THE ASSOCIATION BETWEEN PHYSICAL ACTIVITY AND WORK SCHEDULE AMONG HOSPITAL NURSES: A CROSS-SECTIONAL STUDY

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Abstract

Physically sedentary and overweight nurses appear to be less credible in inculcating healthy behaviour among patients. Shift-work has been shown to promote physical inactivity, whilst sedentarism strongly correlates with a high body mass index (BMI). We aim to determine the level of physical activity among hospital nurses of different work schedules, i.e. shift-work and day-work; and explore any associations between nurses' demographic backgrounds, BMI, and work schedules with their physical activity level. This cross-sectional study design was employed. The self-administered Malaysian International Physical Activity Questionnaire – Long form (IPAQ-L) and a demographic survey sheet were provided to the eligible nurses. Bivariate and subsequent regression analyses were performed to determine their associations. A total of 1988 nurses from the University Malaya Medical Centre, Kuala Lumpur were invited to participate in this study. There were 1504 (76%) returned responses, with 77% of responding nurses working shift. Based on the IPAQ-L, 87% of the nurses were deemed highly active, while another 11% were moderately active. Upon stratifying into shift-work and day-work, statistically significant differences were observed between the groups in the domains of 'work' ($p = 0.016$), 'domestic chores' ($p = 0.038$), and in intensity-specific 'walking' ($p = 0.046$) and 'vigorous' activities ($p = 0.034$). There were no differences among groups within categories of physical activities ($p = 0.355$). Regression analysis showed significant difference for 'duration of daily vehicle travel', with the day-workers reporting a longer adjusted travel time (76.50 minutes/day, $p < 0.001$). Working shift does not seem to harm an individual nurse's overall measured physical activity, as evidenced by equivalent high values of physical activity engagement between both work schedules. Any differences within domains and intensities of physical activities may be attributed to the respective cohort characteristics.

Keywords: Day-work, nurses, physical activity, shift-work

Abbreviations: *BMI: body mass index; IPAQ-L: International Physical Activity Questionnaire – Long version; IQR: inter-quartile range; MET-mins/week: metabolic equivalent task minutes per week; MYR: Malaysian Ringgit; NHMS: National Health and Morbidity Survey; PA: physical activity; SE: standard error; UMMC: University Malaya Medical Centre.*

Introduction

Physical activity is a pertinent element of non-communicable disease prevention action and is defined as 'any bodily movement produced by skeletal muscles that require energy expenditure' (Caspersen, Powell, & Christenson, 1985). Physical activity (PA) may be classified as structured or incidental, and is undertaken in several domains of daily living including occupational, transportation, domestic and leisure time physical activities (Strath et al., 2013). This distinction is particularly relevant in developing countries, where leisure time PA makes a smaller contribution to overall energy expenditure (Macniven, Bauman, & Abouzeid, 2012). It is therefore essential that all domains are captured during assessment; otherwise, overall quantification will be incomplete. Current PA recommendations in adults favour the adoption of at least 150 minutes of moderate-intensity aerobic activity throughout the week or an intensity-equivalent combination for health promotion and disease prevention (Garber et al., 2011; US Department of Health and Human Services, 2008).

The recent Malaysian 5th Health and Morbidity Survey (NHMS) 2015 revealed that in spite of yearly incremental PA trends i.e. from 56.3% (2006) to 66.5% (2015), the majority of the population remains minimally active (Institute for Public Health Malaysia, 2015; Ministry of Health Malaysia, 2016). Paradoxically, the same report goes on to state that overall prevalence of obesity and overweight was at an alarming 64%, leading to Malaysia being labelled as the fattest nation in Southeast Asia, an accolade which is both worrying and reflects poorly on the overall health behaviour practices of its citizens (Ng et al., 2014). The World Health Organisation reports that physical inactivity has been established as the fourth major risk factor for global mortality and morbidity, with those who are inactive being conferred a greater risk of death (World Health Organisation, 2010b).

Together with physicians, nurses play an important role in dispensing healthy lifestyle information. In fact, nurses form the largest group of healthcare workers (World Health Organisation, 2010a), with the profession comprising 50.7% of the Malaysian health human resource (Ministry of Health Malaysia, 2016). The majority work shift. In the University Malaya Medical Centre (UMMC) and other governmental hospitals in Malaysia likewise, nurses are assigned to two main work schedules of either office-hour work (day-workers) or shift work (shift-workers). Three shift schedules are the norm, i.e. morning-shift (7am – 2pm), evening-shift (2pm – 9pm) and night-shift (9pm- 7am). Shift-workers generally serve five successive shifts of either order with a subsequent two day-offs thereafter. Meanwhile, day-workers are scheduled for regular weekday working hours i.e. from 8am to 5pm. In any healthcare service, shift-work plays a fundamental role in

ensuring continuity of care in hospitals. Unfortunately, shift-work has been increasingly implicated in the development of chronic diseases and obesity via a general reduction in overall PA, specifically impairing leisure time PA and organised team sports participation (Atkinson, Fullick, Grindey, Maclaren, & Waterhouse, 2008; Loef et al., 2017; Proper, 2016).

