Original Article

Physical Activity Level and Cardiovascular Risks of Hospital Employees: A Cross-Sectional Study in a Private Hospital.

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Abstract

OBJECTIVES: To assess physical activity at work of hospital employees in order to identify association between physical activity at work and risks for cardiovascular diseases

MATERIAL AND METHODS: From 3,383 employees of a private hospital in Thailand in 2017, 12 percent were randomly selected based on a ten percent sample size with two percent compensation to represent eight strata of job types. After screening and exclusion, 301 subjects remained in the study. Each subject was asked to fill in the International Physical Activity Questionnaire (IPAQ) and was assessed for body fat composition using an Inbody Bio-electric Impedance Analysis (BIA) R20 model at the initiation. Each subject was equipped with an activity tracker device "Feelfit" for five days during work hours to estimate Metabolic Equivalent of Task (MET) and MET minutes per person per work week. Relevant laboratory data were extracted from annual health checkup database for the assessment of cardiovascular risk factors. Statistical analysis was conducted using STATA version 15.

RESULT: The majority (85.4%) of 301 subjects were female and a little more than half (53.5%) were older than 35 years. Data from Feelfit showed 257/301 (85.4%) employees had sufficient (i.e. 600 or more MET minutes per week) physical activity (PA) at work. Operational or clinical employees were 9.8 times more likely to have adequate PA (OR 9.8, 95%CI 4.3 to 22.4). Associations between adequate PA and Body Mass Index (BMI) and waist circumference were in a different direction. Subjects with high BMI (>23 Kg/sq.m.) were more likely to have adequate PA at work (OR 3.3, 95%CI 1.0, 10.5), while those with abnormal waist circumference were less likely to have adequate PA at work (OR 0.8, 95% CI 0.2, 2.5). Around one-third of our subjects had "normal BMI obesity", i.e. 54 (34.6%) of 156 normal BMI subjects had high body fat composition. Laboratory findings were inconclusive to demonstrate association with adequate PA.

CONCLUSION: Although most hospital employees had adequate physical activity at work, one-third of subjects still had high fat composition regardless of normal BMI. Back office subjects were almost ten times less likely to have sufficient PA at work, suggesting urgent interventions for them. Relationship between impulsivity and PA was inconclusive, suggesting a larger study with greater sample size.

Keywords: physical activity, health, feelfit, impulsivity, private hospital, normal BMI obesity

Cardiovascular diseases (CVD) are public health priorities in Thailand and worldwide. Despite numerous interventions that have been implemented targeting control of tobacco use and alcohol consumption, along with health promotion behaviors such as taking healthy foods and practicing mindfulness for good mental health as well as regular exercises, CVD prevalence in Thailand is still increasing.[1,2]

Physical exercises and healthy diet, as well as good mental health and regular social interactions, are among the essential elements that contribute to a healthy condition. Multiple studies have shown the benefits of exercising, where it can reduce the risk of chronic diseases including cardiovascular disease, cerebrovascular disease, high blood pressure and even some types of cancer.[3-16] Furthermore, it also reduces the overall mortality rate of various diseases.[17-19] Also, exercising can

help prolong the life span of people who are suffering from cardiovascular disease.[20, 21] There have been studies that showed the positive effect of physical exercise in reducing the risk of developing diabetes.[11,12, 22-25] Physical exercises or regular physical activity are also observed to help reduce the rate of developing certain types of cancer[26-28] and prolong the life expectancy of breast cancer patients.[29-32] Furthermore, it also helps increase the quality of life and reduce complications in chemotherapy for cancer patients.[33-37] From previous studies by the World Health Organization (WHO),[38] in addition to physically inactive people having a higher mortality rate, the lack of physical activity can lead to the increase in risk of dependency (Odds Ratio 1.40, 95%CI 1.05, 1.87)., leading to effects such as having to reside in a nursing home. Physical inactivity is a smaller cause of dependency than smoking (Odds Ratio 1.56, 95%CI 1.23, 1.99), but a more significant cause than having high blood pressure (Odds Ratio 1.35, 95%CI 1.06, 1.73) and high blood cholesterol (Odds Ratio 1.14, 95%CI 0.89, 1.44).[39] These findings reflect on the need to use health welfare in the future.

