

OCCUPATIONAL PHYSICAL ACTIVITY MEASUREMENT
AMONG NURSES
IN UNIVERSITI MALAYA MEDICAL CENTRE

DR. SYAMSUL RIZAL BIN ABU AMIN
(MBBS IMU)

SPORTS MEDICINE UNIT, FACULTY OF MEDICINE
UNIVERSITI MALAYA
KUALA LUMPUR

2012

**OCCUPATIONAL PHYSICAL ACTIVITY MEASUREMENT
AMONG NURSES
IN UNIVERSITI MALAYA MEDICAL CENTRE**

**DR. SYAMSUL RIZAL BIN ABU AMIN
(MBBS IMU)**

**SUBMITTED AS PARTIAL FULFILLMENT FOR THE DEGREE
MASTER OF MEDICINE (SPORTS & EXERCISE MEDICINE)**

UNIVERSITI MALAYA

KUALA LUMPUR

2012

Wits beyond measure, is man's greatest treasure.

-Rowena Ravenclaw's diadem

(Harry Potter and the Deathly Hallows)

*This work is dedicated to Aiemeeza and Arissa
for taking me as husband and made me a father.*

*Warmest thanks to my former nurses in Klinik Kesihatan Chini (2005-2008)
for taking me as a part of their team and a friend.*

Original Literary Work Declaration

Name of Candidate: Dr SYAMSUL RIZAL BIN ABU AMIN

I.C/ No: 790516-01-6281

Registration/Matric No: MGO 08 0002

Name of Degree: MASTER OF MEDICINE (SPORTS MEDICINE)

Title of Project Paper/Research Report/Dissertation/Thesis ("this Work"):

OCCUPATIONAL PHYSICAL ACTIVITY MEASUREMENT AMONG NURSES IN

UNIVERSITI MALAYA MEDICAL CENTRE

Field of Study: SPORTS MEDICINE

I do solemnly and sincerely declare that:

- (1) I am the sole author/writer of this Work;
- (2) This Work is original;
- (3) Any use of any work in which copyright exists was done by way of fair dealing and for permitted purposes and any excerpt or extract from, or reference to or reproduction of any copyright work has been disclosed expressly and sufficiently and the title of the Work and its authorship have been acknowledged in this Work;
- (4) I do not have any actual knowledge nor do I ought reasonably to know that the making of this work constitutes an infringement of any copyright work;
- (5) I hereby assign all and every rights in the copyright to this Work to the University of Malaya ("UM"), who henceforth shall be owner of the copyright in this Work and that any reproduction or use in any form or by any means whatsoever is prohibited without the written consent of UM having been first had and obtained;
- (6) I am fully aware that if in the course of making this Work I have infringed any copyright whether intentionally or otherwise, I may be subject to legal action or any other actions may be determined by UM.

Candidate's Signature

February 2012

Subscribed and solemnly declared before,

Witness's Signature

February 2012

Name:

Designation:

Abstract

Background:

Although many studies have investigated the correlates of physical activity, these were mostly conducted in the leisure time domain. There is still lack of understanding about correlates physical activity exclusively in the workplace setting, as most study in the occupational domain are coupled with transportation domain. This study objectively examined the correlates of physical activity only in the occupational setting, where different backgrounds of female nurses were examined within the similar physical, social and working environment.

Objectives:

The primary objective is to examine relationships between correlates and components of physical activity in occupational setting. Secondary objectives are to investigate the prevalence of nurses who met the minimum recommended bout of physical activity and the characteristics of those who do.

Method:

37 female nurses in an urban hospital were monitored at work with accelerometer. Nurses who met the recommendation are those who performed activities of >3.0 METs for 10 continuous minutes. Linear regression model were fitted to analyse the correlation and association of sedentary time, averaged intensity of the performed occupation and walk amount with nurses' age, BMI and working experience. Independent sample t-test was used to examine differences between 2 groups of nurses – those who met and did not meet the minimum recommended bout.

Results:

Sedentary time is positively associated with age ($r=0.51$, $\beta=1.6$, $p<0.01$), BMI ($r=0.43$, $\beta=1.8$, $p<0.01$) and working experience ($r=0.48$, $\beta=0.14$, $p<0.01$). Averaged intensity of occupation is negatively associated with age ($r=-0.51$, $\beta=-0.03$, $p<0.01$), BMI ($r=-0.59$, $\beta=-0.1$, $p<0.01$) and working experience ($r=-0.41$, $\beta=-0.03$, $p<0.01$). Walk amount is negatively associated with age ($r=-0.40$, $\beta=-178$, $p=0.01$) and working experience ($r=-0.48$, $\beta=-14$, $p=0.04$) but not BMI ($p=0.87$). 56.8% ($n=21$) of the nurses met the minimum recommendation. These nurses are significantly ($p<0.01$) younger, smaller BMI, and less experience. They significantly ($p<0.01$) spent less time being sedentary, scored higher MET values and walked more.

Conclusion:

The findings of this study have not only confirmed the relationships between the correlates occupational physical activity, but further extended the evidence that workplace activities can contribute to meeting the ACSM-AHA 2007 physical activity recommendations. Age, BMI and working experience are important considerations to increase both incidental and structured physical activity interventions at workplace.

Acknowledgement

For a little person like me, the task of producing this research was perceived with immense doubt and inadequacy. Yet I must humbly express my warmest gratitude to the people who have supported and encouraged me. For without their guiding wisdom, all of these would have not been anywhere near remotely possible:

Associate Professor Dr. Mohd Razif Mohd Ali,
*Head and Senior Consultant Sports Physician and Orthopaedic Surgeon
for Sports Medicine Unit of University of Malaya*

Dr. Abdul Halim bin Mokhtar,
Supervisor, Senior Lecturer and Consultant for Sports Medicine of University of Malaya

Lieutenant Colonel Dr. Ridzuan bin Azmi.
*Sports Physician and Head of Department for Sports & Rehabilitation Medicine of the
Tuanku Mizan Military Hospital, Kuala Lumpur.*

As well as other Sports Medicine Unit lecturers:

Dr Mohd Nahar Azmi,
Dr. Mohd Shariff Abdul Hamid,
Dr. Zulkarnain Jaafar,
and of course Dr Goh Siew Li.

To the staff of this unit: Mdm. Sharmini, Mr Ahmad Kamil, Mdm. Jamilah and Mdm. Shima, who have offered their helping hands every single time I needed one.

To my colleagues in the faculty for their sincere friendship and taught me the meaning of teamwork.

To the nursing officers of the 12U Ward of UMMC – Mdm. Kalsom Supi, Mdm. Zaidah Ismail and Mdm. Sakuntala Kumarasamy, for their tremendous support and great cooperation throughout the study period, as well as constructive feedbacks.

And finally of course, the kind nurses of the Ward 12U for their willingness to participate in this study while simultaneously recruit their other colleagues to enrol.

Content

Original Literary Work Declaration	i
Abstract	ii
Acknowledgement	iv
Content	v
List of Figures	viii
List of Tables	ix
List of Abbreviations	xi
Chapter 1: Introduction	1
Chapter 2: Literature Review	
2.1: Benefits of physical activity in the prevention of noncommunicable Diseases	5
2.2: Global and local burden of noncommunicable diseases	9
2.3: Inadequate physical activity and noncommunicable diseases	13
2.4: Examining occupational physical activity and sedentarism in the occupational domain	18
2.5: Rationale of the study	24
Chapter 3: Objectives of the Study	
3.1: Primary objectives with null hypotheses	27
3.2: Secondary objectives and null hypotheses	29

Chapter 4: Materials and Methods

4.1: Approval from Ethics Committee	30
4.2: Study design	30
4.3: Sample size	30
4.4: Participants and recruitment	31
4.5: Exclusion criteria	31
4.6: Premise of the study	32
4.7: Period of the study	33
4.8: Equipments	
4.8.1: Weight	35
4.8.2: Height	35
4.8.3: Monitoring device (Accelerometer)	
4.8.3.1 Requirement	35
4.8.3.2 Recommended practice	36
4.8.3.4 Monitor of choice	36
4.8.3.5 Instrument's validity	38
4.8.3.6 Preset calibration	38
4.9: Variables recorded	39
4.10: Study protocol	40
4.11: Statistical method	41
4.11.1: Statistical tests for primary objectives	41
4.11.2: Statistical tests for secondary objectives	42
4.11.3: Post hoc analysis	43

Chapter 5: Results	
5.1: Description of participants	44
5.2: Results of primary objectives	46
5.2.1: Associations between accumulated sedentary time with age, BMI and working experience	46
5.2.2: Associations between intensity of occupational physical activity with age, BMI and experience.	51
5.2.3: Associations between amount of walk at work with age, BMI and experience	56
5.3: Results of secondary objectives	60
5.3.1: Prevalence of nurses who met the minimum recommended bout	61
5.3.2: Difference in characteristics of the two groups	62
5.4: Summary of results	64
5.5: Post hoc analysis for statistical power	65
Chapter 6: Discussions and Conclusion	
6.1: Discussions	66
6.2: Implications of the study	75
6.3: Limitations of the study	80
6.4: Conclusion	81
References	82
Appendices	
A: Approval from the Medical Ethics Committee	92
B: Approval from Head of Nursing Services of UMMC	93
C: Circulated Information Handout	94
D: Informed Consent Form	95

List of Figures.

- Figure 4.1: The SenseWear Pro3 Armband accelerometer by BodyMedia used in the study
- Figure 4.2: Study protocol flow chart
- Figure 4.3: An example of histogram representative of minute-to-minute intensity recorded (METs) for the first 75 minutes
- Figure 5.1: Relationship with regression line between accumulated sedentary time and age of participants
- Figure 5.2: Relationship with regression line between accumulated sedentary time and BMI of participants
- Figure 5.3: Relationship with regression line between accumulated sedentary time and working experience of participants
- Figure 5.4: Relationship with regression line between reported intensity of occupation and age of participants
- Figure 5.5: Relationship with regression line between reported intensity of occupation and BMI of participants
- Figure 5.6: Relationship with regression line between reported intensity of occupation and working experience of participants
- Figure 5.7: Relationship with regression line between walk amount and age
- Figure 5.8: Relationship with regression line between walk amount and working experience of participants

List of Tables

- Table 2.1: National prevalence of diabetes and hypertension for population above 30 years of age
- Table 2.2: Ten major causes of hospitalisation in Ministry of Health hospitals for the year 2009
- Table 2.3: Ten major causes of death in Ministry of Health hospitals 2009
- Table 2.4: Proportion of sedentary, moderately active and vigorous lifestyles of Malaysian adults in the Malaysian Adults Nutritional Survey 2010
- Table 4.1: Demographic and accelerometer data collected and analyzed in the study
- Table 5.1: Summary of demographic characteristics of participants
- Table 5.2: Summary of SenseWear Pro3 Armband accelerometer measurements
- Table 5.3: Correlation and association between percentages of accumulated sedentary time with participants' age, BMI and working experience
- Table 5.4: Multiple regression analysis for accumulated sedentary time among the studied population
- Table 5.5: Correlation and association between reported intensity of work (METs) with participants' age, BMI and working experience
- Table 5.6: Multiple regression analysis for reported intensity of occupational physical activity (MET) among the studied population
- Table 5.7: Correlation and association walk amount (steps) with participants' age, BMI and working experience
- Table 5.8: Factors associated with amount of walk (steps) among the studied population

Table 5.9: The prevalence of participants who met the recommended minimum bout of physical activity with mean values for demography and occupational physical activity characteristics; and difference between the groups

Table 5.10: Post hoc analyses for observed statistical power in each dependent Variable

List of Abbreviations.

95%CI	95% confidence interval
ACSM	American College of Sports Medicine
AHA	American Heart Association
BMI	Body mass index
BMR	Basal metabolic rate
COPD	Chronic obstructive pulmonary disease
M	Arithmetical mean
MANS	Malaysian Adult Nutrition Survey
MET	Metabolic equivalent of tasks
MoH	Ministry of Health of Malaysia
NCD	Noncommunicable disease(s)
NHMS	National Health Morbidity Survey
NIDDM	Non-insulin dependent diabetes mellitus
PAL	Physical activity level
r	Pearson's correlation
RR	Relative risk
SD	Standard deviation
SWA	Sensewear Pro3 Armband accelerometer
TEE	Total energy expenditure
UMMC	Universiti Malaya Medical Centre
WHO	World Health Organizations
WHPP	Worksite health promotion program(s)

Chapter 1: Introduction

Physical activity is defined as any bodily movement produced by contraction of skeletal muscles which results in energy expenditure beyond resting values.(Thompson et al., 2003) Every person performs physical activity in their daily living. However the amount is largely subject to various factors. Amount of physical activity or energy expenditure required varies considerably from person to person; as well as for a given person over a period of time. In a 24-hour cycle, a person conducts physical activities continuously in various domains. The domains of physical activity range from leisure-time, transportation, occupational, incidental, and to domestic activities. Exercise is a subset of physical activity performed with the objective of obtaining fitness. The activity is planned, structured, repetitive and purposeful. Other non-exercise activities include habitual conducts that score the metabolic equivalent value above 1.5 METs or even above 6.0 METs, implying light to very vigorous intensity of the activity.(Ainsworth et al., 2000) One metabolic equivalent of task or MET is the cost of energy at rest with oxygen utilization of 3.5ml/kg/min.

Sedentarism on the other hand represents inadequate dose of physical activity and typically associated with resting. It rooted from the word 'sedere', which translates from the Latin vocabulary as 'to sit'. In its literal meaning, sedentary can be described as the addiction to sit and lingers idly; taking a great deal of rest with little or no exercise in extended engagement.(Oxford Dictionary of Current English, 2006) An activity with metabolic equivalent value of 1.5 METs or less is denoted as sedentary for its very low energy expenditure.(Pate, O'Neill, & Lobello, 2008) A value above 1.5 METs but less than 3.0 METs implies light-intensity physical activity. Activities beyond 3.0 METs up to 6.0 METs are moderately intense while exertions beyond 6.0 METs are of vigorous-intensity. An active person regularly engages in activities achieving the threshold recommendation for duration and intensity. A physically inactive person may perform short bouts of

moderate to vigorous intensity activities not sustained beyond the minimum recommended duration. A sedentary person on the other hand is typically engaged in minimal activity with energy expenditure similar to an extended rest.

As a health-related behaviour, physical activity is subject to its determinants. Determinants are causal factors that exert influence in the pattern of a person engaged in the behaviour.(Baumann et al., 2002) Most studies however are concerned with the correlates of physical activities. Behavioural correlation studies are about the predictive relationship between a dependant and an independent variable without making causal inferences. Correlates of physical activity have been studied extensively by the means of epidemiologic analyses, laboratory environment and experimental observations. Trost and colleagues (2002) have taken the task to update a review on the correlates of adults' physical activity. In this review, adults' participation in physical activity is influenced by a diverse range of personal, social and environmental factors. The correlates of physical activities are classified into six broad categories which are: i) demographic and biologic factors, ii) cognitive, psychological and emotional factors, iii) behavioural attributes and skills, iv) social and cultural factors, v) physical environment factors, and vi) physical activity characteristics. Demographic and biologic factors are found to have been studied most extensively. Female gender is consistently found to correlate negatively to physical activity. Similarly, body weights of overweight and obese categories are repeatedly found to document negative association with physical activity. However the review noted that age has weak or mixed evidence as being a negative correlate of physical activity. Although occupational activity is a positive correlate in the male gender, it has little effect on physical activity prevalence among females. The review looked into various design of acceptable criteria across various community. The results of this review can be generalized on the overall domain of physical activity. However studies on specific domain particularly occupational physical activity are still lacking and most studies for this domain are coupled

with transportation domain. This is despite promising outcome from studies meant for workplace healthy lifestyle interventions. Furthermore, objective measurements were not utilized in some literature, giving rise to potentially misleading interpretation from recall or self-reported questionnaires.

Understanding that sedentarism and physical activity are mutually exclusive, abundant literature are available describing their definitions and correlates.(Baumann, Sallis, Dzewaltowski, & Owen, 2002) Both spectrums of the physical activity continuum influence health in ways distinct from another. While researches on moderate and vigorous intensity exertions have led to the establishment of physical activity recommendations, sedentarism remains a fertile field for research. At present, although the ill effects of sedentary behaviour are continually discovered, its definition continues to evolve. Epidemiologists and researchers have yet reached a consensus on the definition of sedentarism, even more so in identifying the harmful doses of such activities. In both spectrums, focus mainly put on leisure time domain and other interventions meant to increase physical activity level in addition to a person's daily habitus. In pursuing lingering questions on physical activity and sedentarism, measurement apparatus of appropriate validity have been utilized. This range from expensive laboratory equipments like doubly labelled water and portable metabolic cart, physical activity monitoring devices like accelerometer and pedometer, and to simple yet reliable score-determined physical activity recall questionnaires. Regardless of their design, objective and measure, many on-going research continue to increase our understanding of these behaviours.

Despite our increasing understanding of physical activity, a paucity of knowledge on correlates of physical activity within the domain of occupation is identified. This stemmed from inadequacy of literature in the relationship within this domain. As employed adults spend most of their waking hour within this domain, workplace setting creates

opportunity for interventions to increase level of activity and reduce sedentarism. An extensive literature review will be undertaken to form the theoretical framework for this study, looking at how an employed population would perform physical activities within a homogenous yet real-living working environment. The population that will be examined in this study is the nursing profession. As healthcare workers, they have a professional responsibility in the health of their patients and potential to become a role model of health. However as with many other demanding professions, nurses might find themselves to be in limited time to commit for proper exercise within the leisure domain. The study will first look at the health consequences frequently associated with this profession as well as the benefits that can be yield if they live actively. It will then investigate patterns of physical activity when performing their duties as frontline healthcare providers.

The study is thus designed and aimed at exploring the patterns of physical activities at workplace and their potential contributions in meeting the recommendations for better health. Correlates of occupational physical activity which are demographic (working experience) and biologic (age and body mass index) are to be examined for their influence exclusively on this domain, as compared with other studies that have coupled occupation with transport domains. Secondary analyses of this study are intended to examine difference between population who meets and does not meet relevant recommendation. The research will utilize a physical activity monitoring device - an accelerometer, in conforming to best practice recommendation. This will enable objective measures and accurate analysis of collected data rather than rely on recall questionnaires. The data will be collected and analyzed, with hope to answer questions and fulfilling its objectives and finally arrive to recommendations to increase physical activity within the occupational domain.

Chapter 2: Literature Review

2.1: Benefits of physical activity in the prevention of noncommunicable diseases.

To date, there is a strong and growing body of evidence on the benefits of physical activity accumulated from researches transcending many cultures and phases of life. For decades these had been conducted with scientific rigor, within various environments. The findings have mainly revolved around the role of physical activity in reducing the risk of developing noncommunicable diseases (NCD). Noncommunicable disease is defined as chronic clinical condition with adverse complications to health not acquired from infectious event or trauma.(Harlan & Harland, 2011) In the context of this study, conformation to the World Health Organization (WHO) on NCD is followed. The WHO has focused its global battle against NCD (but not limited) to cardiovascular diseases, diabetes, chronic respiratory conditions and cancer.

Perhaps modern works on physical activity and NCD began with the work of the late Professor Jeremy N Morris. In 1953, Morris and colleagues systematically examined the incidence of coronary artery disease among over 31,000 male transport workers of the age 35 to 65 years.(Morris et al., 1953) The objective was to infer a relationship between nature of job and incidence of the disease. Observing conductors and drivers of the London bus service, they found that the annual incidence of coronary artery disease was higher among the drivers (2.7/1000) as compared to the conductors (1.9/1000). In addition bus conductors were more likely to suffer less fatal attacks compared to the drivers. These conductors needed 'to pound up and down the buses' with an average range of 500 to 750 steps per working day, in contrast to drivers who sat for more than 90% of their working hour. Lower incidence of coronary artery disease is similarly observed among active postal workers compared to sedentary occupations like telephonists and clerks.(Paffenbarger, Blair, & Lee, 2001) They postulated that the more physically demanding jobs offer

protective effects particularly against sudden cardiac death as the first manifestation of a disease. These landmark works have pioneered a field of research in understanding the dynamic relationship between physical activity and health.

The famous Harvard Alumni Health Study has found that physical activity is associated with decrease stroke risk.(I Min Lee & Paffenbarger, 1998) They followed a cohort of healthy 11,130 alumni with mailed questionnaires and observed reduce risk of stroke among alumnus who expended 1000 kcal/week to 2999 kcal/week. This was further consolidated by Lee and colleagues (1999) in the Physicians' Health Study, where they found that exercising 'vigorous enough to work up a sweat' is associated with lower incidence of stroke.(I Min Lee, Hennekens, Berger, Buring, & Manson, 1999) The inverse association between physical activity and stroke appears to be mediated from the beneficial effects on body weight, blood pressure, serum cholesterol, and glucose tolerance. In both studies, data were adjusted to age, smoking habit, body mass index (BMI) and alcohol intake.

Benefits of physical activity to diabetes are not only limited in preventing the development of non-insulin dependent diabetes (NIDDM). Regular physical activity has been shown to be effective for the secondary prevention of NIDDM as well. In the Physicians' Health Study, over 21,000 male physicians were followed up for 5 years.(Manson et al., 1992) Significant risk reduction in the development of NIDDM at moderate to vigorous intensity of physical activity is observed and independent of participants' body mass index (BMI). Furthermore, frequency of exercise in a week is inversely associated with the risk. The group have earlier reports lower incidence of NIDDM among subjects in the Nurses' Health Study who regularly engage in exercise.(Manson, Rimm & Stampfer, 1991) A recent systematic review has looked into 10 prospective cohort studies over 300,000 participants with more than 9000 incidences of

NIDDM for health effects of moderate physical activity.(Jeon, Lokken, Hu, & Dam, 2007) Brisk walking frequency and total duration was selected as the mode of moderate physical activity (3.8 METs) performed by the participants. It concluded that a 30% risk reduction for NIDDM is observed among subjects who regularly enjoy brisk walking. This is also independent of their BMI; signifying that regular moderate-intensity physical activity can reduce the risk of NIDDM even among those who are not of ideal weight.