One of the main predictors to a successful health promotion counselling by a healthcare professional is appearing fit and physically active (Joy, Blair, McBride, & Sallis 2012). General observation suggests that physical inactivity and weight issues may be more prevalent in the nursing profession, particularly as seniority level increases. The majority of current research on nurses' physical activities centres on its impact on obesity (Aryee, Helegbe, Baah, Sarfo-Asante, & Quist-Therson, 2014; Kim, 2013; Nam & Lee, 2016; Smith, Fritschi, Reid, & Mustard, 2013; Zapka, Lemon, Magner, & Hale, 2009; Zhao, Bogossian, Song, & Turner, 2011). None, however, has attempted to link differing work schedules with PA behaviour. Moreover, a majority of PA research and its correlates target high-income western nations, of which patterns of physical activities are known to differ, especially between occupational PA and leisure time PA (Macniven et al., 2012). A healthcare practitioner who is sedentary and overweight may appear as less credible role models for the adoption of healthy behaviour among patients (Lobelo, Duperly, & Frank, 2009). Therefore, addressing one's own habits is necessary to achieve better counselling outcomes. Nonetheless, a recent systematic review on nursing PA highlights the difficulties of establishing appropriate 'on-the-job' PA norms as reported outcome measures worldwide are rarely comparable (Chappel, Verswijveren, Aisbett, Considine, & Ridgers, 2017).

Population-based surveillance of PA in developing countries favour a subjective measure as objective methods such as using motion sensors, heart rate monitors and accelerometers are labour and resource-intensive (Strath et al., 2013). The International Physical Activity Questionnaire-Long form (IPAQ-L) is a reliable self-administered instrument designed specifically for standardised population survey among adults in developing countries where PA is more likely to be accumulated across a range of domains (Macniven et al., 2012). The validity of IPAQ-L has been proven across 12 different countries including Malaysia (Chu & Moy, 2015; Craig et al., 2003) and has been utilised in the 2015 National Health and Morbidity Survey report, albeit in its short-form.

At present, it is still not well known what patterns of PA exist among the nursing cohort in Asia and particularly Malaysia. Shift work itself, though, has been shown to impact the development of cardio-metabolic disease, reduce healthy PA engagement and lead to obesity. As such, the primary objective of this study is to determine the prevalence of physical activity among the shift and day-working nurses in the University Malaya Medical Centre using the Malaysian IPAQ-L questionnaire, whilst the secondary objective is to explore the association between the demographic, body mass index (BMI), work schedule and job characteristics with their level of PA in the specific domains and intensities of PA.

Methods

Study design and sampling

This cross-sectional study involved all registered nurses in the UMMC. Data collection was conducted over a period of three months, from the 1st of March to the 31st of May 2017. In this study, a nurse is defined as a person having a registration or licence to practice as a nurse, and this includes registered nurses, nurse managers and matrons (Chappel et al., 2017). The UMMC is the second largest tertiary hospital in Malaysia and is generally reflective of the population norms for Malaysian nurses (Ministry of Health Malaysia, 2013; UMMC, 2017). An invitation email with the participation information sheet was extended to all registered nurses practicing in the UMMC. Those employed less than 6 months or on maternity leave were excluded from the study (Figure 1). The former were excluded as newly-registered nurses tend to be placed under probation and thus their work schedule may comprise a mixture of both day and shift-work. Data collection was carried out in their respective workplace according to employment records. Each locality was visited up to four times to obtain adequate responses. Written informed consent was obtained from participating nurses prior to study. Nurses then answered a confidential paper-based self-administered questionnaire in the presence of the primary investigator. Ethics approval was obtained from the Medical Research Ethics Committee of University Malaya Medical Centre (MREC ID NO: 2017210-4903). This study was conducted in accordance with the International Conference on Harmonization – Guidelines for Good Clinical Practice (ICH-GCP) and the Declaration of Helsinki.

