

## Connecting Leisure-Time Physical Activity and Quality of Sleep to Nurse Health: Data from the e-Cohort Study of Nurses and Midwives

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### Abstract

**Background:** Professional nurses are prone to fatigue and poor health. Getting sufficient physical activity and sleep have reported benefits. However, the benefit of ample sleep and physical activity to nurse health is understudied.

**Objective:** The goal of the current article is to report nurse general and workplace health, productivity and wellbeing by comparing those professionals with recommended levels of physical activity and sleep to those with reduced profiles.

**Design:** Data were generated from the 2006-08 delivery of the e-Cohort survey of nurses and midwives.

**Methods:** The primary analysis (n=3967) was based on the physical activity and sleep categories: (LS1) Meeting the recommended guidelines or above for both leisure physical time activity and sleep; (LS2) Meeting the recommended guidelines or above for leisure time activity but not sleep; (LS3) Meeting the recommended guidelines or above for sleep but not leisure time activity; and (LS4) Not meeting the recommended guidelines for both leisure time activity and sleep.

**Results:** LS1 were significantly younger, had a lower body mass index than any other group and were the least likely to report in-work difficulty, emotional barriers to workplace productivity and restriction in basic daily tasks. LS4 were more likely to have osteoarthritis, depression and high blood pressure.

**Conclusion:** The study findings confirm health benefits from achieving recommended levels of physical activity and sleep. Adherence to beneficial lifestyle behaviours has important implications for the self-health of nurses. Workforce administrators should consider this when designing programs to reduce nurse workplace burnout and aid workforce retention.

**Keywords** Guideline adherence; Nurse health; Physical activity; Sleep; Workplace fatigue; Workplace productivity; Workforce planners

### Introduction

Nurses are often reported less than healthy and engaged in health risk behaviours such as poor dietary habits, lack of exercise and physical activity, and smoking [1-3]. The combination of shift work and workplace stress is known to compromise nurse wellbeing, and is a common precursor to poor sleeping quality [4]. As a result, nurses often spiral into fatigue, drowsiness and burnout, which culminate in reduced patient care and staff turnover [5,6]. For those nurses engaged in healthy lifestyle behaviours, measurable positive physical and workplace wellbeing benefits are reported [7-9]. Yet it would appear the translation of this evidence to nurse practice is below expectation. While it could be assumed that nurses might have improved

knowledge of habits proven to combat stress and fatigue, such as regular physical activity, research consistently highlights nursing as a profession with poor physical and cognitive health [1,2,7]. Recent work by Blake et al. [1] reported that poor health was endemic among nurses with the majority not adhering to national guidelines or recommendations. Given the growing need for competent and invested nurse professionals, the existence of poor self-health that compounds workplace fatigue and burnout is a valid concern that requires more detailed investigation [10].

In 2010, the World Health Organization named physical inactivity as the fourth leading risk factor for global mortality [11]. Associated with physical inactivity are increased risks of disease and all-cause mortality [12]. In contrast, being physically active and/or involved in regular exercise has a plethora of benefits including reduced risk of disease and improved vitality among other health outcomes [11]. Sleeping patterns are also recognized as a determinant of health.

Relationships exist between sleeping disorders and declining wellbeing, increased morbidity and mortality, as well as reduced productivity and memory performance [13,14]. In addition, sleeping disorders are linked to obesity, back pain, anxiety and depression [15,16], and are predictive of workplace burnout [4]. In contrast, improved sleep benefits function, mood, reaction time and reduced daytime sleepiness [17]. Investigations of improved sleep quality and quantity consistently show improved performance, alertness and mood, with results appearing most beneficial to those who work shift or night-time [17-19], and extended to reduced post-shift motor vehicle incidents and fatalities [20].

Recent work confirms that nurses involved in regular leisure time physical activity and improved lifestyle choices report an improved health and workplace productivity profile [8,21]. However, the benefit of physical activity and sleep recommendation adherence for nurses is poorly understood. From this evidence, it could be hypothesized that beyond health and wellbeing, nurses achieving the recommended levels will experience reduced workplace stress and burnout, and deliver advance patient care [8,9]. The goal of this article is to report nurse general and workplace health, productivity and wellbeing by comparing those professionals with recommended levels of physical activity and sleep to those with reduced profiles. In addition to the potential to improve nurses' self-health, this work can guide the health promotion, recruitment and retention efforts of workplace administrators.

## Methods

### Study design

Employing survey data captured by the Australian and New Zealand Nurses and Midwives e-Cohort study, this cross-sectional investigation used a group categorization design to analyse the hierarchal impact of an increased sleep and physical activity profile to individuals reporting reduced profiles, in relation to general and workplace health, productivity and wellbeing.

