases (Lorimer, 1997).

Cardiovascular disease (CVD), mainly comprising coronary heart disease (CHD) and stroke now ranks as the world's top cause of death, causing one third of all deaths

globally. Its prevalence varies between different populations and is influenced by a large number of hereditary and environmental factors. Since 1990, more people have died from CHD than from any other causes. It kills more than seven million people each year and most of deaths were in developing countries. In fact, it is on the rise and has become a true pandemic that respects no borders (WHO, 2004).

Death rates from CHD decreased in North America and many western European countries. This decline has been due to improved prevention, diagnosis and treatment, in particular reduced cigarette smoking among adults and lower average levels of blood pressure and blood cholesterol. It is expected that 82% of the future increase in coronary heart disease mortality will occur in developing countries (WHO, 2004). The increase is partly a result of increased longevity, urbanization and lifestyle changes.

CHD is not only a major cause of mortality but also of morbidity and rising health care costs. The costs of cardiovascular disease are diverse. They include the cost to the individual and to the family (of health care and time off work), the cost to government (of health care) and the cost to the country (of lost productivity). As an indication to the total burden of the disease, CVD is responsible for 10% of disability-adjusted life years (DALYs) lost in low- and middle-income countries and 18% in high-income countries. In addition, global CHD burden is increasing. It is projected to rise from around 47 million DALYs in 1990 to 82 million in 2020 (WHO, 2004).

In particular, heart diseases and diseases of pulmonary circulation are the commonest causes of mortality in Malaysian government hospitals, accounting to 16% of all deaths for the year 2001. CHD is the major cause of these deaths (MOH, 2003). In 2003,

DALYs lost per 1000 population of Malaysia as a result of heart disease was eight. Whereas, the number of deaths due to heart disease in the year 2002 was 13,445 (WHO, 2004).

1.5. Risk Factors for Coronary Heart Disease

The major established risk factors must meet three criteria which are a high prevalence in many populations, a significant independent impact on the risk of CHD and their treatment and control result in reduced risk (WHO, 2004). Epidemiological studies have identified the major independent risk factors for CHD to include cigarette smoking of any amount, elevated total cholesterol (TC) and elevated low-density-lipoprotein cholesterol (LDL), elevated blood pressure, low high-density-lipoprotein cholesterol (HDL), diabetes mellitus and advancing age. The predictive power of each of these major risk factors in determining an individual's global risk for CHD, is additive. An individual with more risk factors is at higher risk of developing atherosclerotic disease (Expert Panel, 2001). Approximately 75% of CVD can be attributed to those conventional risk factors (WHO, 2004).

In addition, there are other types of risk factors that have been associated with an increased risk of CHD. These are the predisposing risk factors and the conditional risk factors. Predisposing risk factors are those that worsen the risk associated with the independent risk factors. These are obesity, abdominal obesity, family history of premature CHD (male sibling or parent with CHD < 55 years and/or female parent or first degree relative with CHD<65 years), ethnic origin, psychosocial factors and

physical inactivity (Expert Panel, 2001). Worldwide, physical inactivity causes about 1.9 million deaths, 20% of CVD and 22% of CHD (WHO, 2004).

Conditional risk factors are associated with an increased risk for CHD although their causative and independent contributions to CHD have not been well documented. Those risk factors include elevated serum triglycerides, elevated serum homocysteine, elevated serum lipoprotein (a), prothrombotic factors (e.g. fibrinogen) and inflammatory markers (e.g. C-reactive proteins) (Expert Panel, 2001).

In developed countries, at least one-third of all CVD is attributable to five risk factors which are tobacco use, alcohol use, high blood pressure, high cholesterol and obesity. Similarly, in developing countries with low mortality, such as China, cardiovascular risk factors also figure high on the top-ten list. These populations face a double burden of risks, grappling with the problems of under-nutrition and communicable diseases, while contending with the same risks as developed nations. Even in developing countries with high mortality, such as those in sub-Saharan Africa, high blood pressure, high cholesterol, tobacco and alcohol use already figure among the top risk factors (WHO, 2004).

1.6. Justification of Study

This study is designed to investigate the association between shift work and certain risk factors for CHD which are high blood pressure (BP), dyslipidaemia, diabetes mellitus, obesity and physical inactivity among male factory workers. Since there was no

documented such study done previously in Malaysia as well as there was lack of data pool on effect of shift work particularly on CHD risk factors, the results of the study will hopefully provide useful information for the prevention of CHD among the shift workers.