Positive effects of physical activity on glucose control are not only demonstrable at higher intensity level but also at lower intensities as well. Australian researchers have found that both light-intensity activity and breaking up sitting time more frequently are associated with better 2-hour postprandial blood glucose profile.(Healy et al., 2007) A recent meta-analysis has endorsed implementing structured exercise training using aerobic and resistance modes either alone or in combination.(Umpierre & al., 2011) The analysis has concluded that a greater reduction of glycated haemoglobin is seen with regular, structured exercise of more than 150 minutes per week. This re-emphasizes the current recommendation for diabetics that promotes such exercise of at least 150 minutes per week only.("Position Statement of the American Diabetes Association: Physical Activity/Exercise and Diabetes Mellitus," 2003)

Physical activity may reduce the incidence of certain types of cancer, with accumulated evidence favouring risk reduction and improvement in survival rate. A systemic review has found that adults who increase their level of physical activity can reduce the risk of colon cancer regardless of their BMI status.(Slattery, 2004) The review analyzed data from 48 cohort and case-control studies, concluding that an inverse relationship exists between physical activity and the development of breast cancer. A dose-response relationship of 6% risk reduction with every additional hour per week of higher intensity physical activity is identified. As studies were conducted in pre-menopausal age

group, inference that regular physical activity in young women confers protective effect against post-menopausal breast cancer is plausible.(Monninkhof et al., 2007) In patients diagnosed with breast cancer, risk of death is reduced by 6% at 10 years if they regularly perform physical activity equivalent to walking 3 to 5 hours per week even at the average pace.(Holmes, Chen, Feskanich, Kroenke, & Colditz, 2005)

Chronic respiratory conditions like chronic obstructive pulmonary disease (COPD) can benefit from physical activity too. In a population-based study based in Denmark, researchers have found that risk for hospital admission for COPD sufferers were reduced even with self-reported regular low physical activity. Although dose-response relationships between variables are not clear, they have also found that lower mortality risk from respiratory causes.(Garcia-Amerych, Lange, Benet, Schnohr, & Anto, 2006) However, tobacco consumption remains the single most important modifiable risk factors for chronic respiratory conditions.

It is clear that regular physical activity is not only an effective primary prevention strategy for NCD, but also an effective mean for secondary prevention of the diseases as well. Therefore there is a need to promote and facilitate regular physical activity among the public, and to reduce the exposure to sedentarism.

2.2: Global and local burden of noncommunicable diseases.

In 2005 the World Health Organization (WHO) has estimated that from 58 million deaths worldwide, 35 millions are attributable to chronic diseases.(Beaglehole et al., 2005) Eighty percent of these deaths were projected to occur in countries of low to middle income. An update of this report reveals that in 2008, NCD alone continued to become the leading global cause of death.(Alawan, Armstrong, Bettcher et al., 2011) In the report, 36 million out of 58 million deaths (or nearly two-third) that occurred in 2008 were due to NCD. About a quarter of NCD-related deaths occur before the age of 60. True to the projected figure, 80% of these deaths took place in low to middle income countries. This contradicted popular beliefs that NCD deaths occur mainly in affluent and modernized society. The premature deaths are preventable; if appropriately and timely intervened. For the period of 2010 to 2020, NCD deaths is projected to increase by an alarming 15% globally. This rise is particularly in the regions of Africa, South-East Asia and the Americas.(Alawan, Armstrong, Bettcher et al., 2011) In low to middle income countries, this would account for 29% of deaths for the population below 60 years old. This is compared to a lowly figure of 13% similar deaths in high income countries.

Malaysia is geographically located in the Southeast Asia sub-continent. Its health indices are monitored by WHO under its Western Pacific Regional Office. Persistent economic growth aided by political stability resulted gross national income per capita for financial year 2010 of USD7900, putting the country under the category of higher middle income group.("World Bank data by country: Malaysia," 2010) Despite improved life expectancy to 75 years old, the country's health resource is not spared from the burden of chronic diseases. ('WPRO',2011) The National Health Morbidity Surveys (NHMS) are population-based surveys carried out by the Ministry of Health (MoH) every 10 years since 1986. As shown in Table 2.1, the survey series show rising prevalence of diabetes and hypertension in the country's 20-year course.(Mustapha, 2009)

Table 2.1: National prevalence of diabetes and hypertension for population above 30 years

<i>Disease prevalence (%)</i>	<i>NHMS I (1986)</i>	<i>NHMS II (1996)</i>	<i>NHMS III (2006)</i>
Diabetes	6.3	8.3	14.9
Hypertension	14.4	32.9	42.6

The MoH has reported that although NCD is not most common cause of hospitalization in 2009, collectively it is a major cause of admission into government health facilities. ("Health Facts 2009 by MoH" 2010) The data presented do not group NCD together; instead it classifies to the cause of admission according to organ-system conditions.

Table 2.2: Ten major causes of hospitalisation in MoH hospitals for the year 2009

<i>No.</i>	<i>Causes of death</i>	<i>Percentage (%)</i>
1.	Normal deliveries	13.16
2.	Complications of pregnancy, childbirth and the puerperium	13.10
3.	Diseases of the respiratory systems	9.38
4.	Accidents	8.03
5.	Certain conditions originating in the perinatal period	7.01
6.	Diseases of the circulatory system	6.91
7.	Diseased if the digestive system	5.17
8.	Ill-defined conditions	3.50
9.	Diseases of the urinary system	3.42
10.	Malignant neoplasm	3.02

Noncommunicable diseases also contribute to the nation's major causes of death in hospitals. ("Health Facts 2009 by MoH" 2010) The data presented do not group all NCD of interest together; instead the classification is with organ or system-specific conditions. Cardio-respiratory-vascular conditions are the leading causes of death. The cumulative percentage of death in the government health care facilities from cardiovascular, cerebrovascular disease, chronic lower respiratory diseases, and malignant neoplasm is 37.4%.

Table 2.3: Ten principal causes of death in MoH hospitals 2009

<i>No.</i>	<i>Causes of death</i>	<i>Percentage (%)</i>
1.	Heart diseases and diseases of pulmonary circulations	16.09
2.	Septicaemia	13.82
3.	Malignant neoplasm	10.85
4.	Pneumonia	10.38
5.	Cerebrovascular diseases	8.43
6.	Diseases of digestive system	4.98
7.	Accidents	4.85
8.	Certain conditions originating from perinatal period	3.82
9.	Nephritis nephritic syndrome and nephrosis	3.58
10.	Chronic lower respiratory diseases	2.03

The burden of NCD has had implications to the national health resources. Major indirect implications are to the economy, brought about by the affected productivity of the working population, and provision of financial allocation for these conditions. With regards to the productivity, NCD can cause disability requiring absenteeism from work, healthcare and disability payments, early retirement, and even premature death.(Armstrong et al., 2008) For example, in 2007 the International Diabetes Federation estimated that direct global annual healthcare cost is USD 232 billion to USD 422 billion.("Economic Impact of Diabetes : Factsheet 2009," 2009) The WHO estimated that the healthcare cost of diabetes-related illnesses range from 2.5% to 15% of countries' annual healthcare budget.("2008-2013 Action plan for the global strategy for the prevention and control of noncommunicable diseases," 2008) This would depend on diabetes prevalence and sophistication of treatment available. If the prediction made in 2005 holds true, the percentage of consumption from annual healthcare budget would rise from 7-13% and even up to 40% in countries with high prevalence.

In Malaysia, the cost of care for diabetes and its complication is expensive. Ibrahim and colleagues (2010) have compiled previous unpublished analyses and reported that the mean provider's cost for outpatient treatment is USD361.60 for clinics with family physician and USD257.42 for clinics without specialists.(Ibrahim, AlJunid, & Ismail, 2010)

For inpatient treatment, the cost for each admission into medical wards is USD693.51 while those admitted into orthopaedic wards for diabetic foot costs higher – USD4151.03 per admission.

Noncommunicable diseases have also taken a significant toll in Malaysian political scene. There were 16 by-elections (10 state seats, 6 parliamentary seats) held following the 12th General Election 2008 until May 2011. (BERNAMA, 2011a) Of the 16 by-elections, a significant 8 were held as the incumbents died from cardiac causes. Another by-election was held as the incumbent died from complications of stroke while another succumbed from colon cancer.(BERNAMA, 2011a) The cost of the 16 by-elections exceed RM11 million, with each election costing from a range of RM325,000 to RM1.29 million, not including cost born by contesting political aspirants.(BERNAMA, 2011b)

Clearly NCD has taken a great toll on the nation's health care system in many ways. Globally NCD become a major economic burden too. As NCD are potentially preventable, this would certainly give great saving in the capital expenditure for any nation or even the whole world. Blunting the rising prevalence and complications of NCD would be best by the mean of effective prevention. From the preceding chapter, it is clear that regular physical activity of adequate intensity is an effective preventive strategy.

2.3: Inadequate physical activity and noncommunicable diseases

Noncommunicable diseases may take decades before their fulminant manifestation. This presents interventional opportunities to prevent or delay the disease progress. The WHO in its 2008-2013 action plan for prevention and control of NCD has identified four major modifiable risk factors. These are tobacco use, unhealthy diet, physical inactivity, and harmful use of alcohol. ("2008-2013 Action plan for the global strategy for the prevention and control of noncommunicable diseases," 2008) These risk factors reflect lifestyle changes that took place in tandem with modernisation in any society; but with little comprehension about their complications to health. Of the four shared modifiable risk factors, unhealthy diet and lack of physical activity are very closely related. The two represent positive energy balance in the energy-balance continuum. Increased energy intake accompanied by diminished physical activity inevitably tip-off the delicate balance. Positive energy balance leads to the development non-fatal yet debilitating health conditions like inferior physical fitness, low self esteem, and chronic musculoskeletal problems. Chronic energy excess when linked with obesity may progress to become more serious and life threatening conditions. This mainly occurs from: i) insulin resistance especially diabetes mellitus, ii) cardiovascular conditions including hypertension, stroke and coronary heart disease, and iii) certain type of cancers - mainly hormonal-related and large bowel cancers. (Uauy & Draz, 2005) Structured exercise is capable to significantly suppress subjective feelings of hunger. (N. A. King, 1997) Although intense exercise delays the time to start eating, it has no effect on the amount of food to be consumed. On the other hand, it is likely that sedentarism would stimulate food consumption.

Regular physical activity is an effective mean to maintain a healthy energy balance. It is a key determinant of energy expenditure and fundamental to weight control. Physical activity is proven to reduce mortality from all causes, particularly from cardiovascular and respiratory conditions. (Paffenbarger, Hyde, Wing, & Hsieh, 1986; Ujakala, Kaprio, Sarna,

& Koskenvuo, 1998) Likewise, physical inactivity has been associated with increased risk of death from all-cause mortality, particularly in those with chronic diseases.(Tremblay, Colley, Sanders, Healy, & Owen, 2010)

The study of inadequate physical activity has led interests on the new branch of behavioural knowledge coined 'inactivity physiology'. Inactivity physiology paradigm proposes that with sedentarism (frequently measured as sitting time in various environment, with very low energy expenditure), the body undergoes biological changes distinct from being active.(Hamilton & Bey, 2003) The changes predispose a sedentary person to be at risk for NCD. In animal model, sedentarism (defined as lack of skeletal muscle contraction on electromyography) seems to down-regulate lipoprotein lipase activity. Lipoprotein lipase is a key enzyme that promotes uptake of triglyceride by skeletal muscle. It is also an important risk factor to both metabolic and cardiac diseases. Down-regulated lipoprotein lipase activity in turn increases the level of circulating cholesterol in plasma.

In a laboratory-control experiment, 21 healthy human subjects were admitted in a medical research facility and instructed to be completely sedentary.(Hamburg et al., 2007) The participants were free from diabetes, tobacco use and hypertension. They were asked to maintain regular lifestyle and physical activity level prior to admission. For a 5-day period, they spent 23.5 hours either sleeping or lying in bed performing very low intensity physical activities within the research facility. They were provided with diet similar in nutrition and caloric values as the menu in their daily lives. Researchers have found that physical inactivity significantly induces insulin resistance (glucose level 84.7 mg/dl at baseline, 87.8 mg/dl at day 5, $p=0.02$), increased circulating triglyceride (69 mg/dl at baseline, 93 mg/dl at day 5, $p=0.001$), increases systolic blood pressure (109 mmHg at baseline, 116 mmHg at day 5, $p=0.001$) and impairs microvascular function. It is only

agreeable to assume that not only sedentary person fails to reap the benefits of regular physical activity; the risky behaviour also results in certain physiological changes adverse to health. These changes are seen among healthy subjects and as soon as 5 days of being sedentary.

Physical activity (or lack thereof) is one of the major modifiable risk factor for NCD. (Alawan, Armstrong, Cowan, & Riley, 2011) Despite accumulating evidence favouring regular physical activity and denouncing sedentary behaviour, the incidence of NCD continues to rise. In 2011, WHO reported that prevalence of insufficient physical activity is directly proportionate the nations' level of income. (Alawan, Armstrong, Cowan et al., 2011) In high income countries, the prevalence of physical inactivity is 41% of men and 48% of women. In contrast, low income countries generally report much lower physical inactivity prevalence among men (18%) and women (21%). Global prevalence of physical inactivity for the population above 15 years old is 31% in 2008. The gender specific prevalence is 28% of men and 34% of women.

The National Health Morbidity Survey 1996 (NHMS II) revealed that only 11.6% of Malaysian adults adequately exercise or engage in regular physical activity. Using the cut off point of 150 minutes per week of accumulated exercise or 3 sessions per week of 20 minutes of vigorous intensity physical activity per bout, the survey reported that more men (16.2%) exercise regularly than woman (7.7%). ("Exercise - A report of the National Health and Morbidity Survey 1996," 1999) Ten years later, the third NHMS (2006) was carried out using a different set of recall questionnaire. ("The Third National Health and Morbidity Survey (NHMS III) 2006 - General findings," 2008) Using this physical activity questionnaire, the prevalence of inactivity was examined. A total of 43.7% respondents were physically inactive, with women being more inactive (50.5%) compared to men (35.3%). The two studies are not comparable to each other, as different questionnaires were

used and different outcomes were sought. Two important conclusions however can be inferred from the two surveys. Malaysians are generally not a physically active nation and the female gender are significantly inactive compared to the male.

In a comprehensive survey by Poh and colleagues (2010), the authors analyzed patterns of physical activity as well as energy expenditure among near 7000 adults countrywide.(Poh et al., 2010) Using a set of 24-hour recall questionnaire incorporated into a national nutritional survey; the report offers the most recent update. The survey was designed to cover across various physical activity as well as bodily position throughout the day. It reveals that only 31.3% respondent ever exercised within 2 weeks prior, with more men (40.0%) compared to women (22.3%). Exercise was identified as structured activities like sport, not including occupational or other domains of daily physical activity. Only 14.2% respondents scored adequate level of exercise (men = 18.9%, women = 9.4%). Urban residents (34.7%) are more active than rural respondents (24.9%).

The group also examined physical activity level (PAL) of the participants. PAL is an index of energy balance in daily living. Expressed as ratio of total energy expenditure (TEE) to basal metabolic rate (BMR), a higher PAL value indicates higher level of physical activity. PAL values are categorised into sedentary (1.40 to 1.69), active (1.70 to 1.99) or vigorous (2.00 to 2.40). This ratio however does not include food intake into its consideration. Table 2.4 below summarizes the proportion of PAL in Malaysian adult, extracted and modified from the report. More than a third of respondents are sedentary, with more women (42.6%) than men (36.7%).

The report also presented an opportunity to analyze sedentary behaviour pattern among its respondents. Surrogates of sedentary behaviour like lying down and sitting time were examined for their prevalence. Malaysians generally spend their time sitting (48.8% or

589 minutes) and lying down or sleeping (33.1% of the day or 477 minutes), all in domains especially during leisure time. Male respondents spent more time sitting (614 minutes) compared to female (559 minutes) but lesser time lying down or sleeping (472 minutes) than their female (482 minutes) counterparts.

Table 2.4: Proportion of sedentary, moderately active and vigorous lifestyle of Malaysian adult extracted and modified from the MANS 2010 (% , 95%CI)

<i>Socio-demographic groups</i>	<i>Sedentary</i> (PAL 1.40 – 1.69)	<i>Moderately active</i> (PAL 1.70 – 1.99)	<i>Vigorous lifestyle</i> (PAL 2.00 – 2.40)
All	39.7 (38.2 - 41.1)	47.6 (46.1 - 49.0)	12.8 (11.9 – 13.8)
Gender			
Men	36.7 (34.6-38.9)	47.2 (45.2-49.2)	12.6 (11.3-13.9)
Women	42.6 (40.7 -44.7)	48.1 (46.0-50.2)	9.8 (8.6-11.1)
Strata			
Urban	40.3 (38.3-42.3)	47.2 (45.2-49.2)	12.6 (11.3-13.9)
Rural	38.8 (36.7-40.9)	48.1 (46.0-50.2)	13.1 (11.8-14.6)

Comparing data from the WHO 2011 and MANS 2010; it is evident that not only the female gender are generally less active than male but they are also more sedentary. Yet premature deaths from NCD in Malaysia is much less in women (26.3%) compared to men (33.7%); with national mortality events from the four major NCD being 56%.(Alawan, Armstrong, Cowan et al., 2011) The age standardized death rate per 100,000 populations is also less in women (436.5) than men (605.7).

Prevalence, death and morbidity from NCD continue to rise. However this rise cannot be accounted by the rising physical inactivity prevalence alone as other modifiable and non-modifiable factors are also contributory. The rise in NCD also reflects the prevalence of other risky health behaviours outlined by WHO. Thus the rising trend in NCD prevalence cannot yet be inferred as a surrogate indicator of inadequate physical activity.

2.4: Examining physical activity and sedentarism in the occupational domain

Our ancient forefathers hunt and gather food for survival. Clearly, this would require higher energy expenditure. Creation of wheels, hunting weaponries and farming tools, as well as the discovery of fire marked the beginning of technological advancement. Since the Second World War; industrialization has taken a quicker pace and became the major income generator for many nations. Booming of the world population demands more food from the farming, plantation and fishery industries. This too has pushed for creation of machines that yield harvests unmatched by manpower. Physical activity is no longer a requirement for daily living, the relationship between eating and physical work to yield or harvest food is increasingly attenuated.

The pursuits for ever modern machines and technologies are not only limited to defence sector but to others as well. A simple walk to a colleague delivering notes and messages is fast being replaced with finger-tip technologies like social-network platform, email and intercom. Perceived higher intensity of incidental activities like the use of staircase are no longer popular as more has opt for escalators and lifts to get from place to place. Electronic and robotic technologies are increasingly being innovated and invented to help with domestic chores. Increase automation of work and living in higher economic sovereigns inevitably create larger pockets of insufficient physical activity. Church and colleagues (2011) have looked into the trend of occupation-related physical activity and its association with obesity over 50 years in the United States.(Church et al., 2011) They matched the obesity prevalence data series from the US National Health and Nutrition Examination Surveys with employment census from Current Employment Statistic, Bureau of Labour Statistics of US. Occupations were broadly categorized into agriculture, goods- or service-producing. For the observed period, there has been a decrease in the percentage of individuals employed in occupations needing higher MET-value exertion such as agriculture (mean MET=3.0) and other goods-producing occupations (mean MET=3.0-

4.8). Only the light-sedentary occupations such as the service sector (mean MET=1.5–4.0) shows increment of employment. Since 1960, estimated mean daily energy expenditure for all categories has also dropped by 100 calories. This energy expenditure reduction is seen in both gender and coupled with weight increment above obesity level.

In the local setting, Poh and colleagues (2010) have found that non-working Malaysian men and women spent more time sleeping, resting and watching television compared to the working population. (Poh et al., 2010) This confirms that modern day occupations and job opportunities require lesser physical exertion, and unemployment in modern time is associated with sedentary lifestyle.

Sitting time is being studied by researchers as a surrogate indicator of sedentarism in waking hours. Australian researchers have found that professional workers spent significantly longer duration sitting at their job (249 minutes, $p < 0.01$ 95%CI) compared to white and blue-collar workers (207 minutes and 136 minutes respectively, 95%CI) for both genders. (Mummery, Schofield, Steele, Eakin, & Brown, 2005) Compared to women (189 minutes), men spent more time sitting (209 minutes) and this higher sitting time are significantly associated with obesity for this gender. The results of this study suggest that workplace sitting time plays an important role in overweight and obesity.

The earliest modern work on physical activity focused its observation at incidence of coronary artery disease and nature of occupation. (Morris et al., 1953) It is clear that physical nature of occupation affects the disease outcome. As the knowledge of physical activity and inactivity continues to expand, more questions are being raised than answered within the contrasting realms of research. Morris's observation has led to a conclusion that higher physical activity among bus conductors is a cause for lower incidence of coronary disease. However the notion that inadequate occupational physical activity (or sedentary

occupation) being the cause of higher disease incidence among London bus drivers poses a valid possibility in the light of recent research findings. As highlighted above, sedentary behaviour among healthy subjects induces adverse metabolic and cardiovascular parameters favouring development of NCD albeit at short duration.(Hamburg et al., 2007)

In a recent systematic review, majority of the studies analysed are in agreement that there is a positive association between volume of occupational sitting and BMI.(van Uffelen et al., 2010) However there are conflicting findings with regards to cancer. Of 17 papers examined, only 5 found that occupational sitting is associated with higher risk of breast, ovarian or colorectal cancers while two studies surprisingly observed higher risk for lung cancer in people who are more active at work. Meanwhile, majority of prospective studies for diabetes mellitus have found high association between the two. The risk for cardiovascular disease in association with sitting time is found to be inconclusive, despite the convincing observations by Morris. Overall, prospective studies have found that sitting time is associated with an increased mortality risk from all cause. The systematic review highlighted some inconclusive and conflicting associations between occupational sitting and health risks. The authors noted the difference might be attributed to different study designs and measures. On the other hand, this also highlights the need for more prospective studies about sedentarism and certain health conditions especially cancer.