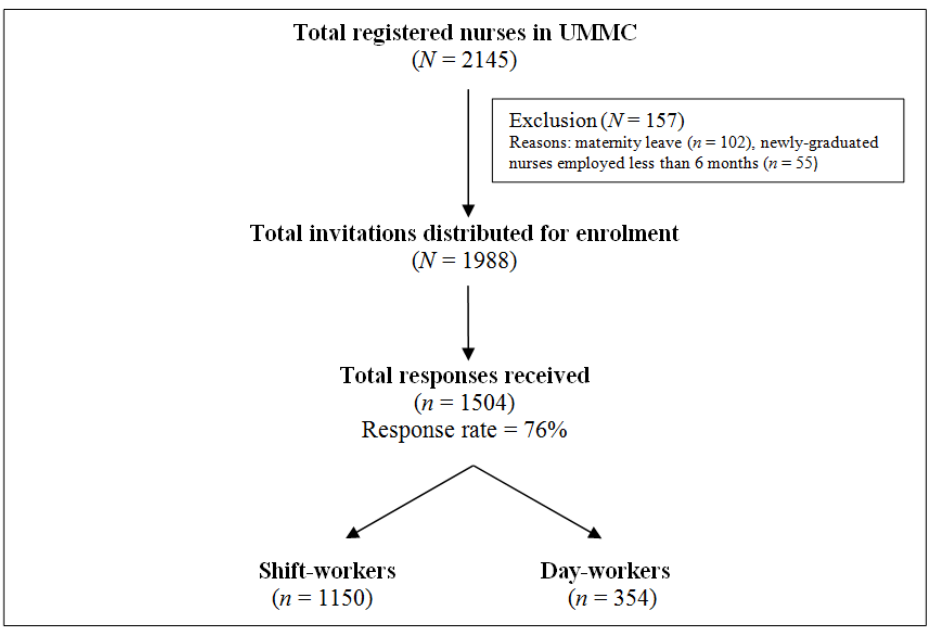

Figure 1: Study sampling framework

Research tools

The research tools utilised include a Sociodemographic survey and the Malaysian IPAQ-L questionnaire. Age (categorised into 20-30 years, 31-40 years, 41-50 years, and 51-60 years), sex (male, female), ethnicity (Malay, Chinese, Indian, Others), marital status (single, married, widow/widower/divorcee), education level (diploma/certificate, post-basic, degree/masters/PhD), height (metres) and weight (kilograms), monthly income [in Malaysian Ringgit (MYR) (1 USD = MYR 3.86); grouped into categories of MYR1000-MYR1999, MYR2000-MYR2999, MYR3000-MYR3999, MYR4000-MYR4999, and MYR5000 and above], duration of employment (years), work-place grade (U19, U29, U32, U36, U42/U44/U48/U52; ordered in ascending level of seniority respectively), work schedule (shift-workers, day-workers), and originating department (inpatient, critical care, ambulatory, operating theatre, emergency, infection control/nursing managers) were considered as potential covariates in the 'work schedule' specific analysis. Body Mass Index (BMI) for each nurse was calculated from self-reported weight and height data [using the formula BMI = weight (kilograms) / height^2 (metres^2)] and categorised according to the World Health Organisation recommendation for Asian population, labelled as underweight (<18.5), normal (18.5 – 22.9), pre-obese (23.0 – 27.4), and obese (≥ 27.5) (Ministry of Health Malaysia, 2004; World Health Organisation, 2004).

The Malaysian International Physical Activity Questionnaire – Long form (IPAQ-L) was used to measure PA. The IPAQ-L designates domain-specific values for walking, moderate-intensity and vigorous-intensity activity within each of the work, transportation, domestic chores and gardening and leisure-time domains. This measure self-reported PA over the past week. PA level and intensity were calculated in terms of metabolic equivalent task minutes per week (MET-minutes/week) based on the IPAQ scoring protocol (IPAQ Research Committee, 2005). 1 MET (metabolic equivalent) is defined as 1kcal/kg/hour and signifies the ratio of the work metabolic rate to the resting metabolic rate (Ainsworth, 2011). Total minutes spent on walking, moderate-intensity and vigorous activity over the last 7 days were multiplied by a factor of 3.3, 4.0 and 8.0 respectively, whilst vigorous yard chores, moderate yard chores and moderate inside chores were designated with factors of 5.5, 4.0 and 3.0, respectively, to calculate MET scores for each activity. The overall PA score was tallied as the sum of all MET scores from the four sub-components. In addition, PA was categorized into low (<600 MET-minutes/week), moderate (600 - <3000 MET-minutes/week) and high PA level (≥3000 MET-minutes/week). In addition, sedentary behaviour was measured as part of the IPAQ-L based on the IPAQ sitting questions but was not included in any part of the derived PA summary score. Nurses were requested to report time spent sitting while at home, at workplace or during leisure time, on a weekday and on a weekend (in minutes per day). Nurses were also required to recall daily time spent travelling in a motor vehicle over the last seven days.