In addition, work environment is increasingly becoming a subject of epidemiological studies. Working irregular hours, including night work and shift work, for example, has been found to be associated with various health problems caused by the disturbance of the biological rhythms. It includes sleep disorders, gastrointestinal disturbances and cardiovascular implication such as increased risk of ischemic heart disease.

Many researchers worldwide have investigated the risks to CHD among shift workers. Many of them have reported that there is an association between shift work and risk of developing CHD as compared to day workers. On the other hand, there is limited data on such study in Malaysia. This study provides scientific data pertaining to the effect of shift work on cardiovascular system especially among Kelantanese factory workers.

On top of that, there are almost 10 million of manual workers in our country among whom, most of them do shift work and they tend to be exposed to various health problems. Those workers contribute a great deal in supporting our economic growth. Hence, the risks of CHD among them should be studied and efforts should be administered to minimize such risks.

CHAPTER TWO

OBJECTIVES

2.1. General Objective

To determine whether there are relationships between shift work and risk factors to coronary heart disease which are dyslipidaemia (either hypercholesterolaemia, hyper-low density lipoprotein-cholesterolaemia, hypo-high density lipoprotein-cholesterolaemia or hypertriglyceridaemia), high body mass index (BMI), high BP, diabetes mellitus (DM) and physical inactivity among male shift workers as compared to male day workers in a factory in Kota Bharu, Kelantan.

2.2. Specific Objectives

2.2.1. To compare the prevalence of CHD risk factors (hypercholesterolaemia, hyper-low density lipoprotein-cholesterolaemia, hypo-high density lipoprotein-cholesterolaemia, hypertriglyceridaemia, high BMI, high BP, DM and physical inactivity) between the male population of shift workers and day workers in a factory in Kota Bharu, Kelantan.

2.2.2. To examine the association between shift work and high BP (as a risk to CHD) among male workers in the same factory.

2.2.3. To examine the association between shift work and dyslipidaemia (as a risk to CHD) among male workers in the factory.

2.2.4. To examine the association between shift work and high BMI (as a risk to CHD) among male workers in the factory.

2.2.5. To examine association between shift work and DM (as a risk to CHD) among male workers in the factory.

2.2.6. To examine association between shift work and being physically inactive (as a risk to CHD) among male workers in the factory.

2.3. Hypothesis

2.3.1. There are differences in the prevalence of CHD risk factors among shift male workers as compared to day male workers.

2.3.2. There is an association between shift work and high BP (as a risk to CHD) among those workers.

2.3.3. There is no association between shift work and dyslipidaemia (as a risk to CHD) among those workers.

2.3.4. There is an association between shift work and high BMI (as a risk to CHD) among those workers.

2.3.5. There is no association between shift work and DM (as a risk to CHD) among those workers.

2.3.6. There is an association between shift work and being physically inactive (as a risk to CHD) among those workers.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Study Design

This study was a cross-sectional study. It was designed to investigate the effect of shift work on risk factors for coronary heart disease. Risk factors which were investigated include hypercholesterolaemia, hyper-low density lipoprotein-cholesterolaemia, hypo-high density lipoprotein-cholesterolaemia, hypertriglyceridaemia, high body mass index, high BP, diabetes mellitus and physical inactivity among male factory shift workers as compared to male day workers.

This study was carried out in a factory located in Pengkalan Chepa, Kota Bharu, Kelantan, about nine kilometers away from Universiti Sains Malaysia. This premise was established in 1989. It specializes in the manufacturing of semiconductors and related components. The products lineup include monolithic integrated circuits (ICs), power modules, photo link modules, transistors, diodes, light emitting diodes (LEDs), laser diodes, resistors, capacitors, liquid crystal displays (LCDs), thermal heads, image sensor heads and LED displays. Total building area is 38,689 square meters and total land area is 83,891 square meters. It has a total of 980 employees, running 24-hours with two shifts. The shift system is as follows: first shift workers work from 0800H to 2000H whereas the second shift workers work from 2000H to 0800H. Shift rotation was as follows: DD-NN-OO-DD-NN-OO- and so on (D= day, N= night, O= off from working).

This study was designed as a cross-sectional study because of time constraint. The effect of shift work on CHD risk factors is a very long process. Since that, prospective study is not possible for a dissertation project.

3.2. Reference and Source Population

Reference and source population were all male workers at the selected factory (Figure 3.1).