Certain sector requires round-the-clock operation like health, defence and aviation. The nature and demands of these occupations require 24-hour operation thus the need for working shifts. Typically there are 2 to 3 shifts per day, with personnel taking rotation in the allocated shifts. A whole working day with 3 shifts is typically divided into morning, evening and night shifts. Shift works pose unique challenges to the health of workers. Three pathways are implicated on the risks of shift work to health. They are i) disturbed circadian rhythm, ii) disturbed socio-temporal patterns and iii) tendency towards risky

health behaviours.(Boggild & Knutsson, 1999) Risky health behaviours such as inadequate physical activity during normal waking hours and tobacco use are identified risk factors for coronary artery disease and were associated with night shift jobs. Furthermore a study has found 15% reduction in plasma high density lipoprotein along with changes in other lipids, plasminogen, and blood pressure among night shift workers.(Boggild & Knutsson, 1999) Data analyzed from the landmark Nurses' Health Study II found higher relative risk (RR) of developing coronary heart disease among nurses who have worked in rotating night shifts for more than 6 years (RR=1.51) compared to junior nurses (RR=1.21).(Kawachi et al., 1995) In a separate analysis, investigators concluded that nurses who have worked in rotating night shifts for more than 30 years had a 36% greater risk to develop breast cancer compared to day-time nurses. This is after adjustment to variables like age, parity and use of contraceptive pills.

Outpouring evidences favouring the positive relationship between physical activity and health has led to research on the effect of increasing occupational physical activity in various settings. Endpoints of this research are typically health outcomes and productivity. The endpoints of health outcomes are usually development of one of the cardinals of NCD, or other health parameters like blood glucose control, BMI and mental health. Productivity outcomes are usually related to cost-benefit analysis, work performance, efficiency and absenteeism related to ill health. Most of the waking hours in adult are committed to employment. This thus provides an opportunity for physical activity intervention with the objectives mentioned previously.

One extensive review has concluded that incorporation of physical activity interventions within the workplace setting can increase employees' level of physical activity and long-term reductions in absenteeism.(Davis & Jones, 2007) These interventions ranged from physical activity counselling, health checks, weight watches and exercise programmes.

The same review found that employer-supported programmes are more effective, being a promoting factor for active lifestyle. Employer-supported active-travel plans to workplace (like cycling or walking) are associated with longer physical activity participation by 1 to 2 hours per week. Supports provided are bicycle parking space, changing room, and even public transport coupons. Healthcare cost and productivity both in short and long terms are found to be affected by the physical fitness of employee. This is the result of reduced disability payment, reduced absenteeism, and increased productivity. These benefits are also seen among the obese employees.

The benefits of higher employees' physical activity level and overall cost-effectiveness of interventions have been studied by a group of experts commissioned by the WHO and World Economic Forum (2008). After reviewing the evidence, the group found that workplace health promotion programmes (WHPP) targeting physical activity and dietary interventions or promotions at work setting are effective. Workplace health promotion programmes change lifestyle behaviours, improve health-related outcomes and facilitate organizational-level changes that will eventually increase productivity, reduce sick-leave, and reduce long-term disability payment.(Alawan, Armstrong, Bettcher et al., 2011) The panel are in agreement that current evidences from WHPP have the potential to optimize overall health of the employees at bearable operational cost, with increase in overall productivity and corporate return, as well as embellished corporate image.

One of the flaws of the report is that the inferences were made from studies conducted in high-income countries. Although the report is a critical document in blunting the global burden of NCD, translation of similar research into the practice of targeted economic sovereigns are at best ambiguous. This is due to the lack of epidemiologic studies and similar interventions in nations of low and higher income groups.

In conclusion, modern day technology has led to more automation of work thus significantly reduces opportunity to perform physical activity. In addition to recent knowledge about imposed ill effects of occupational sedentarism, workers' health is compounded with unique physiologic stress from night shift duties required from certain sectors. Worksite can potentially become a setting for active and healthy living with evidences favouring health of workers and their productivity.

2.5: Rationale of the study

Current understanding on physical activity and health as well effects of sedentarism has led to formulations of various physical activity recommendations. The American College of Sports Medicine (ACSM) and American Heart Association (AHA) had hand-in-hand updated of their position stand on physical activity recommendations (ACSM-AHA 2007 recommendations).(Haskell et al., 2007) Although the target population is the healthy United States adults, it is advocated and adopted by various organizations worldwide. It presents with clarity on issues not addressed by the earlier statement. The excerpt of the recommendation of interest is as below:

“Aerobic activity:

To promote and maintain health, all healthy adults aged 18–65 years old need moderate-intensity aerobic physical activity for a minimum of 30 minutes on five days each week or vigorous-intensity aerobic activity for a minimum of 20 min on three days each week. Also, combinations of moderate- and vigorous intensity activity can be performed to meet this recommendation. For example, a person can meet the recommendation by walking briskly for 30 minutes twice during the week and then jogging for 20 minutes on two other days. Moderate-intensity aerobic activity...can be accumulated toward the 30-minute minimum from bouts lasting 10 or more minutes.”

The position stand does not restrict its recommendations on structured exercise as sole modality of physical activity. In the later part, the prescribed dose recommended is as an addition to daily physical activity habitus of light or higher intensities lasting less than 10 minutes in duration. This indirectly recognizes non-exercise physical activities as potential contributor in meeting the goal. As waking hours are mostly spent in the confine of an occupation, contribution of workplace physical activities toward meeting the goal presents

potential opportunity. In an analysis of occupational physical activity contributions in meeting the goal, a US national survey has found an additional increment by another 6.5% in the prevalence of adults who met the recommendation.(Bensley & Van Eenwyk, 2011) This study was conducted by nation-wide phone interview survey where randomly dialled correspondences were asked to describe their occupational demands (sitting or walking or heavy manual labour). Correspondences were stratified into gender and job categories, along with other demography. Although it concludes a modest contribution of occupational physical activity to the prevalence of adults meeting the said recommendation, it did not objectively measure time spent in the recalled activities. The study however is the first study that directly looked into the contributions of occupational physical activity towards meeting the ACSM-AHA 2007 recommendations.

The current trend of diminishing physical exertion is coupled with evidences indicating a higher risk towards the development of NCD. As one of the major domain, occupational physical activity may contribute in the prevention of NCD. In contrast, occupational sitting time – being the surrogate indicator of sedentarism; may play a role in determining long-term health outcome of the employee. Furthermore certain occupations that require employee to work in rotating night shifts pose unique challenges to the physiology and health, with evidences indicating higher association with NCD. The study on correlates of physical activity is important as any intention-to-treat intervention should understand the modifiable factors thus propose a design that would have significant and clinically meaningful hypothetical outcomes. Understanding that physical activity and sedentarism exerts distinct effects on health, design of study should objectively measure and accurately quantify the attributes of occupational physical activity.

As gender, BMI and age are considerably the most easily identifiable demographic and biologic correlates of physical activity; the study will be conducted on female nurses of a medical institution, correlating with the attributes of occupational physical activity which are sedentary time, reported MET value of occupation (intensity) and amount of walk. Amount of walk is chosen as this mode of physical activity is one of the most frequently being performed by the nurses apart from occasional lifting of light to heavy objects and standing. In addition, the study would also examine the prevalence of nurses who met the recommended minimum bout of physical activity accumulated towards meeting the goal. Analysis between different groups of nurses will be conducted to better understand physical activity as health-related behaviour at workplace. The present literatures that have looked into physical activity in the occupational domain have always also examined the contribution of mode of transportation to work by the employees. This means that yielded data and results are not truly representative of the physical activity as behaviour at workplace. The significant contribution of physical activity level of active and public transport distort the overall data on occupational domain, thus not providing an accurate insight of physical activity among free living adults in a homogenous physical, social and working environment.

In overall, the design and conduct of this study is intended to provide a fundamental understanding for future interventional studies on physical activity in the workplace settings.

Chapter 3: Objectives of the Study.

3.1: Primary objective with null hypotheses

The primary objective of this study is to investigate whether there are linear associations between correlates of occupational physical activity (age in years, BMI in kg/m² and working experience in months) with:

- i) percentage of accumulated time spent in accelerometer-determined sedentary level of occupational physical activity
(% of accumulated sedentary time = $\frac{\text{sedentary time (minutes)}}{\text{total working time (minutes)}} \times 100\%$),
- ii) reported physical intensity exertion (MET value) of the individual nurses, and
- iii) accumulated footsteps during the monitored working period.

The level of sedentary activity is followed at the value of ≤ 1.5 METs. Therefore the null hypotheses of the primary objectives are:

- 3.1.1: There is no statistically significant linear association between age and accumulated percentage of sedentary-intensity occupational physical activity.
- 3.1.2: There is no statistically significant linear association between age and MET values reported.
- 3.1.3: There is no statistically significant linear association between age and step count recorded.
- 3.1.4: There is no statistically significant linear association between BMI and accumulated percentage of sedentary-intensity occupational physical activity.
- 3.1.5: There is no statistically significant linear association between BMI and MET values reported.

- 3.1.6: There is no statistically significant linear association between BMI and step count recorded.
- 3.1.7: There is no statistically significant linear association between working experience and accumulated percentage of sedentary-intensity occupational physical activity
- 3.1.8: There is no statistically significant linear association between working experience and MET values reported.
- 3.1.9: There is no statistically significant linear association between working experience and step count recorded.

3.2 Secondary objectives and null hypotheses

The first part of the secondary objectives assesses prevalence (expressed as percentage) of nurses who met the minimum recommended bout of physical activity during the monitored period. The contribution of physical activity in meeting the recommendation is defined by accelerometer data that records bouts of physical activity ≥ 3.0 METs sustained beyond 10 minutes. This is in compliance with the ACSM-AHA 2007 recommendation which has identified activities at this range is of moderate to very vigorous intensities. A nurse who performs at least 1 recorded bout of activity above the threshold of moderate intensity and adequate duration (≥ 10 minutes) would be categorized as to have met the minimum recommended dose. The second part of the objectives is to compare the means between the two groups' (met versus did not meet the recommendation) profiles which are age, working experience, BMI, percentage of accumulated sedentary time mean, reported MET values, and recorded step count. The null hypotheses for the second part of the objectives would therefore be:

“There is no statistically significant difference in mean of both groups in their:

3.2.1: Age

3.2.2: BMI

3.2.3: Working experience

3.2.4: Percentage of accumulated time performing sedentary intensity activities

3.2.5: MET values reported

3.2.6: Step count recorded”.

Chapter 4: Materials and Methods.

4.1 Approval from Ethics Committee

The study title is “Occupational Physical Activity Measurement among Nurses in University Malaya Medical Centre” (UMMC) and has received approval from Medical Ethics Committee of UMMC on 21st July 2010 (Appendix A). Prior to this, the study has also received approval from both the Hospital Director and the Head of Department for Nursing Services (Appendix B).

4.2: Study design

This is a cross-sectional correlational study observing physical activity behaviour among free-living subjects. The study design allowed participants to resume their physical activity habitus. The participants were monitored for a single working period without intervention and follow up.

4.3: Sample size

An a priori sample size for multiple regression statistics was calculated with the alpha level of 0.05. With medium effect size ($f^2=0.35$) and desired statistical power level of 0.8, a 3-predictor model (age, BMI and working experience) would require a sample size of at least 36 subjects.

4.4: Participants and recruitment.

This study was conducted on 37 healthy nurses in the 12U ward of University Malaya Medical Centre (UMMC). The participants were recruited by voluntary participation through convenient sampling. Words of mouth with handouts explaining the study were circulated. Nurses were approached and briefed before or after their working shifts, either in small groups or individually. All nurses are female and consented to join the study. A copy of the consent form and information handout is available in the Appendix section (Appendix C: Information Handout, Appendix D: Informed Consent). The study was conducted in Bahasa Melayu or English as preferred by the participants. Data collected were recorded in English.

4.5: Exclusion criteria.

All consenting nurses of the grade U29 are eligible to enrol in this study. However, only full-time nurses were enrolled with the lower age limit of 18 years old. In addition, only those involved in the rotational shift system were included. To ensure that the enrolled participants perform their activity habitually, only nurses who have worked for more than 3 months were considered eligible. Individuals meeting any of the following criteria were considered ineligible:

1. Musculoskeletal conditions that affect mobility as this might affect their physical activity habitus. They were however, allowed to participate in the study if they have completely recover from the illness.
2. Nurses who are pregnant during the course of this study; as pregnancy itself imposes higher physiologic demands that may affect physical activity level and accelerometer reading. However, they were welcomed to join the study after delivery and return to work.

4.6: Premise of the study

The study was conducted in one of the wards of UMMC. The 900-bed medical centre is a teaching hospital situated at the border of two large cities (Kuala Lumpur and Petaling Jaya), also serves as tertiary referral centre in the country. The ward 12U was recommended by the senior nursing officers as it is perceived to be among the busiest ward in the hospital. Located at the 12th floor of the main building, the ward receives admissions and manages patients under the discipline of general internal medicine, dermatology and gastroenterology.

Equipped with 60 beds, the ward is divided into 2 wings and managed by a senior nursing officer assisted by 2 nursing managers (sisters) and staffed by 47 nurses. There are 8 beds dedicated for the care of the more ill patients, capable of handling intensive clinical monitoring and advanced respiratory support. However the ward does not provide other intensive clinical services. Handling both female and male patients, the ward sees >90% bed occupancy daily. It handles daily admission of 6 to 14 patients, arranging discharge procedures for 6 to 10 patients.

Nurses of this ward are provided with 3 nursing stations and, a pantry and a changing room. The ward has a day care unit that serves chemotherapy treatment for certain cancer patients. This unit however is staffed by a separate nursing team.

4.7: Period of the study

The study was conducted from April to July 2011. Only morning shift duties were monitored. Morning shift was chosen as the period of observation as it is the busiest shift compared to other shifts. In addition, morning shifts provide ample after-work leisure time during which the nurses may participate in physical activities advocated. Studying physical activity habitus during morning shifts provided data on prevalence of nurses who performed minimum bout of advocated physical activities. The nurses were monitored for the entire shift, targeting a total monitored time of 420 minutes. Only monitored durations of not less than 400 minutes (95% of the official morning shift duration) was accepted. The maximum monitoring time was set to 440 minutes; in excess of 5% of the official working time.

Participants were instructed to wear the monitoring device at the beginning of their shift (7.00 am) until it ended (2.00 pm) or when they have finished their afternoon pass-over session with the next nursing team. Throughout the study, they were asked to perform duties as with other days, with precaution to avoid immersion of the device in water. Prior to this, participants were required to advise the date of preference for the study to be conducted. The morning shift usually starts with 15 to 30 minutes pass-over discussions with the preceding team. Discussions are usually done standing or at slow pace walking. They then begin their duties by recording vital signs parameters, serving medications, occasionally helps patients with their breakfast or toileting needs. Then they resume with morning clinical round with a group of clinicians. Clinical orders were carried out and procedures were performed as instructed. Their job requires walking with occasional need to ambulate patients on trolley or wheelchairs. At times, they were involved in carrying light to heavy objects, ranging from patients' clinical notes, boxes of medical supplies and even help to transfer patients. When writing their clinical reports, the nurses usually stand at the nursing station. The morning shifts officially finishes by 2pm. However the nurses

usually stay for another 15 to 30 minutes where they would hand over the clinical duties to the evening shift team. The morning shifts were usually handled by 7 to 8 nurses.

The percentage of time the device being worn through the study was limited to >95.0%. If it was indicated that participants took the device off for more than 5% of the monitored time, the data recorded will not be accepted and the monitoring is to be repeated at another time. At anytime of the study, the participants were allowed to withdraw at their request.

4.8: Equipments

4.8.1: Weight.

Weight was measured using a calibrated electronic scale available (Seca, model 767-1321004; Birmingham, UK) in the ward. All weights were measured in kilogram and recorded to the next decimal point (0.1kg). Participants were asked to stand on the scale wearing light clothing.

4.8.2: Height.

Height was measured using a calibrated and wall mounted stadiometer (Seca, model 767-1321004; Birmingham, UK) available in the ward. All heights were measured in metre and recorded to two decimal points (0.01m). Participants were asked to stand on the stadiometer without using any footwear with head held erect and their back and heels of their feet against the wall. Calculation of height and weight were done to yield the BMI value, expressed as kg/m^2 to the nearest decimal point.

4.8.3: Monitoring Device (Accelerometer).

4.8.3.1 Requirement: The research objectives demand variables assessed being quantified objectively and continuously. For this, the monitoring device should have such abilities yet affordable and non-obtrusive to habitual activities. Accuracy of the device is a crucial consideration as the participants perform tasks of various intensities. Accelerometry technology has undergone revolutionary changes and being the device of choice among many researchers. It allows continuous data capture and quantifies activity intensity, frequency and duration. It is a small electromechanical device capable of detecting segmental acceleration across space. Data are processed with complex computerized-algorithm which yield intensity, duration, frequency and even estimates energy expenditure. As there are various make and model, an valid and good utility device is a priority.

4.8.3.2 Recommended practice: Ward and colleagues (2005) proposed a best practice recommendation for the use of accelerometer in the field of physical activity research.(Ward, Evenson, Vaughn, Rodgers, & Troiano, 2005) Conforming to the recommendation, the chosen accelerometer should be of reliable validity with local technical support, comfortably worn without affecting the habitual activities, and resilient to harsh environment (example: water splash, impact) as well as adequate non-volatile memory capacity with enduring battery life. The site of wear should optimally be representative of the body movement. To date there is no standard on the position of wear. Different manufacturers may advise differing sites. In addition, the device should allow calibration determined by the researcher. Calibrations that need to be set are activity intensity and epoch length. This is because raw accelerometer data are recorded as incomprehensible ‘clicks’ or ‘counts’. After passing through the algorithmic computation, raw data are converted into meaningful readings. For example, accelerometer ‘counts’ of less than 100 clicks per minute are conventionally accepted as sedentary, implying intensity of ≤ 1.5 METs. Epoch length determines how frequent should the accelerometer collects data. Current studies involving free-living adults has set the epoch length to 60 seconds.(Edwardson & Grolley, 2010) This mean that data is stored after every minute, smoothing and averaging its reading for that particular minute.

4.8.3.4 Monitor of choice: In keeping with the recommendations above, a SenseWear Pro3 Armband (SWA) accelerometer was selected as the equipment for this study. The device (serial number 7458491) is the property of the Tuanku Mizan Military Hospital, Kuala Lumpur. The patented device is manufactured by BodyMedia Inc (Pittsburgh, USA). Figure 4.1 below shows the device photographs:

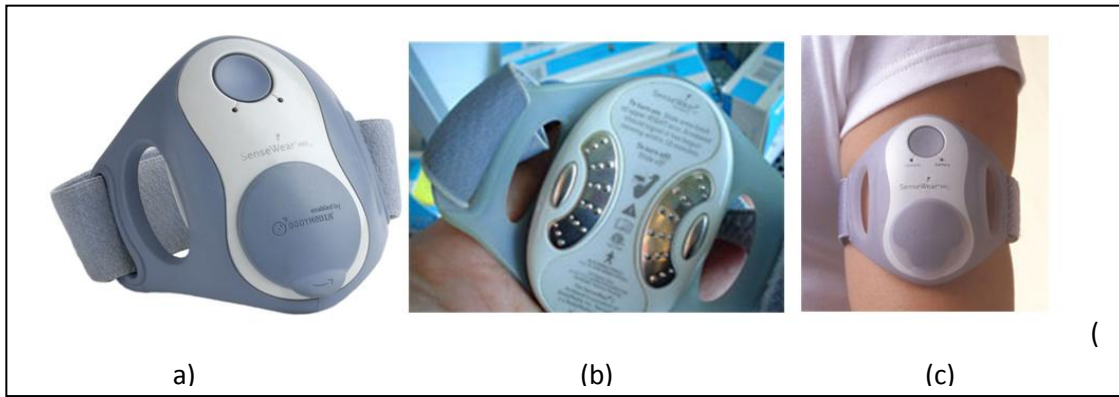


Figure 4.1: The SenseWear Pro3 Armband accelerometer by BodyMedia used in the study. (a) Front view of the accelerometer. (b) Contact-to-skin surface. (c) An example of the accelerometer being worn in the right triceps area of posterior arm.

The device shown in Figure 4.1 is a bi-axial accelerometer that detects motion in two planes. This motion can be mapped from forces exerted by the moving body segment in relation to gravity. This device has multisensory channels that detect environmental and bodily heat.(Andre et al., 2006) All inputs are channelled into predictive algorithmic computation, providing a relatively accurate estimation of energy expenditure and intensity of activity.

Weighing only 80g, SWA is worn on the posterior surface of right upper arm over the belly of triceps muscle and held in place with an adjustable Velcro strap. This position was standardized as the midpoint between acromion and olecranon process for all participants. During the monitored session data were stored in the hardware and downloaded at the conclusion of each session. It has the memory capacity to record minute-to-minute data continuously for 14 days. SenseWear Professional Software version 6.1.0.1528 (copyright of BodyMedia) is a programme that provides predictive algorithms for the capture data. The software is licensed under the Tuanku Mizan Military Hospital and provided with SWA allowing computation and quantification of output variables such as total energy expenditure, physical activity energy expenditure, physical activity duration and intensity (METs), on-body duration and step count. A report can be generated in portable data format or exported into spreadsheet.