Statistical analyses

All statistical analyses were undertaken using the IBM SPSS Statistics software version 22.0 (IBM Corp., Armonk, NY, USA). The statistical significance level was set at p value of .05. The study population was initially stratified into shift-workers and day-workers. At the univariate level, calculation for frequencies, percentages and Pearson's chi-squared

testing were performed for the categorical variables. Interval-scaled variables were reported as medians, inter-quartile ranges (IQR), and means. For these, Mann-Whitney U-test was performed for comparisons between two groups whilst Kruskal Wallis one-way ANOVA was used for comparing two or more groups of independent samples. A Pearson's bivariate correlation was used to investigate the strength of association between the significant variables. The Generalized Linear Model (GLZ) regression analysis was used to compare PA levels between shift-workers and day-workers for non-normal distributed PA sub-domains, whilst the General Linear Model (GLM) was utilized for regression analysis of normally distributed PA sub-domains. A final adjusted mean score was derived for each domain and intensity of PA.

Results

Of the eligible 1988 nurses, a total of 1504 nurses were sampled, giving a response rate of 76%. The mean age of the nurses was 31.17 years (SD = 8.74) and the mean BMI was 24.81 kg/m^2 (SD = 4.83). Table 1 shows the characteristics of the nurses, stratified into of shift-work and day-work. Compared to day-workers, shift-workers tended to be younger (M = 28.44 years, SD = 6.34), single (42%), pre-obese (M = 24.31 kg/m^2, SD = 4.50), held a diploma/certificate qualification (80%), reported a lower monthly income, and mostly worked in the inpatient setting (57%) ($p < .001$ respectively). Conversely, day-workers tended to be older (M = 40.03 years, SD = 9.58) and married (83%), were of higher BMI (M = 26.45 kg/m^2, SD = 5.50), held higher levels of education and workplace grades equivalent to or above U32 levels (60%), and were overwhelmingly from the ambulatory care services (61%) ($p < .001$ respectively). A larger proportion of day-workers (16%) were involved in the 'Be FITT@UMMC' fitness program compared to shift-workers (9%) ($X^2 = 14.34$; $p < .001$). Day-workers were generally found to have a longer employment record with the UMMC (M = 17.54 years) in comparison to shift-workers (M = 6.64 years; $p < .001$).

Table 1: Nurses' sociodemographic characteristics stratified by work schedule

Categories	Level	Work Schedule		$\chi 2$	P-value
		Shift-Workers	Day-workers		
Age[§]	20-30	862 (75.0)	65 (18.4)	474.11	<.001
	31-40	223 (19.4)	120 (33.9)		
	41-50	45 (3.9)	111 (31.4)		
	51-60	20 (1.7)	58 (16.4)		
Sex [§]	Male	76 (6.6)	20 (5.6)	0.42	.519
	Female	1074 (93.4)	334 (94.4)		
Ethnicity [§]	Malay	1084 (94.4)	321 (91.2)	4.99	.173
	Chinese	18 (1.6)	10 (2.8)		
	Indian	38 (3.3)	17 (4.8)		
	Others	8 (0.7)	4 (1.1)		
Marital Status [§]	Single	472 (42.3)	49 (14.3)	99.96	<.001
	Married	638 (57.2)	283 (82.7)		
	Widow/Widower/ Divorced	5 (0.4)	10 (2.9)		

Education Level §	Diploma/ Certificate	913 (79.7)	192 (54.9)		
	Post-Basic	218 (19)	105 (30)	150.19	<.001
	Degree/Masters/ PhD	15 (1.3)	53 (15.1)		
Income §,*	MYR1000-1999	46 (4)	6 (1.7)		
	MYR2000-2999	542 (47.3)	50 (14.2)		
	MYR3000-3999	395 (34.5)	114 (32.4)	266.30	<.001
	MYR4000-4999	129 (11.3)	109 (31)		
	MYR5000 and above	23 (2)	53 (15.1)		
BMI Categories §	Underweight	82 (7.1)	19 (5.4)		
	Normal	390 (33.9)	75 (21.2)	44.5	<.001
	Pre-obese	434 (37.7)	127 (35.9)		
	Obese	244 (21.2)	133 (37.6)		
Be FITT@UMMC Participation §	Current participant	50 (4.3)	30 (8.5)	14.64	<.001
	Ex participant	51 (4.4)	26 (7.3)		
	Never	1049 (91.2)	298 (84.2)		
Workplace Grade §	U19	11 (1)	6 (1.7)		
	U29	1036 (90.6)	136 (38.6)		
	U32	95 (8.3)	176 (50)	453.24	<.001
	U36	0 (0)	13 (3.7)		
	U42/44/48/52	2 (0.2)	21 (6)		
Department §	Inpatient	657 (57.1)	32 (9)		
	Critical Care	270 (23.5)	20 (5.6)		
	Ambulatory	19 (1.7)	214 (60.5)		
	Operating Theatre	106 (9.2)	49 (13.8)	921.14	<.001
	Emergency	96 (8.3)	3 (0.8)		
	Infection Control and Nursing Managers	2 (0.2)	36 (10.2)		
Duration of Employment (years) †		5.00 (6.52); 6.63	18.00 (12.67); 17.54		<.001

Abbreviations: BMI (body mass index); Be FITT@UMMC (an in-house supervised fitness program organised for UMMC staff on a twice or thrice-weekly participation basis); UMMC (University Malaya Medical Centre); MYR (Malaysian Ringgit).