Data were drawn from the large, self-reported survey of practicing nurses and midwives across multiple working environments. The sample, recruitment and survey structure have been described in detail previously [22-24]. In brief, employing Australia and New Zealand academic network support, nursing and midwifery councils were approached to seek permission to recruit nurses for survey. Recruitment commenced in April 2006 and concluded in March 2008. Of the 290 000 Australian and 44 400 New Zealand registered and enrolled nurses and midwives eligible for inclusion, 8247 participated in the survey [22], and 3967 nurses with sleep and physical activity data were included in this analysis.

### Research ethics

Ethics approval was provided by the University of Queensland Human Research Ethics Committee.

### Data collection

To all eligible members, a personalized email was sent with a study introduction and invitation to participate. Within the email, a URL link directed participants to the study website. The 108 question e-Cohort survey took approximately 40 minutes to complete and

population-based information were collected around two central themes:

- **Work/Life Balance:** Describing and quantifying the factors associated with the retention of the existing workforce and patterns of employment; and
- **Staying Healthy:** Measuring the prevalence, incidence and associated risk factors of physical, mental and health behaviours, including musculoskeletal disorders and work-place injuries in the cohort.

These themes were submerged among a composite of validated and widely used questionnaires (e.g., International Physical Activity Questionnaire, SF-36) and the direct assessments of markers of workforce involvement and health (e.g., years of shift work, BMI).

### Data categorization

In this study, total leisure time physical activity in MET (Metabolic equivalent of task) minutes per week and sleeping time per night were categorized, then merged into four distinct groups. Total leisure time physical activity was a combined measure of self-reported low, moderate and vigorous activity undertaken across a seven day continuum, and reported in METs. Data were generated from the International Physical Activity Questionnaire (IPAQ) [25]. The questions used were:

- 'Not counting any walking you have already mentioned, during the last seven days, on how many days did you walk for at least 10 minutes at a time in your leisure?'
- 'During the last seven days, on how many days did you do moderate physical activities [>10 minutes] like bicycling at a regular pace, swimming at a regular pace and doubles tennis in your leisure time?' and
- 'During the last seven days, on how many days did you do vigorous physical activities [>10 minutes] like aerobic running, or fast swimming in your leisure time?'

Participants reported the number of 'Days per Week' and 'Minutes per Day' they undertook physical activity. Data were then converted to MET minutes/week, and the three levels of leisure time activity were summed to give total leisure time physical activity. Participants were categorized as: Low - below the recommendations for weekly physical activity; Moderate - at the weekly recommendation range; or High - above the weekly recommendations. Categories were based on the American College of Sports Medicine guidelines for developing and maintaining health in adults, with those who reported total leisure time activity less than 630 MET minutes/week categorized low and those reporting greater than 1240 MET minutes/week categorized as high leisure time activity [26].

Sleeping time was categorized in accordance with the National Sleep Foundation guidelines that optimal sleep for adults is 7 - 9 hours per night, and the established evidence that less than optimal sleep has detrimental health and productivity implications [27]. Sleep data were generated from the following question:

- 'How many hours of actual sleep do you usually get in a 24 hour period?'

Those who reported sleeping for less than 7 hours a night were categorized as poor sleepers, and those who reported > 9 hours were categorized as above optimal (7-9 hours/night).

To analyse the impacts of *leisure time activity* and *sleep* on health and vitality, four groups were created. These were: (LS1) Meeting the recommended guidelines or above for both leisure time activity (moderate and high physical activity) and sleep (7-9 hours or above); (LS2) Meeting the recommended guidelines or above for leisure time activity but not sleep; (LS3) Meeting the recommended guidelines or above for sleep but not leisure time activity; and (LS4) Not meeting the recommended guidelines for both leisure time activity and sleep. Group comparisons were then undertaken against questions reflecting self-reported health status, vitality, disease and capacity in activities of daily living.

### Data analysis

All data were processed in SPSS version 22.0 (SPSS Inc., Chicago, IL, USA). Data were extensively reviewed and outliers eliminated by case using the parameters described above. Descriptive and frequency analysis were undertaken dependent on the variables status, continuous or categorical. For between group analyses, Pearson's Chi Squared test ( $\chi^2$ ) was conducted for categorical data and where appropriate a logistic regression analysis was undertaken to represent the strength of difference. For continuous data, analysis of variance (ANOVA) was conducted and Bonferroni post-hoc procedure used to identify the source of difference. An alpha level of 0.05 was required for significance. Data are presented as mean  $\pm$  standard deviation.