4.8.3.5 Instrument's validity: In a validation study, SWA is found to have strong correlation in estimating energy expenditure at rest ($r=0.76$, $p<0.01$) when compared to the criterion standard of indirect calorimetry.(Fruin & Rankin, 2004) When compared to the gold standard method of measuring energy expenditure (doubly labelled water), SWA showed very strong correlation ($r=0.8$, $p<0.01$). (St-Onge, Mignault, Allison, & Rabasa-Lhoret, 2007) Another recent study by Johannsen and colleagues (2010) showed similar results.(Johannsen et al., 2010) They compared SWA with doubly labelled water as the criterion standard for energy expenditure in free-living environment among 30 healthy adults for 14 consecutive days. Error rate of SWA is 8.1%, with intraclass correlation showed strong agreement (ICC=0.85, 95%CI=0.92-0.76). When compared to other physical activity monitor devices, SWA showed favourable comparison in terms of price, laboratory and free-living error, wearability and other support features.(Andre & Wolf, 2007)

4.8.3.6 Preset calibrations: The device is calibrated to record the 'count' volume that translates into intensity of:

- i) ≤ 1.5 METs as sedentary,
- ii) 1.6 to 2.9 METs as light-intensity, and
- iii) >3.0 METs as moderate to vigorous intensity.

The epoch length is set at 60 seconds. Calibration was done using the SenseWear Professional v6.1.0.1528 software supplied by the manufacturer. During calibration, participant's age, weight, height as well as hand dominance and smoking status were keyed in.

Accelerometer use will also confer another advantage as any activity that scores MET value of ≤ 1.5 will be detected as sedentary, thus detection of sedentary activity will not only be limited to sitting. This will overcome the limitation of other similar studies on sedentary behaviour that have used only recalled sitting time as the surrogate activity.

4.9: Variables recorded

Demographic variables recorded are age (in years), weight in kilogram (kg), height in metre (m), calculated BMI (kg/m^2) and working experience (in month).

Accelerometer data collected and analyzed are monitoring duration (in minutes), duration of device being worn on-body (percentage), accumulated time spent in sedentary level intensity (percentage), reported MET value of work (METs) and step count. Table 4.1 summarizes data to be collected and mathematical formula for the variables.

Table 4.1: Demographic and accelerometer data collected and analyzed in the study.

<i>Demography and Variables</i>	<i>Unit of measurement</i>	<i>Mathematical formula</i>
Demographic		
Age	years	Date of study – Birth date
Weight	kg	-
Height	m	-
BMI	kg/m^2	$(\text{Weight})/(\text{Height})^2$
Working experience	months	Date of study – Date starting work
Accelerometer		
Total duration	min	-
Accumulated sedentary time	%	$\frac{(\text{Sedentary time})}{\text{Total duration}} \times 100\%$
METs value	METs	-
Step count	steps/min	-

4.10: Study Protocol

Consented participant's biodata and demography is recorded including measurements of height and weight. Data are keyed in with the preset calibration. At the appointed date, participant is met in the ward and instructed to wear the armband. After confirming correct device wear, comfort and function, participant resumes normal duties. Researcher's contact information was provided should the participant need to withdraw or for troubleshooting purposes. Participant returns the accelerometer when her shift is over. Data are downloaded into the SenseWear Professional software and checked for error prior to acceptance. Rejected reading is when recorded duration is <400 minutes or if the device was taken off from the body for > 5% of the monitored period. This would require a repeat of accelerometer wear in another working day. Accepted readings were cleaned prior to appropriate statistical analysis. Figure 4.2 below depicts the process of data collection.

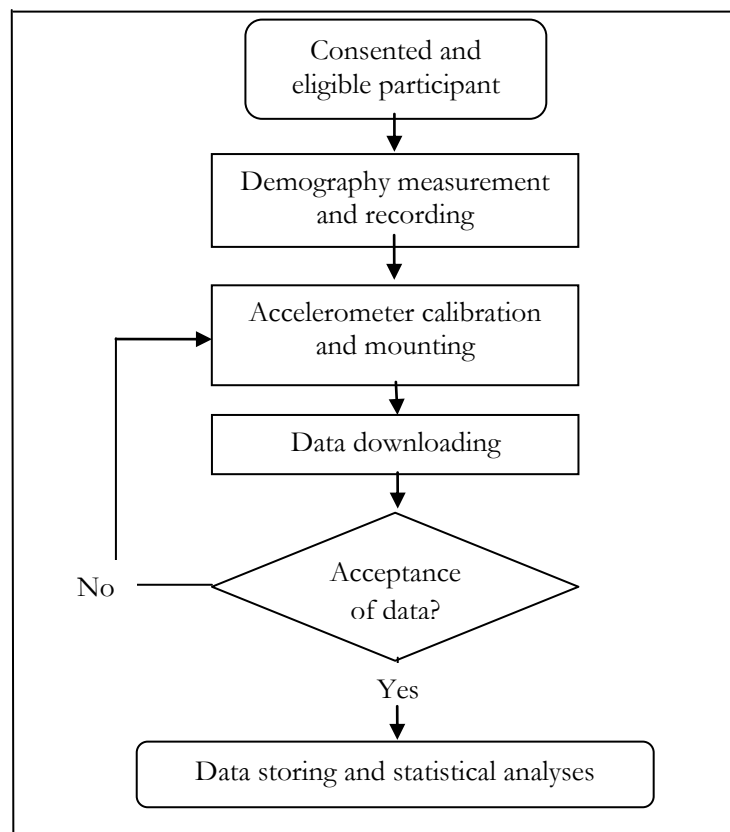


Figure 4.2: Study protocol flow chart.

4.11: Statistical method

Analyses were performed using Statistical Package for Social Sciences (SPSS) for Windows version 18.0 registered under University of Malaya (IBM SPSS Incorporated; Illinois, USA). Statistical significance is accepted at $p \leq 0.05$. All analyses were done in consultation with the Clinical Epidemiology Unit of Clinical Research Centre for Ministry of Health, Kuala Lumpur. Demography characteristics of subjects are presented by their means (M) with standard deviation (SD) and 95% confidence interval (95%CI). Data are analyzed separately for each objective.

4.11.1: Statistical Tests for Primary Objectives:

Simple linear regression analysis was used to measure correlation and to model linear association between dependant (percentage of accumulated sedentary time, MET values reported, step count) and independent variables (age, BMI, working experience). To model linear relationship between each dependant variables after adjustment of the independent variables, multiple linear regression analysis using “Enter” method is selected. Prior to this, exploratory analysis was conducted to detect possible outliers and tested for normal distribution. Outlier is set as a value at 3 standard deviations away from the mean and automatically removed from analyses. Test for normal distribution is by histogram and PP-plots. In the presence of multicollinearity of the independent variables (Pearson’s correlation ≥ 0.8 , and variance inflation factor > 5.0 in the collinearity statistic), one of the collinear variable is omitted from subsequent multiple regression analysis with a satisfactory explanation. Exploratory analysis of linear regression model are calculated for Pearson’s correlation (r), proportion of variance by the statistical model (R square), statistical significance (p -value) and 95% confidence interval. Adjusted R square is also used to analyse the proportion of variance in the multiple linear regression model.

4.11.2: Statistical tests for secondary objectives:

To test the secondary objectives, participants are grouped into those who met the minimum recommended bout of physical activity and those who did not. This was determined by transforming readings from minute-to-minute MET values into bar histogram. Figure 4.1 illustrates an example of a histogram but only for the first 75 minutes. Missing data (arrow, A) are period when the accelerometer being taken off from the body for readjustment of the sleeve. The reading is not omitted to avoid data being misinterpreted as uninterrupted physical activity. Arrow B is MET values that exceed or touched the 3.0 METs line. The counted bar is 20 and interpreted as 20 minutes of moderate intensity bouts. This subject has met more than minimum recommended bout of physical activity (≥ 3.0 METs) and grouped as 'met'. The bar labelled C is still calculated in the active bout as this would reflect the minute-to-minute variations in physical activity of daily living.(Edwardson & Grolley, 2010)

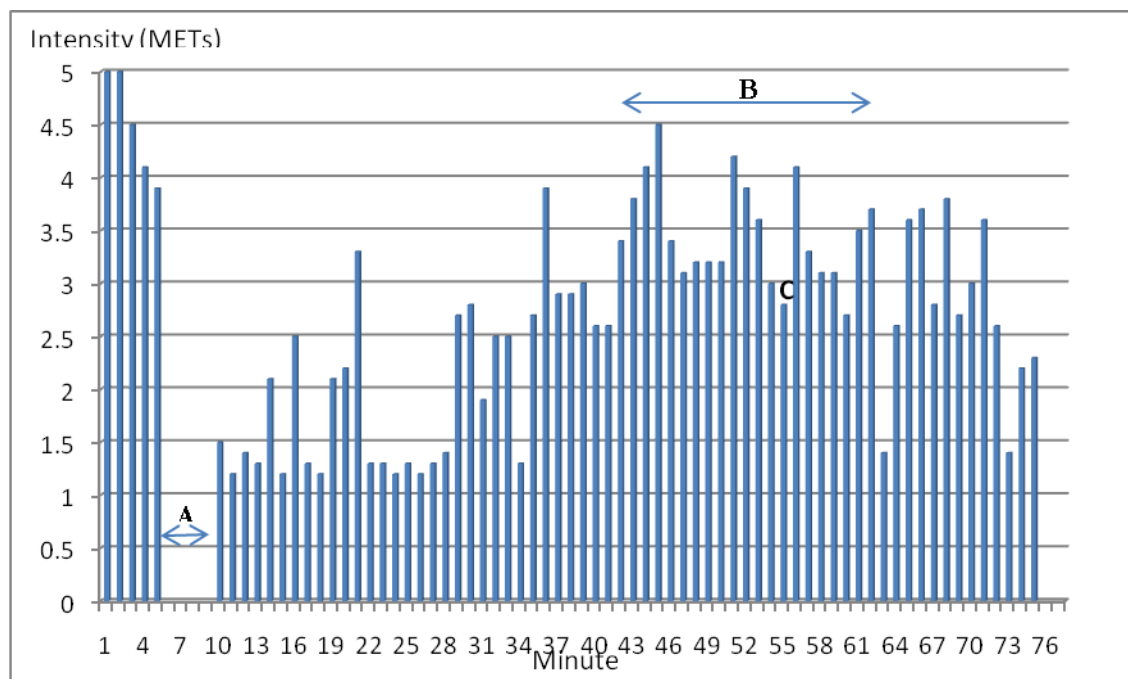


Figure 4.3: An example of histogram representative of minute-to-minute intensity recorded (METs) for the first 75 minutes. A) Missing data when the accelerometer was taken off from the body. B) Bout of physical activity that met the recommendation (moderate intensity for at least 10 minutes). C) A single reading in of light-intensity exertion in between moderate-intensity minutes.

Prevalence of nurses in both groups is presented as descriptive statistic of their demography plus accelerometry-output means, standard deviations, and 95% confidence interval. Distribution of both groups were checked for normality prior to respective test with Shapiro-Wilk test ($p>0.05$). Further analyses are resumed with independent sample t-test when there is no statistical significance between mean of monitored duration between the two groups. This very important analysis is to ensure that participants in both groups were observed without significant discrepancy in the monitoring time.

The research questions are concerned with the comparison of means between the groups' variables (age, BMI, working experience, percentage of accumulated sedentary time, reported MET, and recorded step count). These are tested using 2-tailed independent sample t-test; after Shapiro-Wilk test for normal distribution revealed normal distribution ($p>0.05$) between the groups. Equal variances are assumed when parameters tested by Levene's tests showed no significant variance ($p>0.05$). The results are reported with mean difference, standard deviation of the difference, degree of freedom and significance level.

4.11.3: Post-hoc Analysis:

Post-hoc analysis is conducted for statistical power of the multiple linear regression models since one of the predictor variables was removed from the analysis. The removal is due to very strong multicollinearity between the predictors in the equation. After calculation of observed R Square with only 2 predictors in the new statistical model, observed statistical power is determined.

Chapter 5: Results

5.1: Description of participants

The study was conducted in April to July 2011 where 37 participants or 79% of the nurses in ward 12U participated voluntarily. From a population of 47 nurses, 7 were excluded for being pregnant, 1 was not in the eligible rank (U32). The remaining 2 did not consent for participation. There was no adverse event. However measurements had to be repeated in 2 nurses as one had to withdraw during the monitored time due to family emergency while another requested a repeat as she was assigned to office and clerical duties on the designated date.

Table 5.1: Summary of demographic characteristics of participants (n=37)

<i>Demography</i>	<i>Mean (95% CI)</i>	<i>SD</i>	<i>Range</i>
Age (years)	27.0 (25.6-28.4)	4.22	21.8 – 38.6
BMI (kg/m ²)	21.5 (20.4 – 22.5)	3.08	17.2– 30.1
Working experience (months)	59 (43 – 74)	46	5 – 199
Duration of monitoring (min)	428 (424 - 432)	12	401 – 440
Percentage of device on-body (%)	99.6 (99.3 – 99.9)	0.84	96.9 – 100

Table 5.1 depicts the demographic summary of the participating nurses. The mean age of the nurses is 27.0 years old (95%CI: 25.6-28.4). The youngest is 21.8 years old and the oldest is 38.6 years old (SD: 4.22). Their mean BMI is 21.5kg/m² (95%CI: 20.4-22.5). The nurses' BMI range from 17.2kg/m² to 30.1kg/m² (SD: 3.08). Mean working experience in the ward is 58.9 months (95%CI: 43.3-74.0), ranging from 5 to 199 months (SD: 46.0). All nurses were monitored from a period of 403 to 440 minutes (SD: 12.43). Their mean monitoring time was 428 minutes (95%CI: 424-432).

All nurses wore the accelerometer comfortably. However 19 nurses had to detach the device temporarily in the initial part of the study as they experience slight tightness over their folded sleeve. This was rectified immediately by unfolding their sleeves to accommodate the device comfortably. The mean percentage of the device being worn is 99.6% (95%CI 99.3-99.9) of the monitored period. This ranges from 96.9% to 100% (SD 0.83).

Table 5.2: Summary of SenseWear Pro3 Armband accelerometer measurements

<i>(n=37)</i>	<i>Mean (95% CI)</i>	<i>SD</i>	<i>Range</i>
Accumulated sedentary time (min)	135 (117-154)	56	29 – 226
Percentage of sedentary time (%)	31.5 (27.2 – 36.0)	13.1	7.0 – 53.2
Reported intensity of OPA (METs)	2.2 (2.2 – 2.3)	0.3	1.7 – 2.8
Step count (steps)	7556 (6940 – 8179)	1859	3661 – 11,669

Table 5.2 summarizes data captured from the accelerometer. Sedentary activity was calibrated as value of <1.6 METs. Mean of accumulated sedentary time is 135 minutes (95%CI: 117-154) and ranges from 29 to 226 minutes (SD: 56). When converted into percentage of the overall monitored period, the mean percentage is 31.5% (95%CI: 27.2-36). This percentage ranges from as little as 7% to as many as 53.2% (SD: 13.1). None of the reported intensity of occupational physical activity reached moderate intensity level. The mean reported intensity is 2.2 METs (95%CI: 2.2-2.3). This value ranges from 1.7 METs to 2.8 METs (SD: 0.3). Utilizing the pedometry feature of the SWA, the mean step count is 7556 steps (95%CI: 6940-8179). During the monitored periods, nurses performed step count from as little as 3661 steps to as high as 11 669 steps (SD: 1859).

5.2: Results of primary objectives

The primary objective of the study is to report the associations between correlates of occupational physical activity (age, BMI and working experience) with the characteristics of the nursing profession (accumulated time spent in sedentary level of physical activity, measured intensity of the occupation and amount of walk performed at work). Data presented below satisfied requirements for simple and multiple linear regression models.

5.2.1: Associations between accumulated sedentary time with age, BMI and working experience

In the simple linear regression analyses, no outlier was detected with data normally distributed and independent. Table 5.3 summarizes the relationship between percentage of accumulated time in sedentary intensity activities with participants' age, BMI and working experience.

Table 5.3: Correlation and association between percentage of accumulated sedentary time with participants' age, BMI and working experience (n=37)

<i>Predictor variable (unit)</i>	<i>Pearson's correlation (p-value)</i>	<i>Simple linear regression</i>			
		<i>R square</i>	<i>β</i>	<i>(95% CI)</i>	<i>p-value</i>
Age (years)	0.51 (<0.01)	0.259	1.6	0.7 – 2.5	<0.01
BMI (kg/m ²)	0.43 (<0.01)	0.181	1.8	0.5 – 3.1	<0.01
Working experience (month)	0.48 (<0.01)	0.234	0.14	0.1 – 0.2	<0.01

From Table 5.3, there is a moderately strong correlation ($r=0.51$, $p<0.01$) with positive linear association between age of nurses and their percentage of accumulated time performing sedentary activities. The regression indicated that age explained 25.9% of the variance in sedentary time ($F(1,36)=12.25$, $p<0.01$). As the nurses get older by one year, their time sedentary time will increase by 1.6% ($p<0.01$, 95%CI: 0.7-2.5). Figure 5.1 illustrates the relationship between sedentary time and age of participants.

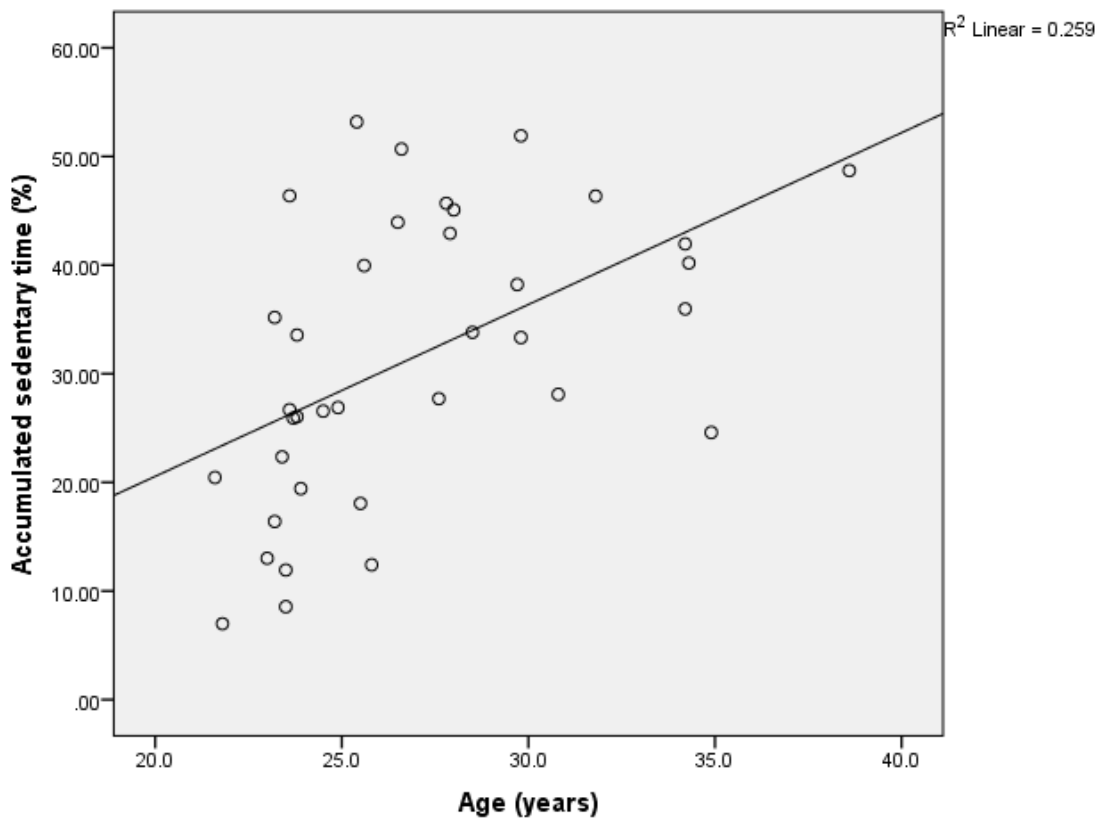


Figure 5.1: Relationship with regression line between accumulated sedentary time and age of participants.

Similarly, there is a moderately strong correlation ($r=0.43$, $p<0.01$) with positive linear association between BMI of nurses and their sedentary time. The result of regression indicated that BMI explained 18.1% of the variance in sedentary time ($F(1,36)=8.97$, $p<0.01$). As the nurses' BMI increase by $1\text{kg}/\text{m}^2$, their sedentary time is found to increase by 1.8% ($p<0.01$, 95%CI: 0.5-3.1). Figure 5.2 illustrates the relationship between sedentary time and BMI of participants.