* MYR 1 ≈ US Dollar 0.251.

§ Values reported as 'numbers (percentages)'

† Values reported as 'years' in 'median (inter-quartile range); mean'.

Prior to data analysis, to compare the level of PA in its sub-domains and intensities, normality tests for both work schedules were conducted. The results indicated that most dependant variables were normally distributed except for 'Domestic Work', 'Leisure', 'Moderate' intensity, and the duration of 'Time spent sitting per weekday'. Table 2 shows that reported volume of energy expenditure was significantly higher among the shift-workers in the domains of 'Work' (M = 4690.12 MET-minutes/week, SD = 4315.57; p = .016) and were spent more on walking (M = 3097.77 MET-minutes/week, SD = 2719.88; p = .046) and performing vigorous activities (M = 1965.70 MET-minutes/week, SD =

2478.33; p = .034). Day-workers were noted to perform more domestic chores (M = 2006.24 MET-minutes/week, p = .038), sitting longer during weekdays (M = 165.77 MET-minutes/week; p = .002) and spent more time on daily work commute (M = 80.13 minutes, SD = 55.12; p < .001). The overall mean physical activity score was 8149.55 MET-minutes/weeks (SD = 6783.65). No differences were observed in outcomes of overall PA categorical score among the groups (p = .355). In general, 87% of the nurses were deemed highly active, while another 11% were categorised as being moderately active.

Table 2: Univariate Analysis of International Physical Activity Questionnaire-Long (IPAQ-L) Domains, Intensity and Categorical Scores for Physical Activity among Nurses.

Variables	Shift-workers	Day-workers	P-value
Domain specific (MET-mins/week) §			
Work	3612.00 (6307); 4690.12	2388.00 (5516); 4012.52	.016*
Transportation	358.05 (1221); 702.83	396.00 (1229); 687.08	.538
Domestic†	1050.00 (2273); 1916.74	1262.50 (2143); 2006.24	.038*
Leisure†	396.00 (1188); 1024.09	396.00 (990); 845.27	.334
Intensity specific (MET-mins/week) §			
Walking	2277.00 (4653); 3097.77	1732.50 (4113); 2815.28	.046*
Moderate†	2145.00 (3938); 3270.31	2130.00 (3635); 3134.77	.998
Vigorous	720 (3140); 1965.70	720.00 (2160); 1601.06	.034*
Time spent sitting (mins) §			
Per Weekday†	120.00 (210); 164.92	120.00 (180); 165.77	.002**
Per Weekend	240.00 (240); 291.96	240.00 (180); 258.95	.115
Duration of daily vehicle travel (mins) §	50.71 (86); 60.55	85.71 (88); 80.13	<.001***
Overall physical activity score (MET-mins/week) §	6572.00 (9553); 8333.77	5399.50 (8386); 7551.11	.108
PHYSICAL ACTIVITY CATEGORY ǂ			
Low	82 (2.4)	4 (1.1)	.355
Moderate	122 (10.6)	36 (10.2)	
High	1000 (87.0)	314 (88.7)	

Abbreviations: Mins (minutes); MET-mins/week (metabolic equivalent task minutes per week)
* Significant at p < 0.05; ** significant at p < 0.005; *** significant at p < 0.001
† Positively skewed data categories include sub-domains of 'Domestic', 'Leisure', 'Moderate' and 'Time spent sitting per weekday'.
ǂ Values reported as 'numbers (percentage)'**.**
§ Values reported as 'median (inter-quartile range); mean'.

Table 3 shows bivariate analysis between domains of PA with the Sociodemographic characteristics. Due to significant correlation between individual dependent variables with certain demographic variables, a covariate analysis was performed to exclude the effects of these variables from the main analysis. A General Linear Model (GLM) was applied for analysis of normally distributed variables, while a Generalized Linear Model (GLZ) was applied for the non-normal distributed variables.

Table 3: Bivariate analysis between the International Physical Activity Questionnaire-Long (IPAQ-L) sub-scores and sociodemographic variables among nurses.