World Health Organization (WHO) has recommended a minimum of 150 minutes of moderate exercise or 75 minutes of intensive physical exercise per week.[38] Despite the recommendation, people continue to neglect the importance of regular exercise. Campaigns promoting regular physical activity showed little impact due to the difficulty in adopting significant lifestyle changes among many people. However, we know that people who are continually moving around spend less time in a sedentary position. Studies have shown that people with sedentary behaviours, such as watching TV on the sofa all day, are often found to be overweight. On the other hand, reducing the length of sedentary behaviours resulted in weight loss and lower body mass index (BMI) value.[40-49] Prolonged inactivity can also lead to cardiovascular diseases. Studies have shown that more extended periods of sedentary behaviour are associated with obesity and cardiovascular diseases. For example, watching television for 2 hours or more per day can lead to the development of obesity. Decreasing time spent watching television, or increasing the number of physical activities to minimise the time of inactivity, can reduce BMI, waite circumference and thickness of fat around the arm.[49-51] Therefore, in addition to encouraging the public to do more exercise, campaigns can also focus on spending less time in a sedentary state.

The International Physical Activity Questionnaire (IPAQ) has been widely used to measure physical activity. IPAQ has been translated into Thai language and has been validated for accuracy.[52] Recently, Faculty of Engineer, Mahidol University, in collaboration with Thai Health Promotion Foundation (THPF) has developed an activity tracker called Feelfit to collect objective data on physical activity. Feelfit records physical activity intensity through its three-axis acceleration sensor and calculates calorie burn. The recording of physical activity by Feelfit is sufficiently precise according to the guidelines of WHO. The device has been tested by Thai people,[53] and was used in a study group consisting of golf caddies.[54]

There has been no specific report on level of physical activity among hospital employees even though they are supposed to be role models for hospital clients.

This study, therefore, has the following objectives.
1. To assess level of physical activity of hospital employees using both objective method of Feelfit activity tracker and subjective method of International Physical Activity Questionnaire (IPAQ).
2. To identify the association between physical activity and risks for cardiovascular diseases, namely hypertension, high blood sugar, dyslipidemia, high body mass index (BMI), metabolic syndrome and high body fat composition.

Materials and Methods

This cross-sectional study involves data of hospital employees of a private hospital from November 2017 to June 2018. Data were collected after approval of the Institutional Review Board (IRB COA number BMC IRB 2017-06-015).

The study team used stratified random sampling to select participants from 3,383 hospital personnel employed in 2017. Participants were full-time employees at the time of data collection who were at least 18 years old and able to communicate well in spoken and written Thai language. The whole group of hospital employees was subdivided into eight stratifications, according to their nature of physical activity during work. The eight stratifications were (1) back-office staff (2) front office staff including customer relation officer (3) inpatient department (IPD) nurses (4) outpatient department (OPD) nurses (5) intensive care unit (ICU) nurses (6) operating room (OR) nurses (7) pharmacists and (8) medical technician. Medical personnel (doctors) were not included because of the physical activity variation by physician specialties and schedules. With available resources, we chose a sample size of ten percent. However, twelve percent of the staff of each stratum were selected to compensate unforeseen non-cooperation. This resulted in 406 eligible subjects who received an invitation to participate in the study. Among 406 eligible subjects, 31 (8%) could not participate, resulting 375 subjects (11% of 3,383) joining the screening process.

After screening, potential subjects who were pregnant, lactating, expressed unwillingness to be equipped with the activity tracker (Feelfit), or were unable to take note of their physical activity correctly, were excluded. Employees who refused to participate in body fat composition assessment were also excluded. Finally, those who reported recent illness or injury that would affect their regular physical activities were also excluded. After exclusion, 301 participants remained in this study.