**Table 1:** Between group differences for age, BMI, sitting time and days off sick.

	Group				P*	Post-hoc**
	1	2	3	4		
<b>Age (yrs)</b>	41.44 $\pm$ 10.15	42.79 $\pm$ 10.07	42.80 $\pm$ 10.09	44.66 $\pm$ 10.23	<.001	4 > 3 > 2, 1
<b>Number†</b>	790	392	1482	880		
<b>BMI (kg/m2)</b>	25.92 $\pm$ 4.92	26.71 $\pm$ 5.42	27.84 $\pm$ 6.02	28.60 $\pm$ 6.38	<.001	4 > 3 > 2, 1
<b>Number (%)‡</b>	779 (98.6)	389 (99.2)	1456 (98.2)	872 (99.1)		
<b>Sitting Time Week days (m/d)</b>	1045.39 $\pm$ 959.35	845.87 $\pm$ 713.14	1121.16 $\pm$ 1437.33	988.16 $\pm$ 1086.83	0.003	3 > 2
<b>Number (%)‡</b>	605(76.6)	300 (76.5)	1077 (72.7)	626 (71.1)		
<b>Sitting Time Weekends (m/d)</b>	341.47 $\pm$ 296.35	347.97 $\pm$ 352.33	386.02 $\pm$ 385.28	378.21 $\pm$ 392.78	0.034	3 > 1
<b>Number (%)‡</b>	730 (92.4)	368 (93.9)	1308 (88.3)	792 (90.0)		
<b>Days off sick</b>	8.41 $\pm$ 26.78	6.76 $\pm$ 14.90	9.99 $\pm$ 48.16	5.91 $\pm$ 12.59	0.357	
<b>Number (%)‡</b>	214 (27.1)	150 (38.3)	480 (32.4)	350 (39.8)		

Data are mean  $\pm$  standard deviation Groups: (1) Meeting the recommended guidelines or above for both leisure time activity and sleep; (2) Meeting the recommended guidelines or above for leisure time activity but with poor sleep; (3) Meeting the recommended guidelines or above for sleep but not leisure time activity; and (3) Not meeting the recommended guidelines for both leisure time activity and sleep. yrs – years, BMI – body mass index, kg/m2 – kilograms per metre squared, m/d minutes per day

\* Between group ANOVA \*\* Between-group Bonferroni post hoc comparison † Total number of individual allocated to each group

‡ Total number of responders per group per variable (% of total possible sample)

### General health and energy

When asked about levels of energy, LS1 were most likely to have sufficient energy “Most of the time” (39.8%) ( $\chi^2=198.635$ , d.f.=12,  $p < .001$ ). In relation to happiness, LS1 were most likely to report feeling happy “All of the time” ( $\chi^2=93.241$ , d.f.=12,  $p < .001$ ), while LS4 most likely to report feeling tired “All of the time” ( $\chi^2=136.012$ , d.f.=12,  $p$

### Results

Prior to group classification, the cohort age was 42.9  $\pm$  10.2 years (n=3967) and reported 673.9  $\pm$  1069.8 MET minute/week of total leisure activity. They were predominantly female (91.4%), with 86.7% of the cohort achieving 7–9 hours’ sleep per night, but greater than 65% not meeting the recommended guidelines for leisure time physical activity per day.

### Workplace wellbeing

Those who had the best activity and sleep profile (LS1) were younger and had lower BMI's than all other groups ( $p < .001$ ) (Table 1). LS1 were most likely to report having difficulty in performing their work “None of the time” ( $\chi^2=88.532$ , d.f.=12,  $p < .001$ ). Similarly, LS1 were most likely to report that due to emotional issues (depression, anxiety) they had cut down on time at work ( $\chi^2=46.567$ , d.f.=12,  $p < .001$ ), accomplished less at work ( $\chi^2=52.503$ , d.f.=12,  $p < .001$ ) or had not demonstrated care in work place tasks ( $\chi^2=30.419$ , d.f.=12,  $p=.002$ ) “None of the time”. In addition, LS1 were most likely to report feeling full of life “Most of the time” ( $\chi^2=162.493$ , d.f.=12,  $p < .001$ ), nervous “None of the time” ( $\chi^2=49.495$ , d.f.=12,  $p < .001$ ) and down hearted and depressed “None of the time” ( $\chi^2=91.734$ , d.f.=12,  $p < .001$ ).

< .001). When asked about General Health, LS1 were most likely to report “Excellent” or “Very Good” (46.1%) health, and LS4 most likely to report “Fair” (18.7%) health ( $\chi^2=244.619$ , d.f.=12,  $p < .001$ ). LS4 were least likely and LS1 the most likely to respond “Definitely false” to their health getting worse ( $\chi^2=71.326$ , d.f.=12,  $p < .001$ ). These data are presented in more detail in (Table 2).

**Table 2:** Group differences for self-reported wellbeing and general health by Pearson's chi squared test ( $\chi^2$ ), Omitted responses given in brackets