Variables	Domain				Intensity			Total PA score	Sitting – weekday	Sitting – weekend	Vehicle travel/ day
	Work	Domestic	Transportation	Leisure	Walking	Moderate	Vigorous				
Age	-.125**	.023	-.035	-.183**	-.116**	-.032	-.167**	-.110**	.021	-.103**	.172**
Marital Status	-.090**	.060*	-.060*	-.154**	-.102**	.004	-.136**	-.078**	-.007	-.073**	.115**
Education Level	-.040	.002	-.014	-.109**	-.040	-.018	-.079**	-.046	.028	-.073**	.052*
Income	-.068**	.038	.011	-.165**	-.065*	.000	-.105**	-.055*	.018	-.067*	.135**
Workplace Grade	-.076**	.060*	.016	-.100**	-.056*	.006	-.124**	-.050	.058*	-.071**	.128**
BMI categories	-.065*	-.003	-.021	-.095**	-.052*	-.035	-.095**	-.068**	.014	-.011	.046
BeFITT@ UMMC Participation	.040	.007	-.021	-.072**	.007	.022	-.026	.016	-.009	.016	-.021
Duration of Employment	-.111**	.031	-.033	-.180**	-.109**	-.024	-.148**	-.098**	.020	-.107**	.173**
Department	-.027	-.065*	-.075**	.011	-.035	-.059*	-.042	-.037	.059*	.021	.069**

Abbreviations: BMI (body mass index); PA (physical activity); Be FITT@UMMC (an in-house supervised fitness program organised for UMMC staff on a twice or thrice-weekly participation basis).

* Correlation is significant at the 0.05 level (2-tailed);

** Correlation is significant at the 0.01 level (2-tailed).

Table 4 shows the analysis of variance for the dependant variables of IPAQ-L sub-scores whilst table 5 depicts the comparison of adjusted means of PA between both the shift and day-workers. There were no significant differences between adjusted mean of overall PA score for shift-workers (M = 8119.68 MET-minutes/week, SE = 212.77, 95% CI = 7702.31, 8537.06) and day-workers (M = 8320.75 MET-minutes/week, SE = 425.45, 95% CI = 7486.19, 9155.32; p = .691). The only significant difference within adjusted means of PA engagement between groups was for 'daily vehicle travel'. This suggests that shift-workers spent an average of 60.89 minutes (SE = 1.72, 95% CI = 57.52, 64.26) commuting in a vehicle daily, while day-workers reported a longer commuting time of 76.50 minutes (SE = 3.56, 95% CI = 69.52, 83.47; Mean square = 38114.49, Wald X^2 = 13.447, p < .001)

Table 4: Analysis of variance for dependant variables of the International Physical Activity Questionnaire-Long (IPAQ-L) sub-scores.

Dependent Variables	Mean Square	F / Wald Chi-Square	P-value
Domain – Work	538961.0	0.030	0.862
Domain – Transportation	727045.3	1.401	0.237
Intensity – Walking	77805.0	0.011	0.918
Intensity – Vigorous	3119291.9	0.610	0.435
Sitting – Weekend	166.8	0.170	0.895
Daily vehicle travel	38114.5	13.447	<0.001
Overall Physical Activity Score	7175494.0	0.158	0.691
Domain – Domestic*	--	0.110	0.741
Domain – Leisure*	--	0.729	0.393
Intensity – Moderate*	--	0.013	0.910
Sitting – Weekday*	--	0.353	0.553

* Based on the Generalized Linear Model (GLZ).

Table 5: Adjusted mean of physical activities between the shift- and day-workers

Dependent Variables[ǂ]	Work schedule	Mean	SE	95% Confidence Interval	
				Lower Bound	Upper Bound
Domain – Work [a]	Shift work	4565.30	134.46	4301.54	4829.06
	Day work	4509.27	270.84	3977.99	5040.56
Domain – Transportation [b]	Shift work	684.59	22.25	640.94	728.24
	Day work	744.02	42.81	660.04	828.00
Intensity – Walking [c]	Shift Work	3048.83	86.51	2879.13	3218.52
	Day Work	3027.54	174.23	2685.76	3369.32
Intensity – Vigorous [d]	Shift Work	1849.37	75.79	1700.83	1997.91
	Day Work	1991.80	153.45	1691.03	2292.56
Sitting – Weekend [e]	Shift Work	285.54	7.00	271.83	299.25
	Day Work	287.75	14.22	259.89	315.62
Vehicle travel per day [f]	Shift Work	60.89	1.72	57.52	64.26
	Day Work	76.50	3.56	69.52	83.47
Overall Physical Activity Score [g]	Shift Work	8119.68	212.77	7702.31	8537.06
	Day Work	8320.75	425.45	7486.19	9155.32
Domain – Domestic [h] *	Shift Work	1937.15	68.92	1802.07	2072.24
	Day Work	1991.50	138.02	1720.99	2262.02
Domain – Leisure [i] *	Shift Work	958.67	50.53	859.64	1057.70