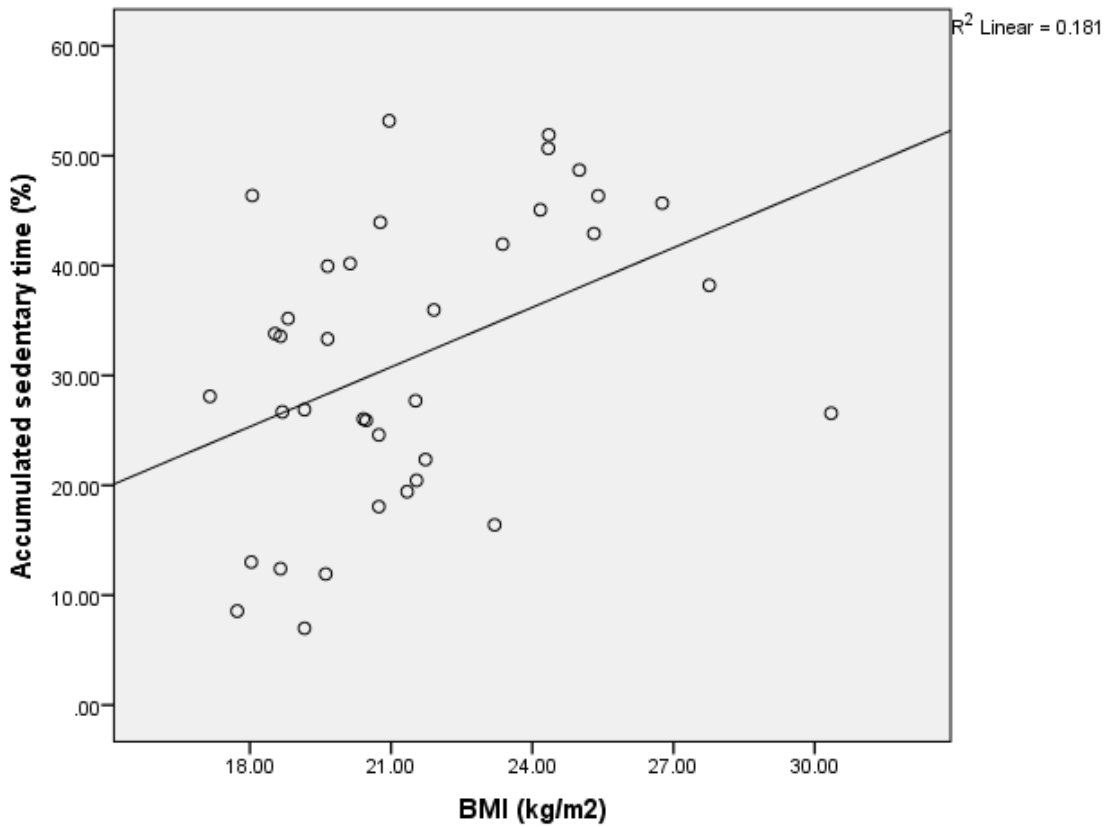


Figure 5.2: Relationship with regression line between accumulated sedentary time and BMI of participants.

Analyzing relationship between sedentary time and working experience, there is a moderately strong correlation ($r=0.48$, $p<0.01$) with positive linear association between the two variables. The result of regression indicated that working experience explained 23.4% of the variance seen in sedentary time ($F(1,36)=7.7$, $p<0.01$). As the nurses' experience increase by 1 year, their percentage of time spent in performing sedentary occupational physical activity will increase by $(12 \text{ months} \times 0.14) = 1.7\%$ ($p<0.01$, 95%CI: 0.05-0.22; both values are for monthly increment). Figure 5.3 illustrates the relationship between sedentary time and working experience of participants.

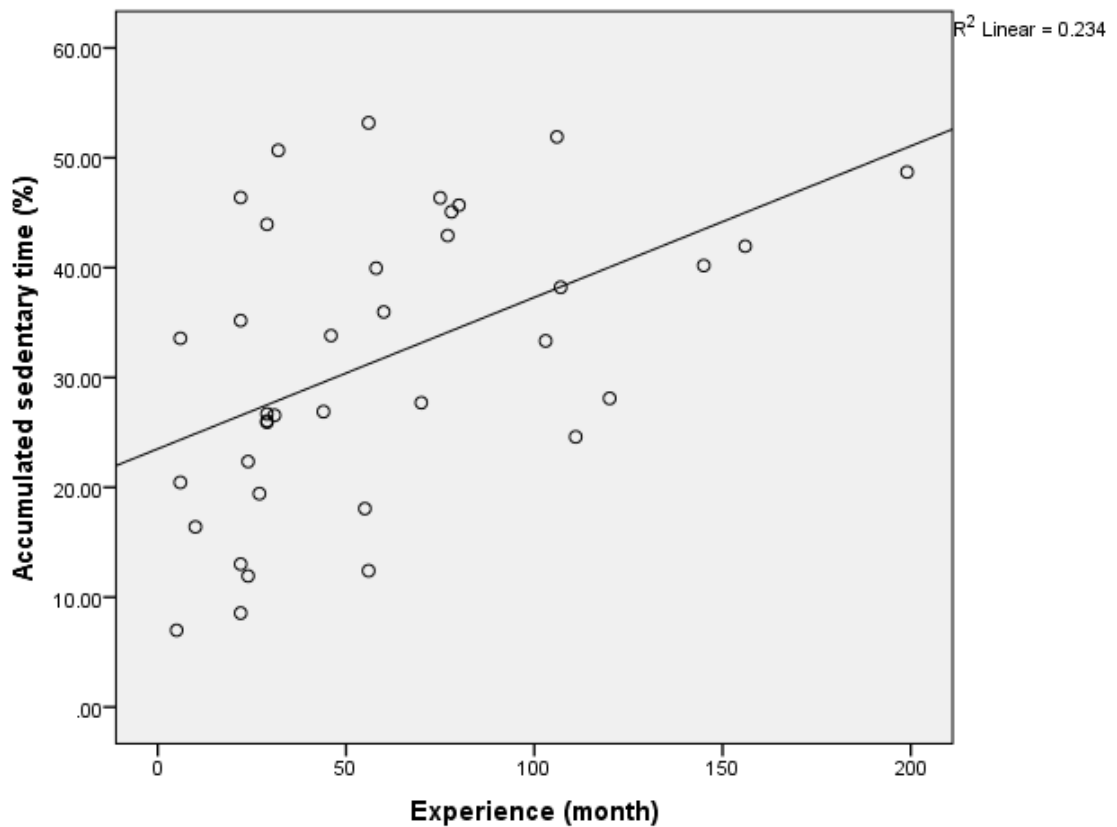


Figure 5.3: Relationship with regression line between accumulated sedentary time and working experience of participants

Prior to multiple linear regression analysis of participants' sedentary time adjusted to the predictors, Pearson's correlation analysis revealed very strong and significant correlation between age and working experience ($r=0.91$, $p<0.01$). An explanation is that as age increased by one year, experience is gained by 12 month. The explanation for the

collinearity between the two variables is accepted. Coefficient analysis of the model showed p-values of age ($p=0.31$) and experience ($p=0.83$) are not significant, with collinearity diagnostics (variance inflation factor = 5.8) indicating multicollinearity. Working experience was thus removed from all subsequent multiple linear regression analyses. Subsequent collinearity diagnostics indicated no multicollinearity between the two predictors. Table 5.4 summarizes the multiple regression analyses for correlates of occupational sedentary time, with working experience omitted from the statistical model.

Table 5.4: Multiple regression analysis for accumulated sedentary time among the studied population ($n=37$)

<i>Variables (unit)</i>	<i>Multiple linear regression</i>			
	<i>Adjusted-β</i>	<i>(95% CI)</i>	<i>t-statistic</i>	<i>p-value</i>
Age (years)	0.42	0.4-2.2	2.9	<0.01
BMI (kg/m^2)	0.3	0.1-2.5	2.0	0.05

The results of the regression indicated that the two predictors explain 29.9% of the variance in sedentary time ($R^2=0.34$, $F(2,35)=8.69$, $p<0.01$). It was found that percentage of accumulated sedentary time has significant linear relationship to both age ($p<0.01$) and BMI ($p=0.05$). Increase in age by 1 year would increase the sedentary time by 0.42% (95%CI: 0.4-2.2) while increase in BMI by 1 kg/m^2 would increase the sedentary time by 0.3% (95%CI: 0.1-2.5).

5.2.2: Associations between intensity of occupational physical activity with age, BMI and experience.

In the simple linear regression analyses, no outlier was detected with data normally distributed and independent. Table 5.5 summarizes the relationships of reported intensity of occupational activity in the morning shifts.

Table 5.5: Correlation and association between reported intensity of work (METs) with participants' age, BMI and working experience (n=37)

<i>Variables</i>	<i>Pearson's correlation (p-value)</i>	<i>Simple linear regression</i>			
		<i>R square</i>	β	<i>(95% CI)</i>	<i>p-value</i>
Age (years)	-0.51 (<0.01)	0.261	-0.003	-0.05 to -0.01	<0.01
BMI (kg/m ²)	-0.59 (<0.01)	0.343	-0.1	-0.1-0	<0.01
Working experience (month)	-0.47 (<0.01)	0.217	-0.003	-0.005 to -0.001	<0.01

From Table 5.5, it is shown that there is a moderately strong negative correlation ($r = -0.51$, $p < 0.01$) with negative linear association between age of nurses and their reported intensity or MET values of work. The result of regression indicated that age explains 26.1% of the variance in intensity of occupation ($F(1,36) = 12.37$, $p < 0.01$). As the nurses get older by one year, their reported intensity decline by 0.03 MET ($p < 0.01$, 95%CI: -0.05 to -0.01). Figure 5.4 illustrates the relationship between sedentary time and age of participants.

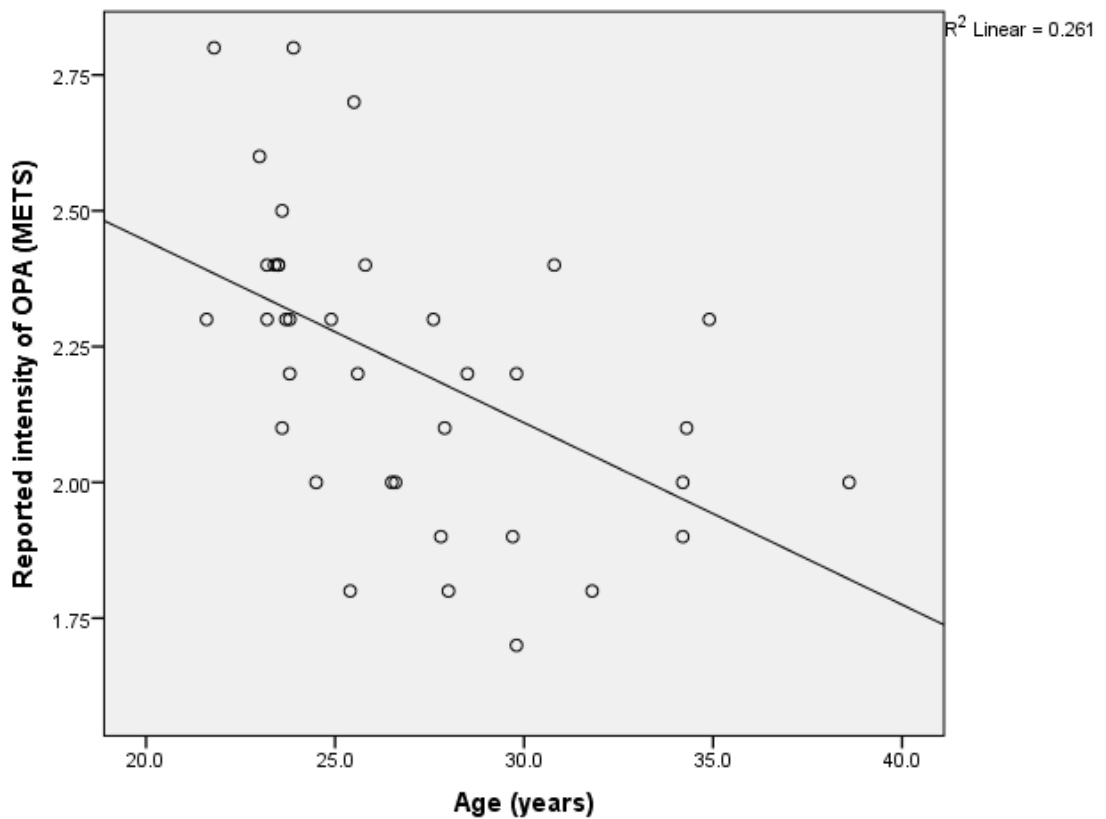


Figure 5.4: Relationship with regression line between reported intensity of occupation and age of participants.

Similarly there is a moderately strong correlation ($r = -0.59$, $p < 0.01$) with negative linear association between participants' BMI and reported overall intensity of work. The result of regression indicated that BMI explained 34.3% of the variance in the reported METs ($F(1,36) = 18.25$, $p < 0.01$). As the nurses gain BMI by 1 kg/m^2 , their reported intensity will decline by 0.1 MET ($p < 0.01$, 95%CI: -0.1 -0). Figure 5.5 illustrates the relationship between participants' reported OPA intensity with BMI.

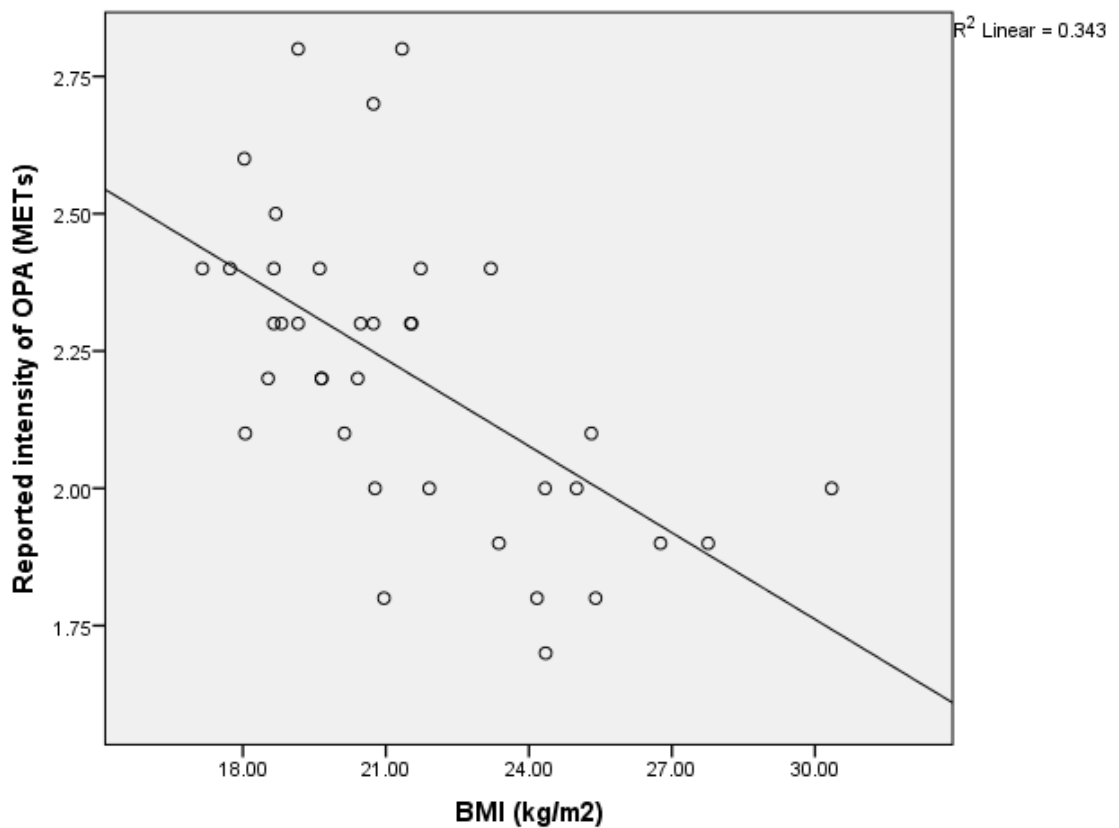


Figure 5.5: Relationship with regression line between reported intensity of occupation and BMI of participants.

There is a moderately strong correlation($r=-0.47$, $p<0.01$) with negative linear relationship between the two variables. The result of regression indicated that working experience explained 21.7% of the variance of the MET values ($F(1,36)=9.69$, $p<0.01$). As the nurses gain experience by 1 year, their reported intensity will decline by 0.003×12 months $=0.04$ MET ($p<0.01$, 95%CI: -0.005 to -0.001; for month-unit). Figure 5.6 illustrates the relationship between participants' reported intensity of work with working experience.

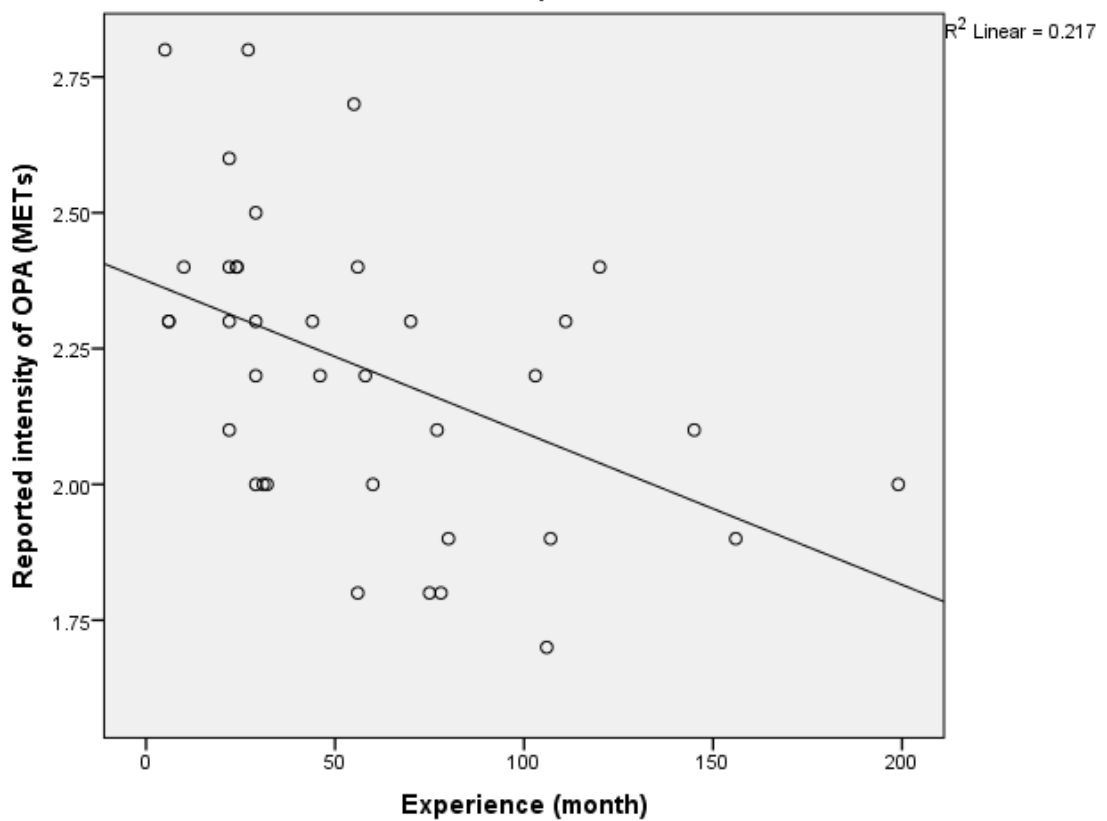


Figure 5.6: Relationship with regression line between reported intensity of occupation and working experience of participants.

The results of multiple linear regression indicated that the two predictors (age and BMI) explain 43.1% of the variance in the reported intensity (R square=0.463, $F(2,36)=14.65$, $p<0.01$). It is found that reported intensity has significant negative linear relationship to both age ($p<0.01$) and BMI ($p<0.01$). Increase in age by 1 year would decrease the OPA intensity by 0.4 MET (95%CI: -0.04 to -0.01) while increase in BMI by 1 kg/m^2 would decrease MET value by 0.5 MET (95%CI: -0.07 to -0.02). The summary of the adjusted linear regression analyses is presented in Table 5.6 below.

Table 5.6: Multiple regression analysis for reported intensity of occupational physical activity (MET) among the studied population (n=37)

<i>Variables (unit)</i>	<i>Multiple linear regression</i>			
	<i>Adjusted-β</i>	<i>(95% CI)</i>	<i>t-statistic</i>	<i>p-value</i>
Age (years)	-0.4	-0.04 to -0.01	-2.8	<0.01
BMI (kg/m^2)	-0.5	-0.07 to -0.02	-3.6	<0.01

5.2.3: Associations between amount of walk at work with age, BMI and experience.

In the simple linear regression analyses, no outlier was detected with data normally distributed and independent. Table 5.7 summarizes the result of relationship between amounts of walk performed by the nurses during their work in the morning shift with its correlates.

Table 5.7: Correlation and association walk amount (steps) with participants' age, BMI and working experience (n=37)

<i>Dependant Variable (unit)</i>	<i>Pearson's correlation (p-value)</i>	<i>Simple linear regression</i>			
		<i>R square</i>	<i>B</i>	<i>(95% CI)</i>	<i>p</i>
Age (years)	-0.40 (0.01)	0.163	-178	40-316	0.01
BMI (kg/m ²)	-0.28 (0.44)	0.001	-17	190-224	0.87
Working experience (month)	-0.48 (0.02)	0.114	-14	1-27	0.04

BMI is not a statistically significant correlate of walk amount at work ($r = -0.28$, $p = 0.44$). There is no linear relationship between the two ($p = 0.87$). On the other hand, Table 5.7 shows there is a moderately strong correlation between age of nurses and their walk amount ($r = -0.4$, $p = 0.01$) with positive linear relationship. The result of regression indicated that age explains 16.3% of the variance in walk amount ($F(1,36) = 6.83$, $p = 0.01$). As the nurses get older by one year, their walk amount will decline by 178 steps ($p = 0.01$, 95%CI: 40-316). Figure 5.7 illustrates the relationship between walk amount and age of participants.