We collected data on demographic characteristics (age, sex, job type), body weight, height, waist circumference, and blood pressure. Body fat composition data were collected using a BIA equipment R20 model supplied by Inbody Co. Ltd. Fat percentage was measured by sending a weak electrical current through the body. Results obtained can be used to classify those who are obese despite having a normal body weight for further studies.[55]

Physical activity data were collected using International Physical Activity Questionnaire (IPAQ). Data from IPAQ were used to determined daily life physical activity in four domains including vigorous-intensity, moderate-intensity, walking and sitting in the past seven days while working, relaxing and traveling. Data from both IPAQ and Feelfit were calculated into the metabolic equivalent of task (MET) value and recorded as MET minutes per week per participant using the following formula:

> **MET × number of minutes per day × number of days per week = MET-minutes per week.[56]**

Objective data on physical activity at work were collected using Feelfit, an activity tracker invented by the Bio-engineering Department of Mahidol University. It contains a triaxial accelerometer that measures the duration and intensity of activity level. Data were then converted into a METS value and subsequently calculated as MET-minutes per week using data from Feelfit. To ensure correct measurement and recording of Feelfit, each participant was trained by the study team before receiving a Feelfit device with fresh batteries. A card containing phone numbers of study team members was handed to each participant in case he/she wanted to seek more advice. In addition, within 48 hours after deploying Feelfit, the study team contacted each participant via phone to verify that the device worked properly and data were collected as planned.

Levels of physical activity were classified according to MET minutes per week as:[56]
1. High-level physical activity: ≥ 3,000 MET minutes per week
2. Moderate-level physical activity: 600-2,999 MET minutes per week
3. Low-level physical activity: < 600 MET minutes per week.

For easy application of study results, participants were classified as having "adequate" physical activity if they had at least 600 MET minutes per week either from Feelfit or IPAQ. Those who recorded lower than 600 MET minutes per week from both Feelfit and IPAQ were classified as "inadequate" physical activity.

Cardiovascular Disease (CVD) risks were determined from health checkup data of subjects extracted from staff medical records, except body fat composition, which was measured at enrollment. Known risk factors include high blood pressure, high fasting blood sugar, dyslipidemia, metabolic syndrome and abnormal fat composition. While most factors were from checkup data where normal ranges were provided, classifying normal or abnormal fat composition was guided by American Council on Exercise (ACE) at cut-off points of 25% among males and 32% among females.

Statistical Analysis

Statistical analyses were performed using EpiInfo version 7 for data entry and STATA version 15 for overall as well as specific data processing and analyses. Physical activity levels

of subjects was displayed in frequency and percentage of overall data. The association between adequate physical activity measured by Feelfit instrument and each demographic characteristic as well as risk factors for cardiovascular diseases were analyzed using multivariate logistic regression. Adjusted odds ratio and respective 95% confidence intervals associated with each factor were calculated from the multivariate logistic regression models. The $p < 0.05$ was considered statistically significant.

Results

Among the 301 subjects who participated in this study, 257 were female (85.4%) and 44 were male (14.6%) with a median age of 36 years. A total of 116 (38.5%) subjects were back-office staff, 109 (26.2%) were nurses, 23 (7.6%) were front-office staff, 26 (8.6%) were technicians, and 27 (8.9%) were in other categories. More than half, i.e. 157 subjects (52.2%) had normal BMI level, 201 (66.8%) had waist circumference in normal limit and 144 (47.8%) were had normal fat composition. (Table 1)

Table 1: Subjects characteristics regarding sex, age, job types, BMI, waist circumference and fat composition.

Subject characteristics	n (%)
Total (n)	301 (100)
Sex	
Male	44 (14.6)
Female	257 (85.4)
Age group (years)	
≤ 35	140 (46.5)
> 35	161 (53.5)
Mean ± SD	36.4 ± 7.8
Median (min:max)	36 (20:59)
Job types	
Back Office	116 (38.5)
Nurse	109 (26.2)
Front Office	23 (7.6)
Technician	26 (8.6)
Physical therapists	13 (4.4)
Management and executives	7 (2.4)
Pharmacists	3 (1.0)
Janitors	4 (1.1)
Body Mass Index (Kg/m²)	
Under weight (< 18.5)	21 (7.0)
Normal weight (18.5 - < 23)	157 (52.2)
Over weight (≥ 23)	123 (40.9)
Waist circumference (cm)	
Within limit	201 (66.8)
(Male: < 90, Female < 80)	
Higher than limit	100 (33.2)
(Male: ≥ 90, Female ≥ 80)	
Percent of Body Fat (%)	
Normal	144 (47.8)
(Male < 25, Female < 32)	
Abnormal	157 (52.2)
(Male ≥ 25, Female ≥ 32)	

Physical Activity Level during work

Data from Feelfit showed that the majority of staff, i.e. 257 (85.4%) already had sufficient physical activity levels during work hours. However, IPAQ data on level of activity during work did not correspond well with this (Table 2). As subjective data from IPAQ could be less accurate due to memory biases, we continue our analysis using only Feelfit data on the assessment of physical activity at work. Subjects with adequate physical activity at work were categorized as adequate regardless of the level of activity out of their work time.