	Day Work	1062.30	102.17	862.06	1262.56
Intensity – Moderate [j] *	Shift Work	3232.96	93.21	3050.26	3415.66
	Day Work	3256.09	176.05	2911.04	3601.13
Sitting – Weekday [k] *	Shift Work	166.82	5.28	156.46	177.17
	Day Work	159.40	10.52	138.77	180.02

Abbreviations: MET-mins/week (Metabolic equivalent task minutes per week); SE (standard error).
* Based on the Generalized Linear Model (GLZ)
[i] Values are in MET-mins/week, except for 'Daily vehicle travel', 'Sitting-Weekday' and 'Sitting-Weekend' which are in 'minutes'.
a: Covariates : Age, Marital Status, Income, Workplace Grade, BMI Categories, Duration of Employment.
b: Covariates : Marital Status, Department.
c: Covariates : Age, Marital Status, Income, Workplace Grade, BMI Categories, Duration of Employment.
d: Covariates : Age, Marital Status, Education Level, Income, Workplace Grade, BMI Categories, Duration of Employment.
e: Covariates : Age, Marital Status, Education Level, Income, Workplace Grade, Duration of Employment.
f: Covariates : Age, Marital Status, Education Level, Income, Workplace Grade, Department, Duration of Employment.
g: Covariates : Age, Marital Status, Income, BMI Categories, Duration of Employment.
h: Covariates : Marital Status, Workplace Grade, Department.
i : Covariates : Age, Marital Status, Education Level, Income, Workplace Grade, BMI Categories, Be FITT@UMMC Participation, Duration of Employment.
j: Covariates : Department.
k: Covariates: Workplace Grade, Department.

Discussion

Working shifts does not affect individual nurses overall measured physical activity, as evidenced by equivalent high values of physical activity engagement among both work schedules after adjusting for covariates. However, a clear distinction exists between the shift and day-working cohorts, whereby differences in eventual PA outcomes may be attributed to the cohort's intrinsic characteristics. The day-working nurses are generally older, possess a higher qualification, and higher income. This itself is in agreement with Malaysian trends of apparent reduced PA levels in the higher-income earners, older and better-educated individuals (Cheah & Poh, 2014; Institute for Public Health Malaysia, 2015; Lian, Bonn, Han, Choo, & Piau, 2016). Conventionally, newly recruited nurses are frequently placed in the inpatient setting to gain clinical work-experience. As they advance up the career ladder, their rising 'seniority' would empower them to seek a more stable working-hour arrangement, particularly with greater childbearing responsibilities shouldered by the predominantly female workforce. This natural progression will lead nurses to either departments which are office-hours based or hold roles with more responsibilities such as ward matrons, both of which tend to be desk-bound, likely reducing PA engagement.

Differences in duration of daily vehicle commute may be explained by the fact that the more senior day-working nurses are likely to be married with assumed additional responsibilities of shuttling their children back and forth to school and attending various extra-curricular activities. Furthermore, day-working nurses encounter regular morning and evening traffic

adversities similar to other office-based workers and therefore may spend a longer time commuting. The younger shift-working nurses may be opting to live nearer to work, as they may be being fairly new to the job and lack a means of personal transportation.

Despite the high rates of PA participation found in this study, conflicting results were noted evidenced by the high prevalence of overweight and obesity among both the shift and day-workers. Physical activity is an integral component of overall cost of energy expenditure and is therefore pertinent to energy balance and weight management considerations (World Health Organisation, 2010b). Internationally, the prevalence of unhealthy weight among nurses is known to be high, and studies conducted in America (Han, Trinkoff, Storr, & Geiger-Brown, 2011; Miller, Alpert, & Cross, 2008; Nam & Lee, 2016; Zapka et al., 2009), Australia (Zhao et al., 2011), Malaysia (Coomarasamy, Wint, Neri, & Sukumaran, 2012), and Ghana (Aryee et al., 2014) has shown that overweight ranges from 41.3% to 65%. This study revealed that the combined prevalence of pre-obese/obesity was at an alarming 62.4%. Unsurprisingly, these findings are in fact supported by the 2015 Malaysian NHMS review whereby levels of PA were observed to be inversely associated with the risk of overweight/obesity in men but not in women (Chan, 2017). This suggested that men tend to attain a higher intensity of PA than women and thus are able to achieve greater efficacy in obesity reduction. An obese nurse may be assumed to be physically inactive in the eyes of patients, which reflects negatively on the role of nurses as health advocates. As a female-predominant vocation, nurses should therefore emphasize more vigorous-intensity PA, rather than merely moderate or low-intensity activities in order to lose weight.