Group	1		2		3		4		Total		P <sup>*</sup>
	n	%	n	%	n	%	n	%	n	%	
<b>Difficulty performing work (Most of/A little of the time)</b>											
All of the time	8	1	11	2.8	30	2	20	2.3	69	2	<.001
Some of the time	133	17	98	25.3	292	19.8	249	28.4	772	21.9	
None of the time	403	51.4	157	40.6	665	45.1	283	32.3	1508	42.8	
Emotional problem causing:											
<b>Cut down on work (Most of/A little of the time)</b>											
All of the time	7	0.9	7	1.8	13	0.9	12	1.4	39	1.1	<.001
Some of the time	104	13.3	63	16.2	222	15	157	17.9	546	15.5	
None of the time	521	66.5	240	61.5	919	62.2	473	53.8	2153	61	
<b>Accomplish less (Most of/A little of the time)</b>											
All of the time	6	0.8	13	3.3	33	2.2	22	2.5	74	2.1	<.001
Some of the time	148	18.8	86	21.9	291	19.7	217	24.7	742	21	
None of the time	394	50.1	162	41.3	689	46.7	327	37.2	1572	44.5	
<b>Be less careful (Most of/A little of the time)</b>											
All of the time	5	0.6	5	1.3	8	0.5	8	0.9	26	0.7	<.001
Some of the time	102	13	66	17	222	15.1	154	17.6	544	15.5	
None of the time	475	60.4	220	56.6	839	57.1	430	49.1	1964	55.8	
<b>Felt full of Life (Most of/A little of the time)</b>											
All of the time	55	7	11	2.8	39	2.6	16	1.8	121	3.4	<.001
Some of the time	247	31.4	155	39.5	556	37.5	345	39.3	1303	36.8	
None of the time	10	1.3	14	3.6	55	3.7	60	6.8	139	3.9	
<b>Felt nervous (Most of/A little of the time)</b>											
All of the time	3	0.4	5	1.3	6	0.4	11	1.3	25	0.7	<.001
Some of the time	192	24.4	103	26.3	337	22.8	263	30.1	895	25.4	
None of the time	312	39.7	121	30.9	547	37	248	28.4	1228	34.8	
<b>Felt down in the dumps (Most of/A little of the time)</b>											
All of the time	2	0.3	4	1	9	0.6	13	1.5	28	0.8	<.001
Some of the time	104	13.2	80	20.5	208	14	202	23	594	16.8	
None of the time	472	60.1	185	47.4	812	54.9	346	39.4	1815	51.3	
<b>Felt calm and peaceful (Most of/A little of the time)</b>											
All of the time	19	2.4	6	1.5	31	2.1	16	1.8	72	2	<.001
Some of the time	303	38.5	155	39.7	583	39.5	329	37.6	1370	38.8	

None of the time	19	2.4	20	5.1	58	3.9	57	6.2	151	4.3	
<b>Had lots of energy (Most of/A little of the time)</b>											
All of the time	33	4.2	10	2.6	19	1.3	21	2.4	83	2.3	< .001
Some of the time	300	38	176	44.9	597	40.3	323	36.9	1396	39.5	
None of the time	30	3.8	16	4.1	116	7.8	106	12.1	268	7.6	
<b>Felt downhearted and depressed (Most of/A little of the time)</b>											
All of the time	2	0.3	7	1.8	12	0.8	13	1.5	34	1	< .001
Some of the time	144	18.3	90	23.1	310	20.9	241	27.4	785	22.2	
None of the time	327	41.6	113	29	503	34	216	24.6	1159	32.8	
<b>Felt worn out (Most of/A little of the time)</b>											
All of the time	19	2.4	22	5.6	61	4.1	56	6.4	158	4.5	< .001
Some of the time	301	38.2	155	39.6	552	37.2	338	38.5	1346	38	
None of the time	91	11.5	25	6.4	115	7.8	37	4.2	268	7.6	
<b>Been happy (Most of/A little of the time)</b>											
All of the time	79	10.1	24	6.2	105	7.1	41	4.7	249	7	< .001
Some of the time	177	22.5	121	31	434	29.3	303	34.5	1035	29.3	
None of the time	3	0.4	4	1	12	0.8	8	0.8	27	0.8	
<b>Felt tired (Most of/A little of the time)</b>											
All of the time	44	5.6	45	11.5	125	8.5	117	13.4	331	9.4	< .001
Some of the time	346	44	156	40	635	42.9	304	34.7	1441	40.8	
None of the time	15	1.9	4	1	25	1.7	12	1.4	56	1.6	
<b>General health (Very good/Fair)</b>											
Excellent	179	22.7	66	16.8	165	11.1	63	7.2	473	13.4	< .001
Good	198	25.1	139	35.4	596	40.2	397	45.2	1330	37.5	
Poor	7	0.9	1	0.3	16	1.18	0.9	32	0.9		
<b>Expect health to get worse (Mostly true/false)</b>											
Definitely true	16	2	10	2.6	27	1.8	30	3.4	83	2.3	< .001
Don't know	181	22.9	108	27.6	425	28.7	261	29.7	975	27.6	
Definitely false	327	41.4	123	31.4	439	29.7	215	24.5	1104	31.2	

Groups: (1) Meeting the recommended guidelines or above for both leisure time activity and sleep; (2) Meeting the recommended guidelines or above for leisure time activity but with poor sleep; (3) Meeting the recommended guidelines or above for sleep but not leisure time activity; and (3) Not meeting the recommended guidelines for both leisure time activity and sleep. n - number, % - percentage of total group. \*Pearson's Chi-squared test 2-sided significance.