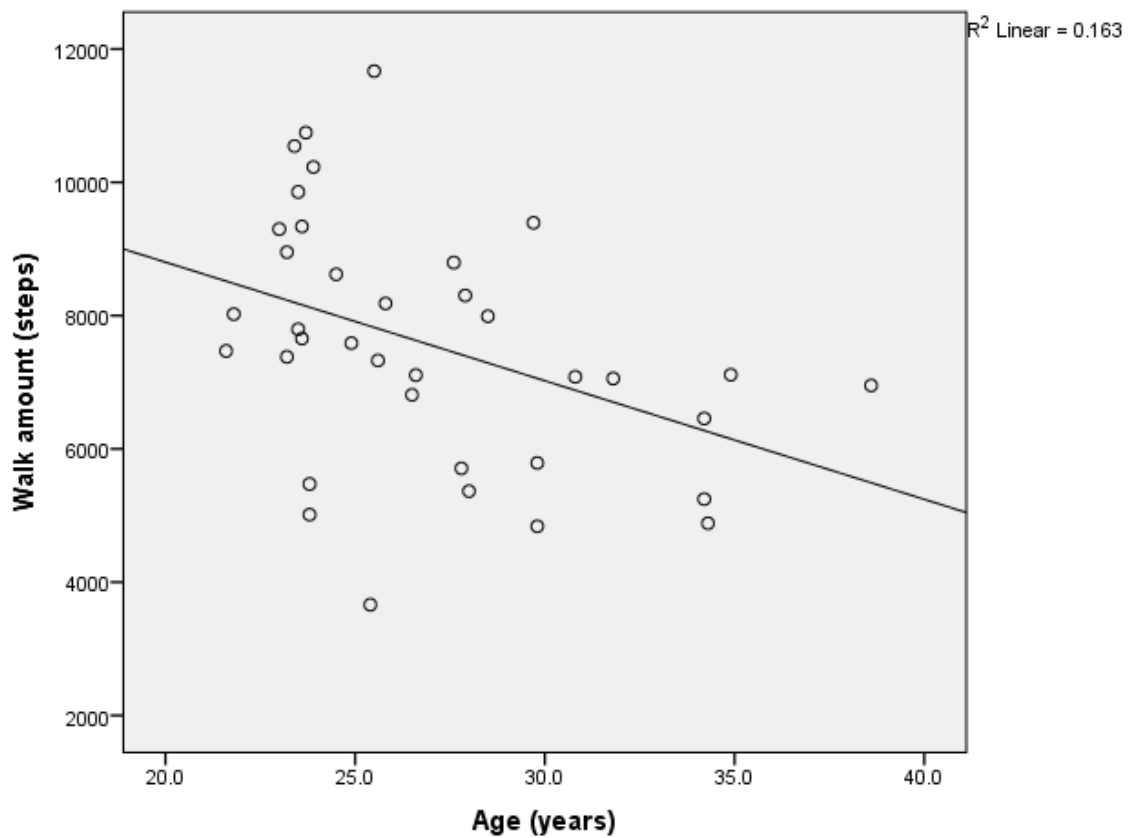


Figure 5.7: Relationship with regression line between walk amount and age

Analyzing relationship between walk amount and working experience, there is a weak correlation between the two ($r = -0.34$, $p = 0.02$) with negative linear relationship. The result of regression indicated that working experience explains 11.4% of the variance in walk amount ($F(1,36) = 4.52$, $p = 0.04$). As the nurses' experience increase by 1 year, their amount of work at workplace is reduced by 12 months $\times 14 = 168$ steps ($p = 0.04$, 95%CI: 1-27; values are for month-unit). Figure 5.8 illustrates the relationship between walk amount and working experience of participants.

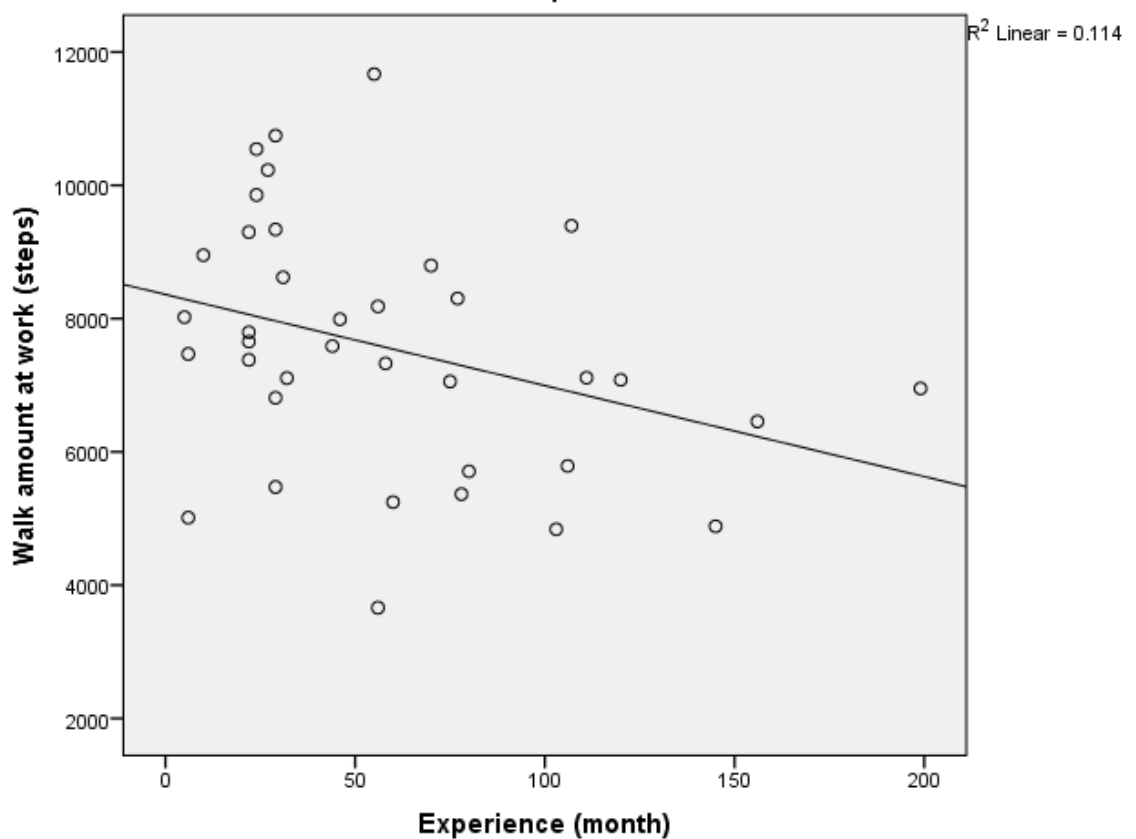


Figure 5.8: Relationship with regression line between walk amount and working experience of participants

The results of the multiple linear regression indicated that the two predictors explain 12.5% of the variance in walk amount (R square=0.174, F(2,36)=3.58, p0.04). It was found that the amount of walk has significant linear relationship to age (p=0.01) but not BMI (p=0.51). Increase in age by 1 year decrease the amount of walk by 192 steps (95%CI: 135-266) after adjustment to BMI. Table 5.8 below summarizes the linear regression analysis for amount of walk performed by the participants in morning shifts after adjustment.

Table 5.8: Factors associated with amount of walk (steps) among the studied population (n=37)

<i>Variables (unit)</i>	<i>Multiple linear regression</i>			
	β	(95% CI)	<i>t-statistic</i>	<i>p-value</i>
Age (years)	-192	-266 to -135	-2.67	0.01
BMI (kg/m ²)	65	46-339	0.66	0.51

5.3: Results of secondary objectives.

The secondary objectives are divided into 2 parts. The first part examines prevalence of nurses who met the minimum recommended bout of physical activity (moderate-intensity activity for 10 minutes). Data on minute-to-minute reported intensity of workplace activities were examined. Nurses who met at least one bout of the recommended activity were grouped together as 'met' group and compared to the 'did not meet' group. The prevalence is then reported as percentage of the total population.

The second part examines the differences between the two groups, provided that both were monitored for the same length of time. The difference in means of the groups' demography and SWA output were tested using independent sample t-test with p-value for significance accepted at $p \leq 0.05$. Both groups' variables were tested with Shapiro-Wilk test and are normally distributed ($p > 0.05$). Using Levene's test, equality of variances for all parameters tested were assumed ($p > 0.05$).

To summarize both objectives, analysed data are presented in Table 5.9 below. The table summarizes the prevalence, mean values of variables, and differences in demography and occupational physical activity characteristics of both groups.

Table 5.9: The prevalence of participants who met the recommended minimum bout of physical activity with mean values for demography and occupational physical activity characteristics; and difference between the groups

<i>Variables (unit)</i>	<i>Met' group (n=21, 56.8%)</i>		<i>Did not meet' group (n=16, 43.2%)</i>		<i>Independent sample t-test</i>		
	<i>Mean (95% CI)</i>	<i>SD</i>	<i>Mean (95%CI)</i>	<i>SD</i>	<i>Mean difference (95%CI)</i>	<i>t(df)</i>	<i>p</i>
<u>Demography:</u>							
Age (years)	25.4 (23.8-26.9)	3.45	29.1 (26.8-31.4)	4.28	3.8 (1.2-6.3)	2.97	<0.01
BMI (kg/m ²)	20.1 (19.1-21.1)	2.19	23.2 (21.4-24.9)	3.27	3.06 (1.24-4.89)	3.40	<0.01
Experience (months)	40 (26-54)	30.89	83 (56-111)	51.70	43 (16-71)	3.17	<0.01
Monitored time (min)	430 (425-436)	12.88	424 (419-431)	11.43	6 (3-14)	1.37	0.18
<u>SWA readings:</u>							
Sedentary time (%)	25.4 (19.6-31.2)	12.72	39.7 (21.4-44.2)	8.59	14.3 (6.74-21.76)	3.67	<0.01
Job intensity (METs)	2.4 (2.3-2.5)	0.24	2.0 (1.9-2.1)	0.18	0.4 (0.2-0.5)	4.85	<0.01
Step count (steps)	8945 (7852-9138)	1413	6332 (5441-7222)	1672	2163 (1133-3193)	4.26	<0.01

5.3.1: Prevalence of nurses who met the minimum recommended bout.

Of the 37 nurses who participated in this study, 21 nurses or 56.6% of the studied participants met the recommendation on minimum bout of physical activity. The mean age of nurses in this group is 25.4 years old (SD: 3.45, 95%CI: 23.8-26.9). Their mean BMI is 20.1 kg/m² (SD: 2.19, 95%CI: 19.1-21.1) and the mean working experience of 40 months (SD: 30.89, 95%CI: 26-54). On the average, these nurses spent 25.4% of their occupational time performing tasks of sedentary intensity or ≤1.5METs (SD: 12.72, 95%CI: 19.6-31.2). The overall intensity of occupational physical activity in performing the morning shift clinical duties reported by accelerometry, when evaluated as the mean of the group is 2.4METs (SD: 0.24, 95%CI: 2.3-2.5). During this shift, the nurses on average performed 8945 recorded step (SD: 1413, 95%CI: 7852-9138).

The remaining 16 participants or 43.2% did not achieve the recommended minimum bout of physical activity. When examined, their mean age is 29.1 years old (SD: 4.28, 95%CI: 26.8-31.4) with the mean BMI of 23.2kg/m² (SD: 3.27, 95%CI: 21.4-24.9). The mean working experience of this group is 83 months (SD: 51.7, 95%CI: 56-111). These nurses spent the mean of 39.7% of their working time performing tasks of only sedentary intensity (SD: 8.59, 95%CI: 21.4-44.2). Mean value of the reported overall intensity when performing nursing duties in the morning shift is 2.0 METs (SD: 0.18, 95%CI: 1.9-2.1). The nurses in this group only performed 6332 walking steps at work (SD: 1672, 95%CI: 5441-7222).

5.3.2: Difference in characteristics of the two groups.

There is no significant difference ($p=0.18$) in the duration of monitoring with the SWA device between the group who met (M: 430 mins, SD: 12.88, 95%CI: 425-436) and did not meet (M: 424 mins, SD: 11.43, 95%CI: 419-431) the recommended minimum bout of physical activity (mean difference = 6 mins, 95%CI: 3-14, $t(35)1.37$, $p=0.18$).

The nurses who met the said recommendation are significantly younger by an average of 3.8 years when compared to those who did not (95%CI: 1.2-6.3, $t(35)=2.97$, $p<0.01$). These nurses also have significantly lower BMI by 3.06kg/m² (95%CI: 1.24-4.89), $t(35)=3.40$, $p<0.05$). Compared to the other group, the nurses are of significantly lesser working experience by 43 months (95%CI: 16-71, $t(35)=3.40$, $p<0.01$). They also committed lesser time in sedentary level of activity by 14.3% of the total working time (95%CI: 6.74-21.76, $t(35)3.67$, $p<0.01$). Although the mean reported intensity of physical activity for both groups are within the light-intensity spectrum, the nurses who met the recommendation performed their duties at a significantly higher intensity by 0.4 METs (95%CI: 0.2-0.5, $t(35)=4.85$, $p<0.01$). Also, the recorded amount of walk is significantly higher in this group by 2163 steps (95%CI: 1133-3193, $t(35)4.26$, $p<0.01$).

Despite the significant difference in demographic as well as accelerometry output means between the groups, the study does not evaluate productivity and staff-efficiency of the population. None of the measured and examined parameters are indices of their occupational performance. Therefore the results of this study should be confined only to understanding the correlates of physical activity at workplace.

5.4: Summary of results.

Sedentary time has moderately strong correlation with age, BMI and working experience; with significant positive linear association.

The averaged intensity of the performed nursing task has moderately strong correlation with age, BMI and working experience; with significant negative linear association.

The amount of walk at workplace has moderately strong correlations with only age but a weak correlate with working experience. The relationship of both age and working experience are negative linear associations. Occupational walk amount however, has no significant correlation with BMI.

Nurses who met the recommendation for minimum bout of physical activity at workplace are significantly younger, with lower BMI but with less working experience. They are also significantly less sedentary, perform their duties at higher intensity of physical activity and performed higher amount of walk when at work.

5.5: Post hoc analysis for statistical power.

A priori sample size for 36 subjects was determined for medium effect size ($f^2=0.35$) with statistical power of 0.8 and alpha value of 0.05. The study analyzed 3 multiple linear regression models for participants', each for sedentary time, intensity of occupation and walk amount. The predictors examined are age, BMI and working experience. However, strong collinearity exists between age and working experience. Multiple linear regression analysis was then resumed with only two predictors (age and BMI). Post hoc analyses for each dependant variables are summarized in the Table 5.10 below. This study is adequately powered to infer relationship between sedentary time and reported intensity of occupational activity with the predictors. However, the two models are adequately powered, while regression model for walk amount has the post hoc power of 0.67. In summary the study have been adequately powered for analysis and draw the appropriate interpretation.

Table 5.10: Post hoc analyses for observed statistical power in each dependent variable

<i>Dependant variables</i>	<i>N</i>	<i>a</i>	<i>Number of predictor</i>	<i>Observed R square</i>	<i>Post hoc statistical power</i>
Sedentary time	37	0.05	2	0.34	0.97
Intensity reported	37	0.05	2	0.46	0.99
Walk amount	37	0.05	2	0.17	0.67

Chapter 6: Discussions and Conclusion

6.1: Discussions.

In this study, physical activities of 37 nurses were examined in their occupational habitus. Coming from various demographic backgrounds, they were studied for their physical activity components in a similar working environment. Monitoring was conducted during the morning shift rotation on the assumption that this is the busiest working period. Furthermore, the after-hours following this shift provides longer waking-hour opportunities to commit into physical activity of recommended dose. The conduct of these activities may be in the domains of leisure-time, domestic, and transportation. Most energy expenditure in the waking hour is expended in the occupational domain. (Vaz & Bharathi, 2004) The primary analyses concerns on the correlates of occupational physical activity. The potential contribution of work-related activities towards achieving the minimum bout of physical activity at adequate dose is examined in the secondary analyses of data. All nurses have been adequately studied for >95% of their working time without interruption from the device or any adverse circumstances.

The study has been designed and conducted with the intention to overcome some weaknesses identified in the examined literature. In meeting the requirements of the study, objective assessment using accelerometry technology was utilized for its prevalent use by other researchers as well as the comparable validity with gold standard criterion. (Petee, Storti, Ainsworth, & Kriska, 2009) Accelerometry with its unobtrusive size and supportive features have allowed monitoring within a wide range of intensity of physical activity from sedentary to very vigorous performed by free-living subjects. Data captured by the accelerometry have satisfied the pre-requisites for the study. Therefore the measurements and quantifications were objective unlike what can be yielded from recall questionnaires or direct observation. These have allowed analyses and interpretation within acceptable

accuracy, exclusive to the occupational domain. In addition, data on sedentary behaviour is not relied solely upon conventional surrogate of sedentary activity like sitting; instead it encompasses all sedentary activity potentially recorded by the device. Minute-to-minute monitoring is made possible with the robustly accurate technology.

Although the negative correlation between physical activity and age has been recognized, the study on age (and thus working experience) as a correlate in occupational domain has remained relatively unexplored. In this work, physical activity variables in workplace setting are found to be correlated with age. Occupational activity is studied from the spectrum of sedentary time, summated intensity of physical exertion demanded by the participants' occupation, and walk amount – which is representative of mode of occupational activity.

Along with other studies that have shown decrease in physical activity with age, this study has found similar correlation. In a relatively similar working environment and demands, sedentary time is found to increase with participants' age. Measured as the percentage of accumulated sedentary time recorded over total wear time, age appears to be a moderate correlate of sedentarism. The direct relationship is also seen in other domains of physical activity like leisure-time excursion. A phone survey (n=296 971 in 2004 alone) for leisure time physical activity in United States showed reduction by 0.6% of inactivity prevalence from the period of 1994 to 2004.(Kruger, Ham, & Kohl, 2005) The trend is also seen across all ages. Despite this reduction however, physical inactivity is reported to be in higher proportion in the older age group. The group that records greatest physical inactivity prevalence appears to be the elderly population. In fact, in another study conducted on the adult population of Geneva, the odds ratio of being sedentary increases with every decade of life.(Bernstein, Costanza, & Morabia, 2001) Similar changes are seen in both male and female gender. In a cross-sectional analysis of a national survey, decline in leisure-time

physical activity is greatest in the teen age years than in adulthood.(Caspersen, Pereira, & Curran, 2000) Although the decline continues into adulthood and elder years, it is less precipitate than in teen age and among the female gender. Figure 5.4 illustrates the relationship between sedentary time and age of participants. Although the linear regression model shows statistically significant association, it is not clinically significant as MET values are conventionally reported to one decimal point. Rounding the figures to one decimal point will yield zero value. However it is to note that this association is clinically meaningful with 5-year increase in age.

No known studies have tried to examine the causal relationship between age and sedentarism or inactivity. Sallis (2000) have put forth a biological explanation for this association by reflecting upon studies with animal model.(Sallis, 2000) Decline in physical activity with age is similarly seen in various species in the animal kingdom. One plausible biological hypothesis is the effect of naturally occurring dopamine on specific brain areas related to the motivation for locomotion. However, although physical activity or inactivity appears to be strongly influenced by biologic factors, non-biologic determinants and correlates such as psychological, environmental and social also have their role. This study has further extended the evidence, confirming the hypothesis that physical inactivity is correlated and linearly associated with age. Given the same physical, occupational and social environment, sedentary time increases with age. In the secondary analysis, significantly higher sedentary time is reported among nurses of significantly higher age group. These are the nurses who did not meet the minimum recommended dose of physical activity during the monitored period.

The causal relationship between the age and working experience to occupational physical activity is beyond the scope of this study. However, analyses on other attributes of occupational physical activity have provided new insights on this correlate. This study has

found that the reported intensity of physical exertion demanded by the occupation (MET values) declines with the age of the participants. This result must be interpreted with caution. The construct and conduct of the study have allowed minute-to-minute reporting of the MET values. Relationship of reported MET values with age (and experience) does not indicate a decline in working capacity with increasing age. Although it is established that exercise and working capacity declines with this correlate, such studies are usually modelled to simulate specific physical demand of the job or conducted in controlled environment. For example in a study evaluating the decline of physical work capacity of Swedish firemen with age, data was compared to cardiopulmonary response reported in an earlier simulated fire fighting condition.(Kilbom, 1980) Similar relationship between physical working capacities with age is also seen among population of higher physical fitness like athletes. In longitudinal study among professional swimmers, the authors have followed up the cohort for 12 years and reported age related decline in performance.(Donato et al., 2003) The authors have further reported that the decline is more pronounced in women, and more in the aerobic capacity of the athletes.

As high variation of physical activities performed, this study did not examine working capacity in specific occupational task. Instead it analyzed the averaged intensity of occupation among the nurses throughout their morning shift. Final analysis reveals that overall intensity of nursing occupation in morning shifts falls into the light-intensity category. This is seen in all nurses even among the group of nurses who met the minimum recommendation. However it is worthy to note that certain activities in the nursing occupation are of moderate intensity, potentially contributing towards the daily goal. For example, walking either with or without load at the speed of more than 2.5 miles per hour has the MET values of 3.0 to 4.8 METs, while pushing wheelchair expends 4.8 METs.("Updated online Compendium of Physical Activity: item 11 - Occupation," 2011; Ainsworth et al., 2000) In this study, it is found that intensity of various activities

demanded by the same social, physical and working environment declines with age and experience of the employees. Although the linear regression model showed statistical significance, it is not clinically significant as METs are recorded to one decimal point. Rounding the change of METs after 1 year will yield 0. However the model is clinically significant after 5 year gain in experience, equivalent to 60 months.

The age related decline in the attributes of physical activity at work as observed in this paper does not represent similar decline in productivity or job efficiency. This study merely examined the components of physical activity and not performance indicator of the nurses. Although there is a decrease in cognitive abilities of older workers, their longer experience and higher level of job knowledge may outweighs such decline.(Skirbekk, 2003) Salthouse (1984) has earlier approved this view, demonstrating older typewriters work just as effectively as their younger counterparts despite at lower speed.(Salthouse, 1984) He concluded that this is due to more efficient work strategies employed by the more senior typewriters. In addition, Hunter and colleagues (1986) have proposed that working experience is more important than age in predicting individual efficiency.(Hunter, Schmidt, & Outerbridge, 1986) Job efficiency is strongly correlated with experience and especially with jobs that require complex tasks or demands.(Avolio, Waldman & McDaniel, 1990) In view of all these findings, it is possible that the decline in physical activity indicators among the more senior nurses may come from better efficiency of work. However this remains speculative and is not explored in this research.