Male hospital employees were more likely to have adequate physical activity (PA) during work hours (adjusted OR 2.2, 95%CI 0.6, 8.1). Subjects in older age group were more likely to have adequate PA (adjusted OR 1.4, 95% CI 0.6, 2.8) than their younger counterparts. Job characteristics derived from job types revealed that operational and clinical (non-back office) subjects were more likely to have adequate physical activity during work (adjusted OR 9.8, 95%CI 4.3, 22.4). Associations between adequate PA and Body Mass Index (BMI) and waist circumference were in a different direction. Subjects with high BMI (> 23 Kg/sq.m) were more likely to

have adequate PA at work (OR 3.3, 95%CI 1.0, 10.5)), with statistical significance while those who had higher than limit of waist circumference were less likely to have adequate PA at work (OR 0.8, 95% CI 0.2, 2.5)). This raised our curiosity on the issue between BMI and waist circumference. (Table 3)

BMI and body fat composition

The different direction of association between adequate physical activity at work and BMI and waist circumference suggested that not all high BMI subjects had abnormal fat composition. Some might have high muscle mass. As a result, we explored the association between BMI and body fat composition (Table 4) and found 20 (16.1%) of 124 high BMI subjects had normal fat composition. At the same time, we found 54 (34.6%) of 156 normal BMI subjects who had high body fat composition. Although there was a statistically significant association between BMI and body fat composition, the substantive proportion of staff with normal BMI and high body fat composition would call for more attention to rely on body fat composition, in addition to BMI alone in judging overweight levels. For future reference, we suggest using the term "normal BMI obesity" for this category of people.

Table 2: Physical activity levels during work by Feelfit and in daily life by IPAQ

Physical Activity Levels	IPAQ (n = 274)	Feelfit (n = 301)	Feelfit
High (≥ 3,000 MET-minutes/wk.)	52 (19.0%)	10 (3.3%)	Adequate
Moderate (600-2,999 MET-minutes/wk.)	54 (19.7%)	247 (82.1%)	
Low (<600 MET-minutes/wk.)	168 (61.3%)	44 (14.6%)	Inadequate

Table 3: Potential risk factors and their association with the adequacy of physical activity during work hours.

Subject characteristics	Total	Adequate (Feelfit)	Inadequate (Feelfit)	Adj. Odds ratio[a]	p
Sex	301	257 (85.4)	44 (14.6)		
Female					0.240
Male	257	216 (84.0)	41 (16.0)	-	
Age group (years)	44	41 (93.2)	3 (6.8)	2.2 (0.6 to 8.1)	
≤35					0.425
>35	139	118 (84.9)	21 (15.1)	-	
Job types	162	139 (85.8)	23 (14.2)	1.4 (0.6 to 2.8)	
Back Offices					< 0.001**
Nurse	116	81 (69.8)	35 (30.2)	-	
Front offices	109	103 (94.5)	6 (5.5)	-	
Technicians	23	22 (95.7)	1 (4.3)	-	
Other	26	25 (96.2)	1 (3.8)	-	
Job characteristics	27	26 (96.3)	1 (3.7)	-	
Back office					< 0.001**
Operation (Nurse, Front office, Technicians and others)	116	81 (69.8)	35 (30.2)	-	
	185	176 (95.1)	9 (4.9)	9.8 (4.3 to 22.4)	
Body Mass Index (Kg/m²)					0.047*
Not over weight (<23)	177	142 (80.2)	35 (19.8)	-	
Over weight (≥23)	124	115 (92.7)	9 (7.3)	3.3 (1.0 to 10.5)	
Waist circumference (cm)					0.687
Within limit (Male: <90, Female <80)	200	165 (82.5)	35 (17.5)	-	
Higher than limit (Male: ≥90, Female ≥80)	101	92 (91.1)	9 (8.9)	0.8 (0.2 to 2.5)	

Note: [a] adjusted odds ratio by multivariate logistic regression including sex, age group, job characteristic, BMI and waist circumference in the model.