### Physical capacity

Supporting the trend in better general health for LS1 was the greater likelihood of being in a healthy BMI category (18.6 – 24.9 Kg/m<sup>2</sup>) (46.9%), with LS4 having a greater likelihood of being obese ( $\geq 30$  kg/m<sup>2</sup>) (34.3%) ( $\chi^2=73.848$ , d.f.=9, p<.001). In addition, LS1 were most likely to report having no limitation in lifting groceries

( $\chi^2=28.00$ , d.f.=6, p<.001), climbing one ( $\chi^2=56.559$ , d.f.=6, p<.001) or several ( $\chi^2=131.666$ , d.f.=6, p < .001) flights of stairs, walking one mile ( $\chi^2=95.121$ , d.f.=6, p < .001) or kneeling ( $\chi^2=65.771$ , d.f.=6, p<.001). These data are presented in more detail in Table 3.

**Table 3:** Self-reported restrictions in physical capacity by Pearson's chi-squared test ( $\chi^2$ ), Omitted responses given in brackets Groups: (1)

Group	1		2		3		4		Total		P*
	n	%	n	%	n	%	n	%	n	%	
<b>Restricted in:</b>											
<b>Lifting groceries (Limited a lot/a little)</b>											
Not at all	691	88	327	84.3	1205	82.3	682	78.5	2905	82.9	< .001
<b>Climbing one flight of stairs (Limited a lot/a little)</b>											
Not at all	739	94.3	351	91.4	1288	87.7	721	82.9	3099	88.4	< .001
<b>Climbing several flights of stairs (Limited a lot/a little)</b>											
Not at all	652	83.3	295	76.2	1015	69.2	529	60.7	2491	71	< .001
<b>Walking one mile (Limited a lot/a little)</b>											
Not at all	719	91.5	336	87	1184	80.8	642	74	2881	82.2	< .001
<b>Bending or kneeling (Limited a lot/a little)</b>											
Not at all	621	79.1	274	70.8	1021	69.5	531	61	2447	69.7	< .001

Groups: (1) Meeting the recommended guidelines or above for both leisure time activity and sleep; (2) Meeting the recommended guidelines or above for leisure time activity but with poor sleep; (3) Meeting the recommended guidelines or above for sleep but not leisure time activity; and (3) Not meeting the recommended guidelines for both leisure time activity and sleep,

n - number, % - percentage of total group,

\*Pearson's Chi-squared

**Table 4:** Association between disease and adherence to physical activity and sleep recommendations

Group	2			3			4			p*
	OR	CI	p	OR	CI	p	OR	CI	p	
Anxiety	1.34	.95-1.90	0.097	1.12	.88-1.48	0.329	1.56	1.19-2.06	0.001	0.006
Cervical cancer	2.18	1.22-3.92	0.009	1.05	.63-1.70	0.867	1.22	.71-2.11	0.474	0.023
Congestive heart failure	2.07	.86-5.02	0.107	0.91	.41-1.99	0.803	0.54	.19-1.49	0.231	0.056
Depression	1.6	1.21-2.12	0.001	1.38	1.12-1.70	0.003	1.76	1.41-2.21	>.001	>.001
Elevated triglycerides	1.2	.74-1.94	0.464	1.52	1.08-2.15	0.016	1.83	1.28-2.63	0.001	0.007
Elevated cholesterol	1.57	1.12-2.22	0.009	1.52	1.18-1.97	0.001	1.92	1.46-2.52	>.001	>.001
High blood pressure	1.29	.90-1.84	0.163	1.2	.92-1.56	0.176	1.56	1.18-2.06	0.002	0.015
Osteoarthritis	1.86	1.17-2.96	0.009	1.69	1.18-2.43	0.005	2.29	1.57-3.34	>.001	>.001

Groups: (1) Meeting the recommended guidelines or above for both leisure time activity and sleep; (2) Meeting the recommended guidelines or above for leisure time activity but with poor sleep; (3) Meeting the recommended guidelines or above for sleep but not leisure time activity; and (3) Not meeting the recommended guidelines for both leisure time activity and sleep, Group 1 are the reference group and the association is presence of disease, OR – Odds Ratio, CI – 95% confidence interval, p – significance by binary logistic regression between group and the reference group, p\* model significance by binary logistic regression

#### Disease

For disease, LS1 were most likely to report no history of anxiety (87.8%) ( $\chi^2=12.385$  d.f.=12, p=.006) and osteoarthritis (94.8%) ( $\chi^2=19.196$ , d.f.=3, p<.001). LS2 was most likely to report a history of

cervical cancer (6.2%) ( $\chi^2=9.911$ , d.f.=3, p<.019) and congestive heart failure (2.6%) ( $\chi^2=8.197$ , d.f.=3, p<.042). LS4 were most likely to report a history of depression (31.1%) ( $\chi^2=26.019$ , d.f.=3, p<.001), elevated triglycerides (10.7%) ( $\chi^2=12.178$ , d.f.=3, p<.007), cholesterol (20.3%)

( $\chi^2=22.313$ , d.f.=3,  $p<.001$ ) and high blood pressure (17.3%) ( $\chi^2=10.478$ , d.f.=3,  $p<.015$ ). Logistic regression analyses for diseases (Table 4) demonstrated LS1 had a significantly reduced risk for osteoarthritis, elevated cholesterol and depression compared to all other groups ( $p\leq.009$ ).