Although no specific task was examined, amount of walk has been focussed in this research. Walking is a form of physical activity performed with the primary intention of locomotion. The repetitive muscular contraction of the lower limbs in the gait cycle requires energy expenditure beyond resting value. Energy expenditure of walking is proportional to body mass and increases with speed, slope, terrains and arm movement.

(Bobbert, 1960; Schoenfield, Keren, Shirmoni, Birnfield, & Sohar, 1980) The MET values of walking at various speed fall from light-intensity to vigorous intensity activity.(Ainsworth et al., 2000) Walking as a form of exercise is another recommended physical activity to maintain health. (Ainsworth & Basset, 2004) A value of 10,000 steps per day is recommended to the general public as studies have documented health benefit of attaining to similar level. Lower step count at 7500 to 9999 steps per day reflects 'somewhat active' while 5000 to 7499 steps per day represents 'low active' category. Some (n=3) of the nurses have already achieved beyond the recommendation, while the majority of participants scored step count in the 'somewhat active' and 'low active' category. However, a significant correlation describing the association between age and step count at work has been identified. There is an age-related decline in walking amount among the studied population. Similar relationship has been reported in the literature.(Ling, 2008; Tudor-Locke & Basset, 2004) Further analysis in this study has discovered that for those nurses who met the minimum recommended bout of physical activity, they fall in the 'somewhat active' category. In contrast, nurses who did not meet the recommended dose are in the 'low active category'. This study has thus extended the evidence that the decline in pedometer count with age among female gender is partly explainable by the similar decline seen in occupational setting. Given the same physical, social and working environment, age is found to be negatively associated with amount of occupational walking.

Age and working experience are correlated and negatively associated with occupational physical activity. This study has confirmed the inverse relationships between age and experience with occupational physical activity. These findings are perhaps explainable by increase in sedentary time, reduce intensity of physical exertion demanded by the occupation, and reduce amount of walk at workplace.

Body mass index (BMI) is expressed as the ratio of weight (in kg) to the square of the height (in metre). BMI is an acceptable indicator of body composition and has association with health. The cut off point for healthy BMI for the Asian population is between 17.5 to 23.0kg/m².(WHO Expert Consultation, 2004) BMI of higher values signify overweight to morbidly obese categories and are strong correlates of ill health.(Schofield, Quigley, & Brown, 2009) However the causal relationship between certain clinical conditions like diabetes and BMI is unclear. This index is an easily identifiable demography in many epidemiologic studies. This study has examined BMI as a correlate of physical activity in occupational setting.

As a correlate of a sedentary behaviour, overweight/obesity has been repeatedly documented to have negative association with physical activity.(Baumann et al., 2002) This inverse relationship is also seen in occupational domain. Studies on sedentary time have typically analyzed data from self-reported occupational sitting as a surrogate of sedentary behaviour. Cross sectional studies have shown positive association between occupational sitting and BMI.(van Uffelen et al., 2010) This study has also found a similar relationship. The use of accelerometer as an objective assessment tool has allowed continuous assessment for activities not associated with sitting but equally sedentary. Standing still for example is a form of sedentary activity that might have been underreported by studies looking at sitting time only. (Ainsworth et al., 2000) Calibrated to record activity count of ≤ 1.5 METs as of sedentary intensity, all form of such activities were recorded and analyzed. Therefore this study has objectively demonstrated that sedentary time is positively associated with the participants' BMI. In the secondary analysis, it is found that participants who met the minimum recommended bout of activity have the mean BMI within the healthy range. Significant BMI discrepancy that fell within the unhealthy categories is noted within the group who did not meet the dose of recommended physical activity. They were found to spend much higher time performing occupational tasks at

sedentary level of intensity. Given the same environment, BMI is positively correlated with sedentary time thus nurses who are more sedentary at workplace tend to be of higher BMI.

The study of BMI in relation to performance has always focussed on the overweight to obese categories. In a cross-sectional study, obesity is associated with significantly higher number of work-loss days.(Pronk et al., 2004) It utilized mail-based questionnaires and designed to categorize BMI and work performance. Work performance is measured as absenteeism and productivity; no direct analysis between BMI with work performance is made. In another cross-sectional study, the researchers have found a marginal association between level of activity and BMI.(Barberio & McLaren, 2011) The effect is small however and only seen among women. Women in occupations of medium activity level have lower BMI than women with occupations of low physical activity. They too utilized subjective measures; concluding that BMI does not appear to be a correlate of physical activity at work. Similar finding is reported in a study among the Spanish workforce.(Gutierrez-Fissaz et al., 2002) Various occupations were classified according to their level of physical activity. No significant difference in BMI means were noted between varying levels of activities. In contrast, this study has found a moderately strong correlation between BMI and reported intensity of physical exertion demanded by an occupation. The contrasting outcome can be attributed to measurement tool and population observed. Results of this study are based from continuous objective measure within the same environment. In the studied environment environment, BMI is found to be a moderately strong negative correlate with intensity of occupational activities.

A landmark study among healthy adults has established a moderately strong correlation between BMI and daily step count.(Tudor-Locke et al., 2001) In this study the researchers mounted pedometer on participants for 21 consecutive days. Recorded daily step count was regressed with BMI of participants. Step count of less than approximately

5000 steps/day is observed within the obese subjects. Step counts of >9000 steps/day are seen within participants of healthy BMI. In contrast to the Tudor-Locke's finding, this study has found that BMI is not a significant correlate of walk amount in workplace. This is even after taking the nurses' age into consideration. Comparing between two groups of nurses however, significant difference between the means of step count is observed. The nurses who met the recommended activity are not only of the healthy BMI category, their walk amount achieved the 'somewhat active' level. The other group are nurses have their BMI mean within the 'overweight' category and mean step count within the 'low active' level. Difference between the two studies is explainable by the domains which they examined. Tudor-Locke and colleague (2001) have monitored their participants for almost all the time of the day, through all domains.(Tudor-Locke et al.,2001) This study has only examined the participants within the occupational domain. Therefore the recommended steps/day amount is achievable within work setting, and this is regardless of the BMI.

6.2: Implications of the study.

Nurses have defined themselves as role model of health promotion to the patients and community that they served.(Connolly, Gulanick, Keough, & Holm, 2005; Rush, Kee, & Rice, 2005) The perceived expectation requires them to be a source of health information and model practitioner of healthy lifestyle. As the nursing profession typically associated with night shift work, they are at risk to develop coronary heart disease, breast cancer, colorectal cancer and metabolic syndrome.(Kawachi, Colditz, & Stampfer, 1995; Schernhammer et al., 2003) In addition, night shift itself might be attributed to deviant health-related behaviours adopted by the workers.(Boggild & Knutsson, 1999) In Malaysia, the prevalence of hospital nurses (24.3%) who suffers metabolic syndrome is higher than the general population (16.5%).(Shafei, Awang, & Mohamad, 2011) Unfortunately the prevalence of physical inactivity among these nurses is very high (91.1%).(Awang, Shafei, & Mohamad, 2011) It is possible that just like any other person nurses too might struggle to find time and motivation to exercise. Although the value of physical activity to health is commonly understood, the nurses might find limited time at work for preventive counselling to their patients.

The positive effects of being engaged in regular physical activity to health have been well documented in literature. Interestingly enough, many findings were derived from studies on female nurses, notably the Nurses' Health Study series. Apart from positive effect to personal health, the nurses' personal practise is strongly associated with the role-model concept perceived. In a study by McDowell and colleagues (1997), nurses who regularly engage in regular exercise were more likely to promote physical activity as part of patients' treatment.(McDowell, Mckenna, & Naylor, 1997) In addition, nurses who are contemplating to increase their personal physical activity level is four times more likely to promote similar actions to their patients than other colleagues.(McDowell, Mckenna, &

Naylor, 1998) Similar study has not been able to determine whether systematic barrier presence among the nurses in promoting physical activity to patients. Personal health belief on benefits of physical activity and self-efficiency has been implicated as the major determinant to adopt regular physical activity among female nurses.(Kaewthummanukul, Brown, Weaver, & Thomas, 2005) More importantly perceived barriers to exercise and perceived social support were identified as significant predictors of exercise participation among female Thai nurses. Another encouraging finding was that psychological and physical demands of the nursing profession were not statistically significant predictor of exercise. From this study, it seems that nursing profession does not present as barrier to active living and social support in the workplace setting may increase the nurses' participation in regular exercise. Physical activity should ideally be advocated and facilitated among the nurses and other healthcare providers. Nurses who believe in health promotion and embrace healthy behaviours are more likely to be positive role model and teach healthy behaviours to their patients.(Esposito & Fitzpatrick, 2011) Their unique role and position in the community, as well as adverse health challenges imposed by their profession should make this subset population as the target for interventions to increase physical activity and reduction in sedentarism. It is to note that most of the studies examined and presented have been conducted in the overall or leisure-time domains of physical activity. This study on the other hand has demonstrated that active living specifically within the occupational setting is feasible.

Occupation is a domain where physical activity is conducted purposefully or incidentally. The domain provides potential opportunity advocating healthy lifestyle practices. Understanding this potential, various worksite wellness programs aiming for cardiovascular prevention are readily available.(Armstrong et al., 2008; Carnethon et al., 2009) Interventional studies set in occupational setting have documented positive outcome to the health of the employees without affecting the productivity with only minimal impact

on the overall operational cost.(Dunn et al., 1999; Gilson et al., 2009; Schwarz & Hasson, 2011). An increased in operational cost despite the evident benefits may itself present as a barrier towards promoting WHPP among employers.

Recent Scandinavian research has found that there is no significant effect of WHPP on productivity.(Schwarz & Hasson, 2011) In this study, almost 180 subjects from 6 different healthcare settings were randomly intervened with mandatory weekly physical education programmes. The intervention took away 6.25% (or 2.5 hours of 40 working hours) of weekly working hours. At baseline and after 12 months of the intervention, employees were asked to response to self-rated productivity and workplace production levels as well as absenteeism/presenteeism analyses. It was found that despite lesser working hours per week, intervened group reported no significant difference in productivity or absenteeism. This study further strengthens the evidence that WHPP does not negatively affect job productivity even with lesser working hours. However it does not report any alteration in biologic parameters of participants. Also, no long term outcome on physical activity level before and after the intervention was sought.

Dunn et al (1999) have earlier overcome the weakness of the Scandinavian group. They measured the efficiency of two different types of intervention programs designed to increase physical activity and cardiorespiratory health among participants in a workplace setting for 24 months.(Dunn et al.,1999) A lifestyle physical activity intervention was prescribed for the first group, and a gymnasium-based physical activity intervention was prescribed for the second group. In the lifestyle intervention group, participants received motivational support and were taught how to incorporate more physical activity into their daily schedules during weekly small group meetings. These participants also received a quarterly newsletter and monthly calendar of activities and were encouraged to monitor their physical activities. They had on average added 19 to 20 minutes more of walking as

the activity of choice in their daily routine. Participants in the gymnasium-based intervention group received an exercise program to follow, quarterly newsletter, monthly calendar of activities, and they exercised at a fitness facility. Participants recorded their physical activities using a computer program. Both the lifestyle and structured activity groups had significant and comparable improvements in physical activity and cardiorespiratory fitness from baseline to 24 months. There were significant and comparable reductions in systolic blood pressure and diastolic blood pressure. Neither group significantly changed their weight, but each group had significantly reduced their percentage of body fat. The average cost expended per month for every employee is much cheaper in the lifestyle group (USD17.15) as compared to the structured group (USD49.31). The findings of the two researches have confirmed that promoting physical activity at workplace is beneficial to overall health, non-burdening to the organization and feasible in the working environment.

As health behaviours, both physical activity and inactivity have correlates that influence a person's level of participation. The study for correlates of physical activity not only provides plausible explanation on participation, but also serves to provide evidence for broader initiatives in health promotion policy and practice.(Baumann et al., 2002) Within the preset agenda, this study has further strengthened the evidence that age, working experience and BMI are significant correlates of occupational physical activity. Age is negatively correlated with intensity of which the physical demands of the job performed and walk amount at work. In addition, it is also a moderately strong positive correlate for sedentary time. Future intervention and policies on occupational physical activity setting should take into account of these associations. Emphasis should be for interventional program in the ageing employee. However, promotion on physical activity and reducing sedentary behaviour at work place should encompass all age. Similar approach is recommended when BMI becomes the target of such activities. Although the

relationship of BMI to sedentary time and reported intensity of occupation are not indicative of work capacity and performance, it is apparent that interventions in the workplace setting should consider incorporating activities of longer duration and relatively higher intensity exertion. The considerations are recommended for all categories of BMI.

The study has further strengthened the evidence that walking at work is a feasible approach in accumulating bouts of physical activity towards the recommended goal. It is evident that the recommended 10,000 steps per day target is achievable regardless of the nurses' BMI. Walking interventions and promotion should include all ages and BMI. Incidental walking in the workplace setting among the nurses was examined and proven to potentially contribute toward meeting the goal. Future physical activity recommendations should examine and evaluate related evidences; considering adopting of walking as a strategy of physical activity for health and more aggressive in advocating the strategies to reduce sedentary time.

6.3: Limitations of the study.

Interpretation of the results in this study should be done with caution. Although adequately powered to detect moderate effect size, the monitoring of each participant involved only a single measurement. A 7-day period of continuous monitoring in free-living environment is the ideal.(Ward et al., 2005). In addition, the study has examined only 3 correlates. The effect of other correlates and factors were not specifically investigated. The strong collinearity issue between age and working experience has limited the examination of the individual correlate. Future works are recommended to consider participants of the same age (or experience) but of different experience (or age).

The study has focussed its assessment on the female gender, within the very same working environment. Variation with participants from other wards or discipline is not included in the design. Thus generalization of this study beyond the scope of the examined environment and population is cautioned. Furthermore the age range of the population is narrow, limiting the evidences derived beyond this range, particularly among female nurses of perimenopausal age. These limitations should be considered in future works.

6.4: Conclusion.

Physical activity and inactivity at workplace have been studied extensively in the past. To date, there are documented evidence with regards to their positive effect on health and productivity of the employee including the nursing population. This correlational cross-sectional study is designed to specifically investigate activities in the occupational domain of the nursing profession, taking considerations of the age, working experience and BMI of the participants. The said correlates were examined with attributes of physical activity, along with examination of activities within this domain that may potentially contribute to the recommendations on physical activity.

As with studies that have examined other domains; age, working experience and BMI are found to be moderate correlates of occupational physical activity among female nurses. Age being a negative correlate was found to be inversely related with intensity of the occupation and walk amount, and positively associated with sedentary time. BMI is also a negative correlate and inversely related to intensity of the task demanded by the studied profession, with a direct relationship to sedentary time. Interestingly however it is found that BMI is not associated with the amount of walk.

This study has consolidated the evidence that workplace can potentially contribute towards achieving various physical activity recommendations available. The outcomes of this study should be considered in the planning and design for future works.

References.

- 2008-2013 Action plan for the global strategy for the prevention and control of noncommunicable diseases. Geneva, WHO Press, 2008
- Ainsworth BE, Haskell WL, Whitt MC, et al.: Compendium of physical activities: an update of activity codes and MET intensities. *Medicine and Science in Sports and Exercise* 32:S498-S516, 2000.
- Ainsworth BE, Basset DR: How many steps/day are enough? Preliminary pedometer indices for public health. *Sports Medicine* 34:1-8, 2004.
- Alawan A, Armstrong T, Bettcher D, et al.: *Global Status Report on Noncommunicable Disease 2010*. Geneva, World Health Organization, 2011
- Alawan A, Armstrong T, Cowan M, et al.: *Noncommunicable diseases country profiles 2011*. Geneva, World Health Organization, 2011
- Andre D, Pelletier R, Farrington J, et al.: *The Development of the SenseWear® armband, a Revolutionary Energy-Assessment Device to Assess Physical Activity and Lifestyle*, BodyMedia Incorporated, 2006.
- Andre D, Wolf DL: Recent advances in free-living physical activity monitoring: A Review. *Journal of Diabetes in Science and Technology* 1:760-767, 2007.
- Armstrong T, Candeias V, Quintillani L, et al.: *WHO/WEF Report of a Joint Event: Preventing Non-communicable Diseases at Workplace through Diet and Physical Activity*. Geneva, World Health Organization & World Economic Forum 2008.
- Avolio BJ, Waldman DA, McDaniel MA: Age and work performance in nonmanagerial jobs: The effects of experience and occupational type. *Academy of Management Journal* 2:407-422, 1990.

- Awang AF, Shafei MN, Mohamad WMZW: Metabolic syndrome and occupational risk factors among healthcare workers in Kelantan. *Health and the environment Journal* 2:23-28, 2011.
- Barberio A, McLaren L: Occupational physical activity and BMI among Canadian adults: Does physical activity at work help to explain the socio-economic patterning of bodyweight? *Canadian Journal of Public Health* 102:169-173, 2011.
- Baumann AE, Sallis JF, Dzewaltowski DA, et al.: Toward a Better Understanding of the Influences on Physical Activity: The role of Determinants, Correlates, Causal Variables, Mediators, Moderators and Confounders. *American Journal of Preventive Medicine* 23:5-115, 2002.
- Beaglehole R, Abegunde D, Durivage S, et al.: *Preventing Chronic Disease : A vital investment*. Geneva, World Health Organization. WHO Press, 2005.
- Bensley L, VanEenwyk J: *Contributions of Occupational Physical Activity Toward Meeting the Recommended Physical Activity Guidelines - United States, 2007*. Atlanta, Centre for Disease Control and Preventions, 2011
- BERNAMA: Wakil rakyat sambut baik cadangan wajib jalani ujian kesihatan, *The New Sabah Times*, 24/01/2011, 2011a.
- BERNAMA: Penggal Parlimen Genap 3 Tahun, Tiada Lagi Pilihanraya Kecil, *mstar*, 2011b.
- Bernstein MS, Costanza MC, Morabia A: Physical activity of urban adults. *Praventivmed* 46:49-59, 2001.
- Bobbert AC: Energy expenditure in level and grade walking (abstract). *Journal of Applied Physiology* 15:1015-1021, 1960.
- Boggild H, Knutsson A: Shift work, risk factors and cardiovascular disease. *Scandinavian Journal of Work, Environment and Health*. 25:85-99, 1999.

- Carnethon M, Whitsel LP, Franklin BA, et al.: Worksite Wellness Programs for Cardiovascular Disease Prevention: A Policy Statement from the American Heart Association. *Circulation* 120:1725-1741, 2009.
- Caspersen CJ, Pereira MA, Curran KM: Changes in physical activity patterns in the United States, by sex and cross-sectional age. *Medicine & Science in Sport & Exercise* 32:1601-1609, 2000.
- Church T, Thomas DM, Tudor-Locke C, et al.: Trends over 5 decades in US occupation-related physical activity and their association with obesity. *PLoS One* 6:e19657, 2011.
- Compendium of Physical Activities Online: Item 11 - Occupation. (2011). Retrieved 15 November 2011, from <http://www.sites.google.com/site/compendiumofphysicalactivities/Activity-Categories/occupation>
- Connolly MA, Gulanick M, Keough V, et al.: Health practices of critical care nurses: are these nurses good role model for patients? *American Journal of Critical Care* 6:261-266, 2005.
- Davis A, Jones M: Physical activity, absenteeism and productivity: Evidence Review. *J Occup Med* 32:95-99, 2007.
- Definition of 'sedentary' in English, *Oxford Dictionary of Current English*, Vol. 8. Edited by Thompson D. Oxford, Oxford University Press, 2006.
- Donato AJ, Tench K, Glueck DH, et al.: Declines in physiological functional capacity with age: a longitudinal study in peak swimming performance. *Journal of Applied Physiology* 94:764-769, 2003.
- Dunn AL, Marcus BH, Kampert JB, et al.: Project ACTIVE: Comparison of lifestyle and structured interventions to increase physical activity and cardiorespiratory fitness. *Journal of the American Medical Association* 281:327-334, 1999.

Economic Impact of Diabetes: Factsheet 2009. (2009). Retrieved 12/8/2011, from http://www.worlddiabetesday.novonordisk.com/images/PDFs%20and%20materials/FACT09_EconomicImpact.pdf

Edwardson CL, Grolley T: Epoch Length and Its Effect on Physical Activity Intensity. *Medicine & Science in Sport & Exercise* 42:928, 2010.

Esposito EM, Fitzpatrick JJ: Registered nurses' beliefs on the benefits of exercise, their exercise behaviour and their patient teaching regarding exercise. *International Journal of Nursing Practice* 17:351-356, 2011.

Exercise - A report of the National Health and Morbidity Survey 1996. Institut Kesihatan Umum, Kementerian Kesihatan Malaysia, 1999.

Fruin M, Rankin J: Validity of a multi-sensor armband in estimating rest and exercise energy expenditure. *Medicine & Science in Sport & Exercise* 36:1063-1069, 2004.

Garcia-Amerych J, Lange P, Benet M, et al.: Regular physical activity reduces hospital admission and mortality in chronic obstructive pulmonary disease. *Thorax* 61:772-778, 2006.

Gilson ND, Puig-Ribera A, McKenna J, et al.: Do walking strategies to increase physical activity reduce reported sitting in workplaces: a randomized control trial. *International Journal of Behavioural Nutrition and Physical Activity* 6, 2009.

Gutierrez-Fissaz JL, Guallar-Castillo P, Diez-Ganan L, et al.: work-related physical activity is not associated with BMI and obesity. *Obesity Review* 10:270-276, 2002.

Hamburg N, CJ M, AL H, et al.: Physical inactivity rapidly induces insulin resistance and microvascular dysfunction in healthy volunteers. *Arteriosclerosis, Thrombosis and Vascular Biology* 27:2650-2656, 2007.

Hamilton MT, Bey L: Suppression of skeletal muscle lipoprotein lipase activity during physical inactivity: a molecular reason to maintain daily low physical activity. *Journal of Physiology* 551:673-682, 2003.