Also, a major proportion of reported PA was attributed to occupational PA, with leisure time PA being only marginally more than that of transportation's PA (see figure 2 in supplementary document), despite 97.9% of the sampled nurses being deemed sufficiently active. Therefore, these results should not be viewed favourably as a high occupational PA indicates greater physical work-stress predisposing to a detrimental reduction in leisure time PA participation. This may be hypothesised by the fact that occupational PA is often of low intensity to adequately stimulate cardio-respiratory fitness, tends to increases average heart rate, blood pressure and inflammation, and is often performed in static and constrained postures without sufficient recovery period; all these conferring an increased prospect of developing cardiovascular diseases (Holtermann, Krause, van der Beek, & Straker, 2018). The term 'physical activity health paradox' has been described previously to explain, in a dose-response manner, that having a high occupational PA was linked to an increased risk for long-term illness absence spells, whilst greater leisure time PA favours physical well-being (Holtermann, Hansen, Burr, Sogaard, & Sjogaard, 2012). High occupational PA with low leisure time PA participation have been shown to contribute to a higher BMI, sleep disorders and certain psychological manifestations among nurses (Zapka et al., 2009). Therefore, time-poor individuals in professions which consider themselves work-active should commit to greater leisure time PA engagement as overwhelming occupational PA is not seen as a sufficient health stimulus but is in fact detrimental to overall well-being.

'Be FITT@UMMC' is a unique hospital-based fitness program conducted during office hours which is designed to promote fitness among all hospital staff in the UMMC. However, its benefits on overall PA engagement remains inconclusive as only a small number of nurses seem to have embarked on it. 8.7% (100) of shift versus 15.8% (56) of day-workers sampled were either current or ex-participant of this staff-exclusive fitness program, ongoing since

2016. Perhaps, further initiatives such as extending the 'Be FITT@UMMC' program after office-hours or permitting more 'time-inclusive participation' off their regular working hours, particularly among shift-working nurses with co-morbidities may encourage greater involvement of leisure time physical activity.

Strengths and Weaknesses

This study has several strengths. Firstly, this is the largest known PA census study conducted among Malaysian nurses that enables extrapolation of the results to the average Malaysian nursing population. Secondly, a high response rate enhances the validity of the sampled data. In addition, an earlier survey on nurses of the same institution using IPAQ-L noted that more than 85% of nurses (n = 44) were physically active, thus supporting our findings (Lingesh, Khoo, Mohamed, & Taib, 2016). Thirdly, the use of validated IPAQ-L allows comparison with other population-based research worldwide. Nonetheless, this study is not without limitations. Firstly, the causal relationship between PA and shift-work cannot be established by the cross-sectional study design. Secondly, self-assessment of PA and anthropometry may invariably entail a degree of misclassification. Social desirability bias may encourage nurses to report a higher PA engagement. The IPAQ-L is less accurate compared with other objective measures of PA such as pedometers. Lastly, other factors such as home circumstances and social interactions are known to impact lifestyle behaviours and these have not been addressed in this study (Newey & Hood, 2004).

Recommendations

Having ascertained that rising workplace seniority may inadvertently select nurses into more work-passive day schedules, future research should attempt to further understand how the differing nursing roles within departments such as emergency medicine, critical care, operating theatre, paediatric or surgical inpatient nursing, may ultimately affect overall PA engagement. Additional longitudinal studies looking into establishing the eventual outcomes of incorporating a hospital-based fitness program such as the 'Be FITT@UMMC' in modulating positive active behaviour and practices, particularly among those at risk of inactivity, will hopefully guide policy-makers into creating a work environment which is both conducive and supportive to the global well-being of their healthcare practitioner, leading to improved patient care delivery.

Conclusion

This study reports high rates of physical activity engagement among UMMC nurses. 97.9% of the sampled nurses were deemed sufficiently active. Work schedule, particularly shift-work does not seem to harm individual nurses' overall measure of PA. We believe that the differences within domains and intensities of physical activities may be attributed to their respective cohort characteristics. However, as the nurses were found to be overwhelmingly work-active at the expense of adequate leisure time physical activity engagement, this 'physical activity health paradox' may not confer sufficient health benefits as previously thought. Worryingly, we also noted a high prevalence of overweight and obesity among both the shift and day-workers. Appearing fit and trim by practicing what one preaches is indeed very important to convince the patients and the broader public to be physically active.

Strategies such as profiling nursing staff from specific work localities which are at risk of inactivity will allow more targeted resources and organised interventions to facilitate and instil the needed behavioural modifications.

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