## Discussion

This study demonstrates significant benefit for nurses physically active and sleeping at or above the recommended level. Specifically, the findings conclusively show that those attaining the recommended physical activity and sleep profile are most likely to be productive, experience reduced barriers to workplace and external physical activities, have a reduced risk of disease and be more likely to report 'better' health. Moreover, we hypothesize these "healthier" nurses would have a greater capacity for caring. To this end, affirmed are the benefits to nurses that actively pursue personal wellbeing and to the efforts of employers who support employee healthy lifestyle promotion.

Across all populations physical inactivity and sedentary behaviour are established precursors to premature mortality; and poor sleeping patterns are linked to reduced wellbeing, increased morbidity and diminished productivity [11,13,14]. For nurses, the impact of daytime fatigue associated to poor sleep, reduces workplace productivity and lowers cognitive function [14,28]. When coupled with shift-work, consistent poor sleep has been shown to play a significant role in reducing work and post-work safety, and specifically the increased risk of post-shift road fatality [20]. In our study, 32% of the sample reported getting less than optimal sleep, which is consistent with norms that report greater than one third of adult populations have poor sleeping patterns [27].

As a countermeasure, there have been a number of reported strategies targeting improved sleep. Recently, Steffen et al. [29] demonstrated the value of an 8-week workplace healthy sleep program, where following a 1 hour session per week that delivered improved sleep technique education, participants reported reduced stress and fewer nights of "poor sleep", as well as an improved quality of life and energy levels. Other strategies specific to nurses that have been successful have included structured workplace napping and permanent night or day duty rosters [30]. Given the extended duration of nurse shifts and the impact of rotating rosters on life balance, workplace interventions hold potential for improved sleeping profiles [20,31]. These considerations should also be extended to physical activity. Workplace based interventions and/or educational seminars either; (a) targeting improved activity participation, or (b) lobbying holistic healthy lifestyle behaviours, have been consistently demonstrated successful [32-36]. For participants, workplace interventions are convenient to access and are reported to improve markers of disease and quality of life as well as reduce job stress and improve productivity [34,37]. For the employer, the investment of delivering workplace interventions is associated with reduced absenteeism and staff turnover [33].

The current study findings indicate that when physical activity participation is coupled with good sleep practice, nurses achieve a psychosomatic benefit. With the exception of congestive heart failure, LS1 reported an enhanced level of disease resistance to all other groups for osteoarthritis, elevated cholesterol and depression. Moreover, when compared to those not achieving sufficient sleep and physical activity, the LS1 health profile extended to a reduced risk of high blood

pressure, elevated triglycerides and anxiety. This disease disparity between those with the highest profile and those with the lowest, speaks to the value of a healthy lifestyle. With increased disease risk comes other personal and financial implications [38]. For osteoarthritis alone, individuals can incur medical cost 28% - 30% higher than their non-arthritis counterparts, with the cost increasing in the presence of a secondary diagnosis such as high blood pressure [39]. With an ageing population, and the increase in chronic illness and complex health care needs, the demand for nursing services will increase [40]. Therefore, the promotion of a healthy nurse workforce is paramount to meet the increased demands for services and reducing the potential for nurses prematurely being consumers of health care services themselves.

Work to date demonstrates that within the nursing profession, turnover is high and consistently associated with reduced patient care and nurse burnout [41]. Recent work by Wang et al. [42] reported emotional exhaustion and depersonalization as underlying factors in nurse burnout. Supported by previous research, Wang et al. urged workforce administrators to seek means of improving nurse self-efficacy and reduce environmental stressors [10,42]. This and previous work undertaken by our group, has consistently demonstrated an association between improved workplace vitality, emotional capacity and general health among nurses adhering to one or multiple lifestyle health behaviour [8,21]. Workforce administrators need to take note of this if they wish to reduce nurse staff turnover, extend staff workforce retention and the attendant quality of care.

The present study limitations include the following. Firstly, data are self-reported and the development of the sub-grouped units of analysis is informed by a two stage categorization process in a convenience sample. However, this form of delivery is common in epidemiological evaluation, with large internet population-based surveys and other web-based questionnaires having demonstrated acceptance and feasibility. In an electronic age, web-based surveys have greater accessibility and integrity, with improved cost-effective outcomes over traditional telephone contact and/or face-to-face collections [22]. For this work, categorization is substantiated by that BMI increased across groups (LS1-4) as would be expected with decreasing levels of physical activity participation [43]. In addition, the cohort figures for physical activity (<28%) and sleep (>70%) guideline adherence are consistent with national estimates [27,44]. While barriers to participation are an important consideration not discussed here, for workforce administrators looking to intervene in poor nurse health the underlying fact delivered by this work is that adherence and participation play an undisputable role in an individual's health and wellbeing. Finally, the current data was drawn from nurses working in the southern hemisphere and the findings reported here may not be generalizable to nurses working elsewhere. That said, similar results have been reported in a study of nurses working in the northern hemisphere [9].