Harlan WR, Harland LC. Noncommunicable disease control. *Encyclopedia of Public Health*
Retrieved 1/8/2011, from www.enotes.com/public-health-encyclopedia/noncommunicable-disease-control

Haskell WL, Lee I-M, Pate RR, et al.: Physical Activity and Public Health: Updated Recommendation for Adults From the American College of Sports Medicine and the American Heart Association. *Circulation* 116:1081-1093, 2007.

Health Facts 2009. Health Informatics Centre, Ministry of Health Malaysia, 2010

Healy GN, Dunstan DW, Salmon J, et al.: Objectively Measured Light-Intensity Physical Activity Is Independently Associated With 2-h Plasma Glucose. *Diabetes Care* 30:1384-1390, 2007.

Holmes MD, Chen WY, Feskanich D, et al.: Physical Activity and Survival After Breast Cancer Diagnosis. *Journal of American Medical Association* 293:2479-2486, 2005.

Ibrahim WN, AlJunid S, Ismail A: Cost of Type 2 Diabetes Mellitus in Selected Developing Country. *Malaysian Journal of Public Health Medicine* 10:68-71, 2010.

Jakicic JM, Marcus M, Gallagher KI, et al.: Evaluation of the SenseWear Pro Armband™ to Assess Energy Expenditure during Exercise. *Medicine & Science in Sport & Exercise* 36:897-904, 2004.

Jeon CY, Lokken RP, Hu FB, et al.: Physical activity of moderate intensity and risk of type 2 diabetes: A systematic review. *Diabetes Care* 30:744-752, 2007.

Johannsen DL, Calabro MA, Stewart J, et al.: Accuracy of Armband Monitors for Measuring Daily Energy Expenditure in Healthy Adults. *Medicine & Science in Sport & Exercise* 42:2134-2140, 2010.

Kaewthummanukul T, Brown KC, Weaver MT, et al.: Predictors of exercise participation among female nurses. *Journal of Advanced Nursing* 54:663-675, 2005.

Kawachi I, Colditz GA, Stampfer MJ, et al.: Prospective study of shift work and risk of coronary heart disease in women. *Circulations* 92:3178-3182, 1995.

- Kilbom A: Physical work capacity of firemen with special reference to demands during fire fighting. *Scandinavian Journal of Working Environment and Health* 6:48-57, 1980.
- King GA, Torres N, Potter C, et al.: Comparison of Activity Monitors to Estimate Energy Cost of Treadmill Exercise. *Medicine & Science in Sport & Exercise* 36:1244-1251, 2004.
- King NA: Effects of exercise on appetite control: implications for energy balance. *Medicine and Science in Sports and Exercise* 29:1076-1089, 1997.
- Kruger J, Ham SA, Kohl HW: Trends in leisure-time physical inactivity by age, sex, and race/ethnicity - United States 1994-2004. *Morbidity and Mortality Weekly Report* 54:991-994, 2005.
- Lee IM, Paffenbarger RSJ: The Harvard Alumni Health Study: Physical activity and stroke incidence. *Stroke* 1998:2049-2054, 1998.
- Lee IM, Hennekens CH, Berger K, et al.: Exercise and risk of stroke in male physicians. *Stroke* 30:1-6, 1999.
- Ling DL. (2008). Activity levels for small samples of college students on Pohnpei in the Federated States of Micronesia as measured by pedometer step counts. Retrieved 12th November, 2011, from <http://www.comfsm.fm/~dleeling/health/pedometers.html#college>
- Manson J, Rimm E, Stampfer MJ, et al.: Physical activity and incidence of non-insulin dependent diabetes mellitus in women. *Lancet* 339, 1991.
- Manson JE, Nathan DM, Krolewski AS, et al.: A prospective study of exercise and incidence of diabetes among US male physicians. *Journal of American Medical Association* 268:63-67, 1992.
- McDowell N, Mckenna J, Naylor PJ: Factors that influence practice nurses to promote physical activity. *British Journal of Sports Medicine* 31:308-313, 1997.

- McDowell N, Mckenna J, Naylor PJ: Barriers to physical activity promotion by GPs and practice nurses. *British Journal of Sports Medicine* 32:242-247, 1998.
- Monninkhof EM, Elias SG, Vlems FA, et al.: Physical activity and breast cancer: A systematic review. *Epidemiology* 18:137-157, 2007.
- Morris J, Heady J, Raffle P, et al.: Coronary heart disease and physical activity of work. *Lancet* 265:1053-1057, 1953.
- Mummery WK, Schofield GM, Steele R, et al.: Occupational Sitting Time and Overweight and Obesity in Australian Workers. *American Journal of Preventive Medicine* 29:91-98, 2005.
- Mustapha FI. (2009). Presentation: National Strategic Plan for Non-communicable disease. Disease Control division, Ministry of Health Malaysia. Retrieved 1/8/2011, from http://www.malaysianheart.org/file_dir/17730830514a516f6b9f87.pdf
- Paffenbarger RSJ, THyde R, Wing AL, et al.: Physical activity, all causes mortality and longevity of college alumni. *New England Journal of Medicine* 314:605-613, 1986.
- Paffenbarger RSJ, Blair SN, Lee IM: A history of physical activity, cardiovascular health and longevity: The scientific contributions of Jeremy N Morris, DSc, DPH, FRCP. *International Journal of Epidemiology* 30:1184-1192, 2001.
- Pate RR, O'neill JR, Lobello F: The Evolving Definition of "Sedentary". *American Journal of Sports Medicine* 36:173-178, 2008.
- Pettee KK, Storti KL, Ainsworth BE, et al.: Measurement of physical activity and inactivity in epidemiologic studies, in *Epidemiological Methods in Physical Activity Studies*. Edited by Lee IM. New York, Oxford University Press, 2009, pp. 15-33.
- Poh B, MY S, A T, et al.: Physical Activity Pattern and Energy Expenditure of Malaysian Adults: Findings from the Malaysian Adults Nutrition Survey (MANS). *Malaysian Journal of Nutrition* 16:13-37, 2010.

Position Statement of the American Diabetes Association: Physical Activity/Exercise and Diabetes Mellitus. *Diabetes Care* 26:s73-s77, 2003.

Pronk NP, Martinson B, Kessler RC, et al.: The association between work performance and physical activity, cardiorespiratory fitness and obesity. *Journal of Occupational Environment Medicine* 46:19-26, 2004.

Regional Office for the Western Pacific for World Health Organization. Retrieved 1/8/2011, from www.who.int/about/regions/wpro/en/index.htm

Rush KL, Kee CK, Rice M: Nurses as imperfect role models for health promotion. *Western Journal of Nursing Research* 27:166-183, 2005

Sallis JF: Age-related decline in physical activity: a synthesis of human and animal studies. *Medicine & Science in Sport & Exercise* 32:1598, 2000.

Salthouse TA: Effects of age and skill in typing. *Journal of Experimental Psychology* 13:345-371, 1984.

Schernhammer ES, Laden F, Speizer FE, et al.: Night shift work and Risk of Colorectal Cancer in the Nurses' Health Study. *Journal of the National Cancer Institute* 95:825-828, 2003.

Schmidt FL, Hunter JE, Outerbridge AN: Impact of job experience and ability on job knowledge, work sample performance and supervisory ratings of job performance. *Journal of Applied Psychology* 71:432-439, 1986.

Schoenfield Y, Keren G, Shirmoni T, et al.: A Method for Rapid Improvement of Physical Fitness (abstract). *Journal of the American Medical Association* 243:2062-2063, 1980.

Schofield G, Quigley R, Brown R: Does sedentary behaviour contribute to chronic disease or chronic disease risk in adults? New Zealand, 2009

- Schwarz UvT, Hasson H: Employee Self-rated Productivity and Objective organizational Production Levels. *Journal of Occupational Environment Medicine* 53:838-845, 2011.
- Shafei MN, Awang AF, Mohamad WMZW: Prevalence of metabolic syndrome and its associated factors among female nurses in a teaching hospital in North-eastern state of Malaysia. *Journal of Public Health and Epidemiology* 3:394-400, 2011.
- Skirbekk V: Age and Individual Productivity: a Literature Survey. Rostock, Max Planck Institute for Demographic Rresearch, 2003
- Slattery M: Physical activity and colorectal cancer. *Sports Medicine* 34:239-252, 2004.
- St-Onge M, Mignault D, Allison DB, et al.: Evaluation of a portable device to measure daily energy expenditure in free-living adults. *American Journal of Clinical Nutrition* 85:742-749, 2007.
- The Third National Health and Morbidity Survey (NHMS III) 2006 - General findings. Institut Kesihatan Umum, Kementerian Kesihatan Malaysia, 2008
- Thompson PD, Buchner D, Pina IL, et al.: Exercise and physical activity in the prevention and treatment of atherosclerotic cardiovascular disease: A statement from the Council on Cardiology (Subcommittee on Exercise, Rehabilitation and Prevention) and the Council in Nutrition, Physical Activity and Metabolism (Subcommittee on Physical Activity). *Arteriosclerosis, Thrombosis and Vascular Biology* 23, 2003.
- Tremblay MS, Colley RC, Sanders TJ, et al.: Physiological and health implications of a sedentary lifestyle. *Applied Physiology in Nutrition Metabolism* 35, 2010.
- Tudor-Locke C, Ainsworth BE, Whitt MC, et al.: The relationship between pedometer determined ambulatory activity and body composition variables. *International Journal of Obesity* 25:1571-1578, 2001.
- Tudor-Locke C, Basset DR: How many steps/day are enough? Preliminary pedometer indices for public health. *Sports Medicine* 34:1-8, 2004.

- Uauy R, Draz E: Consequences of food energy excess and positive energy balance. *Public Health Nutrition* 8:1077-1099, 2005.
- Uffelen GZJv, Wong J, Chau JY, et al.: Occupational Sitting and Health Risks: A Systematic Review. *American Journal of Preventive Medicine* 39:379-388, 2010.
- Ujakala UM, Kaprio J, Sarna S, et al.: Relationship between leisure-time physical activity and mortality. *Medicine & Science in Sport & Exercise* 279:440-444, 1998.
- Umpierre D, al. e: Physical activity advice only or structured exercise training and association with HbA1C levels in type 2 diabetes : A meta-analysis. *Medicine & Science in Sport & Exercise* 305:1790-1799, 2011.
- Vaz M, Bharathi AV: How sedentary are people in 'sedentary' occupations? The physical activity of teachers in Urban South India. *Occupational Medicine* 54:369-372, 2004.
- van Uffelen JGv, Wong J, Chau JY, et al.: Occupational Sitting and Health Risks : A systematic review. *American Journal of Preventive Medicine* 39:397-388, 2010.
- Ward DS, Evenson KR, Vaughn A, et al.: Accelerometer Use in Physical Activity: Best Practices and Research Recommendations. *Medicine & Science in Sport & Exercise* 37:s582-s588, 2005.
- World Bank data by country: Malaysia. (2010). Retrieved 1/8/2011, from data.worldbank.org/country/malaysia
- WHO Consultation Expert: Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet* 363:157-163, 2004.

Appendix A: Approval from Medical Ethics Committee



**UNIVERSITY
OF MALAYA**
KUALA LUMPUR
UM MEDICAL CENTRE

MEDICAL ETHICS COMMITTEE
UNIVERSITY MALAYA MEDICAL CENTRE
ADDRESS: LEMBAH PANTAI, 59100 KUALA LUMPUR, MALAYSIA
TELEPHONE: 03-79493209 FAXIMILE: 03-79494638

NAME OF ETHICS COMMITTEE/IRB: Medical Ethics Committee, University Malaya Medical Centre	ETHICS COMMITTEE/IRB REFERENCE NUMBER: 800.71
ADDRESS: LEMBAH PANTAI 59100 KUALA LUMPUR	
PROTOCOL NO: TITLE: Occupational physical activity measurement among in University Malaya Medical Centre (UMMC)	
PRINCIPAL INVESTIGATOR: Dr. Syamsul Rizal Abu Amin	SPONSOR:
TELEPHONE: KOMTEL:	

The following item have been received and reviewed in connection with the above study to be conducted by the above investigator.

<input checked="" type="checkbox"/> Borang Permohonan Penyelidikan	Ver date: 06 Jul 10
<input checked="" type="checkbox"/> Study Protocol	Ver date:
<input type="checkbox"/> Investigator's Brochure	Ver date:
<input checked="" type="checkbox"/> Patient Information Sheet	Ver date:
<input checked="" type="checkbox"/> Consent Form	Ver date:
<input checked="" type="checkbox"/> Subject's Record & Data Sheet	Ver date:
<input type="checkbox"/> Investigator(s) CV's (if applicable)	

and have been

Approved
 Conditionally approved (identify item and specify modification below or in accompanying letter)
 Rejected (identify item and specify reasons below or in accompanying letter)

Comments:

Investigator are required to:


- 1) follow instructions, guidelines and requirements of the Medical Ethics Committee.
- 2) report any protocol deviations/violations to Medical Ethics Committee.
- 3) provide annual and closure report to the Medical Ethics Committee.
- 4) comply with International Conference on Harmonization – Guidelines for Good Clinical Practice (ICH-GCP) and Declaration of Helsinki.
- 5) note that Medical Ethics Committee may audit the approved study.

Date of approval: 21st JULY 2010

c.c Head
Sports Medicine Unit

Deputy Dean (Research)
Faculty of Medicine

Secretary
Medical Ethics Committee
University Malaya Medical Centre



PROF. LOOI LAI MENG
Chairman
Medical Ethics Committee

Appendix B: Approval from Head of Nursing Services UMMC.



UNIT PERUBATAN SUKAN
FAKULTI PERUBATAN
UNIVERSITI MALAYA
50603 KUALA LUMPUR

SPORTS MEDICINE UNIT
FACULTY OF MEDICINE
UNIVERSITY OF MALAYA
50603 KUALA LUMPUR

Tel. 03-79674968, 03-79677522 Fax. 03-79677511

Pn Sharifah Asiah bt Syed Al-Junid
Ketua Pegawai Kejururawatan PPUM
Pusat Perubatan Universiti Malaya
59100 Kuala Lumpur.

Melalui:

Profesor Madya Dr Mohd Razif Ali
Ketua Unit Perubatan Sukan
Fakulti Perubatan Universiti Malaya
59100 Kuala Lumpur.

Puan,

Prof. Madya Dr. Mohd Razif B. Mohd Ali
Ketua
Unit Perubatan Sukan,
Fakulti Perubatan,
Universiti Malaya,
50603 Kuala Lumpur

SHARIPAH ASIAH BTE SYED JUNID ALJUNID
KETUA PEGAWAI KEJURURAWATAN
PENTABEGAN KEJURURAWATAN
PUSAT PERUBATAN UNIVERSITI MALAYA

Dr. Syamsul Rizal,
Pena Kembalikan salinan
kelulusan dan Jawatankuasa
Etika sebelum mula kegiatan
diumpu

Permohonan Melakukan Kajian Saintifik Di Pusat Perubatan Universiti Malaya.

Adalah saya Dr Syamsul Rizal bin Abu Amin (IC: 790516-01-6281, nombor pelajar: MGO 080002) merupakan seorang pelajar tahun 3 dalam bidang Sarjana Kepakaran Perubatan Sukan di Universiti Malaya. Saya memohon izin dan sokongan tuan untuk menjalankan satu penyelidikan bagi memenuhi tuntutan pengajian saya di salah sebuah wad seliaan jabatan puan.

Kajian saya bertajuk "Occupational Physical Activity Measurement Among Nurses in University Malaya Medical Centre" (Penentuan Tahap Fizikal Aktiviti Ketika Bertugas dikalangan Jururawat di Pusat Perubatan Universiti Malaya). Kajian ini bertujuan menentukan tahap kesukaran aktiviti fizikal para jururawat ketika bertugas dan jangkaan penggunaan tenaga metabolik. Selain itu, saya juga ingin menilai hubungkait tahap aktiviti fizikal dengan faktor-faktor seperti usia, pengalaman bekerja, indeks jisim tubuh badan (BMI), syif bekerja dan juga ukurilit pinggang.

Untuk tujuan itu, saya telah berbincang dan mendapat pandangan beberapa pegawai kejururawatan di jabatan puan. Saya ingin melakukan kajian ini dikalangan jururawat di wad 12U dan ini memerlukan 30 orang peserta kajian. Rekabentuk kajian ini tidak akan mengganggu kegiatan dan tugas para peserta serta tidak menimbulkan sebarang bahaya. Untuk maklumat lanjut, puan bolehlah merujuk kepada lampiran berkenaan cadangan kajian berkenaan atau boleh menghubungi saya di 012-727 8295 atau di sambungan 2994 (Klinik Perubatan Sukan).

Buat maklumat puan, permohonan menjalankan kajian ini telah dipanjangkan ke Jawatankuasa Etika Kajian Perubatan PPUM. Semua kos kajian ini akan dibiayai melalui geran Peruntukan Penyelidikan Pascasiswazah Universiti Malaya. Penyelia kajian ini ialah Dr Abdul Halim Mokhtar –salah seorang Pensyarah Kanan dan Pakar Perubatan Sukan.

Segala perhatian, pertimbangan dan kerjasama pihak tuan amatlah diharapkan dan didahului juataan terima kasih.

Sekian.

Yang benar,

(Dr SYAMSUL RIZAL ABU AMIN)
Calon Sarjana Kepakaran Perubatan Sukan
Fakulti Perubatan Universiti Malaya.

s/k:

1. Professor Dato' Dr Ikram Shah Ismail
Pengarah, Pusat Perubatan Universiti Malaya
2. Professor Madya Dr Mohd Razif Ali
Ketua Unit Perubatan Sukan PPUM
3. Dr Abdul Halim Mokhtar
Penyelia, Pensyarah Kanan dan Pakar Perubatan Sukan
PPUM
4. Fail

Appendix C: Circulated Information Handout

Lembaran maklumat peserta kajian aktiviti fizikal

]Salam sejahtera,

Para jururawat U29 yang berkhidmat di wad 12U adalah dialu-alukan untuk menyertai satu kajian saintifik bertajuk:

Pengukuran Tahap Aktiviti Fizikal di Tempat Kerja dikalangan Jururawat di Pusat Perubatan Universiti Malaya

Kajian ini bertujuan mengukur tahap kesukaran fizikal yang dilaksanakan ketika anda sedang bekerja. Dengan menggunakan sebuah peranti elektronik kecil bernama *Sensewear Armband Pro3 Accelerometer*, beberapa data penting berkenaan aktiviti fizikal boleh diukur dan dinilai iaitu:

- jumlah tenaga (kalori) yang digunakan/dibakar
- tempoh masa anda melakukan aktiviti fizikal pada tahap kesukaran yang berbeza
- jumlah langkah atau berjalan kaki yang dilaksanakan ketika bekerja

Alat yang kecil ini disarungkan di lengan kanan anda dan ia tidak akan mengganggu rutin pekerjaan. Alat ini selamat dan tidak mendatangkan kemudaratan kepada pemakainya.

Apakah manfaat kajian ini?

Kajian ini memberi petunjuk penting tentang tahap kesukaran melaksanakan aktiviti fizikal semasa bekerja. Ini akhirnya dapat merumuskan tentang jumlah dan tahap aktiviti yang anda perlu lakukan bagi mencapai sasaran gaya hidup sihat.

Siapakah yang boleh menyertai kajian ini?

Semua jururawat U29 di wad 12U adalah dialu-alukan untuk menyertai kajian ini. Bagi mereka yang sedang hamil, anda boleh menyertainya selepas bersalin dan kembali semula ke pekerjaan.

Dari semasa ke semasa, penyelidik dari Klinik Pakar Perubatan Sukan (Dr Syamsul Rizal) akan menemui anda di wad 12U. Anda amatlah digalakkan untuk menghubungi beliau teus di sambungan 2994 atau email kepada sraaz@yahoo.com bagi sebarang pertanyaan. Mereka yang berminat akan diberi penerangan yang lebih lanjut.

Sekian terima kasih.

Appendix D: Informed Consent Form

UNIVERSITY MALAYA MEDICAL CENTRE

KEIZINAN OLEH PESERTA UNTUK PENYELIDIKAN KLINIKAL

Saya, No. Kad Pengenalan

(Nama Pesakit)

beralamat.....

(Alamat)

dengan ini bersetuju menyertai dalam penyelidikan klinikal seperti berikut:

Tajuk Penyelidikan:

Occupational Physical Activity Measurement Among Nurses in University Malaya Medical Centre (UMMC)

yang mana sifat dan tujuannya telah diterangkan kepada saya oleh Dr Syamsul Rizal bin Abu Amin
(Nama & Jawatan Doktor)

mengikut terjemahan(tiada).....
(Nama & Jawatan Penterjemah)

yang telah menterjemahkan kepada saya dengan sepenuh kemampuan dan kebolehannya di dalam Bahasa / loghat Melayu.

Saya telah diberitahu bahawa dasar penyelidikan klinikal dalam keadaan methodologi, risiko dan komplikasi (mengikut kertas maklumat pesakit). Selepas mengetahui dan memahami semua kemungkinan kebaikan dan keburukan penyelidikan klinikal ini, saya merelakan/mengizinkan sendiri menyertai penyelidikan klinikal tersebut di atas.

Saya faham bahawa saya boleh menarik diri dari penyelidikan klinikal ini pada bila-bila masa tanpa memberi sebarang alasan dalam situasi ini dan tidak akan dikecualikan dari kemudahan rawatan dari doktor yang merawat.

Tarikh:

Tandatangan/Cap Jari

(Peserta kajian)

DI HADAPAN

Nama :

No. K/P :

Jawatan:

Tandatangan

(Saksi untuk Tandatangan Pesakit)

Saya sahkan bahawa saya telah menerangkan kepada pesakit sifat dan tujuan penyelidikan klinikal tersebut di atas.

Tarikh:

Tandatangan

(Doktor yang menyelidik)