3.3. Sampling Frame

The study involved all registered male workers who practiced shift and non-shift work (Figure 3.1). There were 620 male workers in the factory. Among those male workers, 450 of them did shift work and 170 did day work. Shift workers were among process operators, whereas day workers were among process operators, maintenance men and administrative workers. Inclusion and exclusion criteria were used to form the sampling frame.

3.4. Study Subjects

Subjects for each group of workers were selected through a simple random sampling method (Figure 3.1). We could not run a screening to exclude those who do not fulfill the inclusion criteria such as having chronic illnesses like diabetes mellitus, hypertension, dyslipidaemia or any cardiovascular diseases (to minimize healthy worker effect). It was due to the factory's rules and regulations. In view of the possibilities of selecting those who do not fulfill the criteria, we over-sampled the workers. The over-sampling was based on the overall prevalence of hypertension in Kelantan which was 14% (Mafauzy, *et al.*, 2003).

Those who did not fulfill the inclusion criteria as in section 4.6 and 4.7 were not included in the analysis. The exclusion of subjects was done when they answered "Ya" to a question on "Adakah anda pernah disahkan menghidap penyakit diabetes mellitus/kencing manis atau darah tinggi atau masalah lemak berlebihan atau masalah jantung?" in the self-administered questionnaire (Appendix E).

3.5. Research Framework

Figure 3.1 shows our research framework in the selection process of subjects into the study.

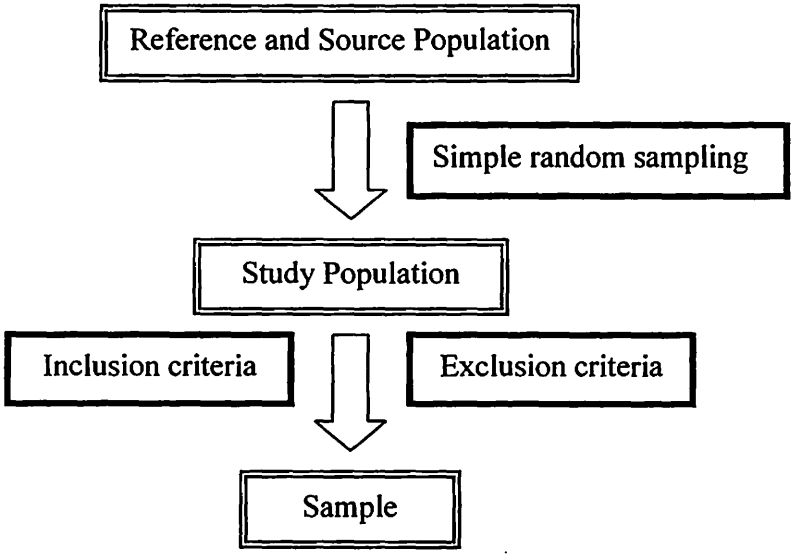

Figure 3.1 Research Framework of Reference and Source Population, Study Population and Sample

3.6. Inclusion Criteria

A worker was selected as a study subject when he fulfilled the following criteria:

1. One who is doing shift work or day work only
2. A worker whose age ranges from 19 to 50 years
3. Malaysian citizen
4. One who has been working for more than a year (Romon, *et al.*, 1992)
5. Male worker

3.7. Exclusion Criteria

A subject was excluded to be a sample when he fulfilled the following criteria:

1. One who has changing working schedules, for example from shift work to day work or vice versa
2. A worker with any known chronic illnesses such as diabetes mellitus, hypertension, dyslipidaemia or any cardiovascular diseases (to minimize healthy worker effect since employer tend to put those 'unhealthy' workers into day work)

3.8. Sample Size

The sample size was calculated for each objective. The largest and feasible sample size was from the high triglyceride (> 1.7 mmol/l) variable (Karlsson, *et al.*, 2001) with the specified level of significance (α) at 0.05 and power of the study (1-β) as 80%.

As found by Karlsson, *et al.* (2001), the proportion of high triglyceride among day workers was 0.1 and the proportion of high triglyceride among shift workers was specified as 0.3 (with detectable difference of 20%). The ratio of non-shift to shift workers was taken as one.

The formula used for sample size calculation was as followed:

Sample size for each group, $n = \frac{\{P_1(1-P_1)+P_2(1-P_2)\}(Z_\alpha + Z_\beta)^2}{(P_1-P_2)^2}$

where, P_1 = proportion of high triglyceride among non-shift workers = 0.1