## Conclusion

This study demonstrates the benefits to nurses of meeting and exceeding the recommended guidelines for physical activity and sleep. These benefits are further contextualized against measures of disease, workplace productivity and general health and wellbeing, especially when compare to nurses who do not adhere to the recommendations. The majority of nurses were insufficiently engaged in physical activity, but were achieving the recommended level of sleep. However, it is the combination of attaining the two recommendations that affords the

greatest benefit. The implications of not adhering to recommended levels of sleep and activity extends to individual wellbeing and would be assumed to reduce capacity for patient care. The findings from this study are an important reminder to employers seeking to bolster their nurse recruitment and retention efforts. For example, effective workplace activity based programs are likely to yield significant benefits to workers, patients and the organization's 'bottom line'.

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## References

1. Blake H, Malik S, Mo PK, Pisano C (2011) 'Do as say, but not as I do': are next generation nurses role models for health? *Perspect Public Health* 131: 231-239.
2. Malik S, Blake H, Batt M (2011) How healthy are our nurses? New and registered nurses compared. *Br J Nurs* 20: 489-496.
3. Zapka JM, Lemon SC, Magner RP, Hale J (2009) Lifestyle behaviours and weight among hospital-based nurses. *J Nurs Manag* 17: 853-860.
4. Alimoglu MK, Donmez L (2005) Daylight exposure and the other predictors of burnout among nurses in a University Hospital. *Int J Nurs Stud* 42: 549-555.
5. Poissonnet CM, Véron M (2000) Health effects of work schedules in healthcare professions. *J Clin Nurs* 9: 13-23.
6. Wong H, Wong MCS, Wong SYS, Lee A. (2010) The association between shift duty and abnormal eating behavior among nurses working in a major hospital: a cross-sectional study. *Int J Nurs Stud* 47:1021-7.
7. Hawker CL (2012) Physical activity and mental well-being in student nurses. *Nurse Educ Today* 32: 325-331.
8. Henwood T, Tuckett A, Turner C (2012) What makes a healthier nurse, workplace or leisure physical activity? Informed by the Australian and New Zealand e-Cohort Study. *J Clin Nurs* 21: 1746-1754.
9. Sveinsdóttir H, Gunnarsdóttir HK (2008) Predictors of self-assessed physical and mental health of Icelandic nurses: results from a national survey. *Int J Nurs Stud* 45: 1479-1489.
10. Vahey DC, Aiken LH, Sloane DM, Clarke SP, Vargas D (2004) Nurse burnout and patient satisfaction. *Med Care* 42: II57-66.
11. World Health Organistaion. Global Recommendations On Physical Activity For Health. 2010.
12. Owen N, Healy GN, Matthews CE, Dunstan DW (2010) Too much sitting: the population health science of sedentary behavior. *Exerc Sport Sci Rev* 38: 105-113.
13. Hillman DR, Lack LC (2013) Public health implications of sleep loss: the community burden. *Med J Aust* 199: S7-10.
14. Petersen H, Kecklund G, D'Onofrio P, Nilsson J, Åkerstedt T (2013) Stress vulnerability and the effects of moderate daily stress on sleep polysomnography and subjective sleepiness. *J Sleep Res* 22: 50-57.
15. Chan MF (2009) Factors associated with perceived sleep quality of nurses working on rotating shifts. *J Clin Nurs* 18: 285-293.
16. Hsieh ML, Li YM, Chang ET, Lai HL, Wang WH, et al. (2011) Sleep disorder in Taiwanese nurses: a random sample survey. *Nurs Health Sci* 13: 468-474.
17. Mah CD, Mah KE, Kezirian EJ, Dement WC (2011) The effects of sleep extension on the athletic performance of collegiate basketball players. *Sleep* 34: 943-950.
18. Sagaspe P, Taillard J, Chaumet G, Moore N, Bioulac B, et al. (2007) Aging and nocturnal driving: better with coffee or a nap? A randomized study. *Sleep* 30: 1808-1813.
19. Signal TL, Gander PH, Anderson H, Brash S (2009) Scheduled napping as a countermeasure to sleepiness in air traffic controllers. *J Sleep Res* 18: 11-19.
20. Ftouni S, Sletten TL, Howard M, Anderson C, Lenné MG, et al. (2013) Objective and subjective measures of sleepiness, and their associations with on-road driving events in shift workers. *J Sleep Res* 22: 58-69.
21. Tuckett A, Henwood T. (2014) The impact of five lifestyle factors on nurses' and midwives' health: the Australian and New Zealand nurses' and midwives' e-cohort study. *Int J Health Promot Educ* 1-13.
22. Turner C, Bain C, Schluter PJ, Yorkston E, Bogossian F, et al. (2009) Cohort Profile: The Nurses and Midwives e-Cohort Study--a novel electronic longitudinal study. *Int J Epidemiol* 38: 53-60.
23. Huntington A, Gilmour J, Schluter P, Tuckett A, Bogossian F, et al. (2009) The Internet as a research site: establishment of a web-based longitudinal study of the nursing and midwifery workforce in three countries. *J Adv Nurs* 65: 1309-1317.
24. Schluter PJ, Turner C, Huntington AD, Bain CJ, McClure RJ (2011) Work/life balance and health: the Nurses and Midwives e-cohort Study. *Int Nurs Rev* 58: 28-36.
25. Ainsworth BE, Bassett DR Jr, Strath SJ, Swartz AM, O'Brien WL, et al. (2000) Comparison of three methods for measuring the time spent in physical activity. *Med Sci Sports Exerc* 32: S457-464.
26. Garber CE, Blissmer B, Deschenes MR, et al. (2011) American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Med Sci Sports Exerc*. 43:1334-59.
27. The Division of Sleep Medicine at Harvard Medical School. Get Sleep: Steps you can take to get good sleep and improve health, work, and life. Available from: <http://healthysleep.med.harvard.edu/need-sleep/whats-in-it-for-you/mood>; 24.1.2014.
28. de Lange AH, Kompier MA, Taris TW, Geurts SA, Beckers DG, et al. (2009) A hard day's night: a longitudinal study on the relationships among job demands and job control, sleep quality and fatigue. *J Sleep Res* 18: 374-383.
29. Steffen MW, Hazelton AC, Moore WR, Jenkins SM, Clark MM, et al. (2015) Improving sleep: outcomes from a worksite healthy sleep program. *J Occup Environ Med* 57: 1-5.
30. Alward RR, Monk TH (1990) A comparison of rotating-shift and permanent night nurses. *Int J Nurs Stud* 27: 297-302.
31. Smith-Coggins R, Howard SK, Mac DT, Wang C, Kwan S, et al. (2006) Improving alertness and performance in emergency department physicians and nurses: the use of planned naps. *Ann Emerg Med* 48: 596-604, 604.
32. Anderson LM, Quinn TA, Glanz K, Ramirez G, Kahwati LC, et al. (2009) The effectiveness of worksite nutrition and physical activity interventions

- for controlling employee overweight and obesity: a systematic review. *Am J Prev Med* 37: 340-357.
33. Cancelliere C, Cassidy JD, Ammendolia C, Côté P (2011) Are workplace health promotion programs effective at improving presenteeism in workers? A systematic review and best evidence synthesis of the literature. *BMC Public Health* 11: 395.
34. Morgan PJ, Collins CE, Plotnikoff RC, Cook AT, Berthon B, et al. (2012) The impact of a workplace-based weight loss program on work-related outcomes in overweight male shift workers. *J Occup Environ Med* 54: 122-127.
35. Peterson M (2004) What men and women value at work: implications for workplace health. *Gend Med* 1: 106-124.
36. Whitehead D (2006) Workplace health promotion: the role and responsibility of health care managers. *J Nurs Manag* 14: 59-68.
37. Flannery K, Resnick B, McMullen TL (2012) The impact of the Worksite Heart Health Improvement Project on work ability: a pilot study. *J Occup Environ Med* 54: 1406-1412.
38. Katzmarzyk PT, Janssen I (2004) The economic costs associated with physical inactivity and obesity in Canada: an update. *Can J Appl Physiol* 29: 90-115.
39. Maetzel A, Li LC, Pencharz J, Tomlinson G, Bombardier C; Community Hypertension and Arthritis Project Study Team (2004) The economic burden associated with osteoarthritis, rheumatoid arthritis, and hypertension: a comparative study. *Ann Rheum Dis* 63: 395-401.
40. Goss. J (2008) Projection of Australain health care expenditure by disease, 2003 to 2033. In: Australian Institute of Health and Welfare. AIHW, Canberra.
41. Hsu HY, Chen SH, Yu HY, Lou JH (2010) Job stress, achievement motivation and occupational burnout among male nurses. *J Adv Nurs* 66: 1592-1601.
42. Wang S, Liu Y, Wang L (2015) Nurse burnout: personal and environmental factors as predictors. *Int J Nurs Pract* 21: 78-86.
43. Bonnefoy M, Cornu C, Normand S, et al. (2003) The effects of exercise and protein-energy supplements on body composition and muscle function in frail elderly individuals: a long-term controlled randomised study. *British Journal of Nutrition*. 89:731-9.
44. Physical Activity in Australia: A Snapshot, 2007-08 (2011) In: Australian Bureau of Statistics, ABS, Canberra.