Laboratory findings

Regarding laboratory measurements, subjects with four known risks for cardiovascular diseases (high blood pressure, high fasting blood sugar, having metabolic syndrome and high body fat composition) were more likely to have adequate physical activity at work (high blood pressure OR 1.4, 95%CI 0.4, 6.0, high fasting blood sugar OR 1.7, 95%CI 0.2, 78.6, fulfilled criteria of metabolic syndrome OR 1.6, 95% CI 0.2, ∞ and high body fat composition OR 2.0, 95%CI 0.7 to 5.8) while those with dyslipidemia were less likely to have adequate physical activity at work (OR 0.7, 95% CI 0.3, 1.8) (Table 5).

Table 4: Association between BMI and body fat composition.

Physical Activity Levels	Total	Percentage of body fat		p
		Normal	High	
High (≥ 23)	124	20 (16.1)	104 (83.9)	< 0.001**
Normal (18-22.9)	156	102 (65.4)	54 (34.6)	
Low (<18)	21	21 (100.0)	0 (0.0)	

Table 5: Potential risk factors and their association with the adequacy of physical activity during work hours.

Cardiovascular risk factors	n	Adequate (Feelfit) n(%)	Inadequate n(%)	Adj. Odds ratio[a]	p
Blood Pressure	301				0.794
Normal	231	196 (84.8)	35 (15.2)	-	
High (SBP >140 or DBP > 85)	70	61 (87.1)	9 (12.9)	1.4 (0.4 to 6.0)	
Fasting blood sugar	239				1.00
Normal	213	185 (86.9)	28 (13.1)	-	
High (FBS ≥ 100)	26	24 (92.3)	2 (7.7)	1.7 (0.2 to 78.6)	
Dyslipidemia	195				0.530
No	98	87 (88.8)	11 (11.2)	-	
Yes	97	85 (87.6)	12 (12.4)	0.7 (0.3 to 1.8)	
Metabolic Syndrome	195				0.705
No (< 3 criteria)	177	1 54 (87.0)	23 (13.0)	-	
Yes (≥ 3 of 5 criteria)	18	18 (100.0)	0 (0)	1.6 (0.2 to ∞)[b]	
Percentages of Body Fat	301				0.201
Normal	144	119 (82.6)	25 (17.4)	-	
High	157	138 (87.9)	19 (12.1)	2.0 (0.7 to 5.8)	
(Male: ≥ 25%, Female ≥ 32%)					

Note: [a] adjusted odds ratio by multivariate logistic regression and [b] multivariate exact logistic regression including blood pressure, fasting blood sugar, dyslipidemia, status of metabolic syndrome and group of body fat percentage in the model.

These findings are inconclusive. Our sample size of less than ten percent was not sufficient to demonstrate a statistically significant association. Different directions of the association between various laboratory results and adequate physical activity were likely to be from the nature of cross-sectional design. In our study, blood tests were several months to several weeks before PA measurement. Hospital employees who were aware of their abnormal laboratory results could have been motivated to increase their physical activity. Besides, learning of thee number of steps taken each day during the PA measurement period may have served as an additional motivation to walk. We did not have data to confirm this as it was beyond the approved protocol.

Discussions

The overall finding that the majority of hospital employees had adequate physical activity at work was due to the adequacy among operational or clinical employees over the back-office staff. Adequate physical activity was detected among 95.1% of 185 operational staff in comparison with 69.8% of 116 back-office staff. Back-office staff, were almost 10 times more likely to have inadequate physical activity at work, so environmental and work adjustments need to be in place.

There is a positive association between adequate physical activity and male gender, older age group (more than 35 years), being operational or clinical staff (not back office) and being overweight. At the same time, high waist circumference was negatively associated with adequate physical activity at work. The scattering two-directional association could be due to information biases related to cross-sectional study design where some exposures could have changed over time. A prospective design study is required to assess these associations.

While being overweight and high waist circumference are usually perceived as markers of being obese, our study demonstrated they were not the same. Abnormal waist circumference is mostly either from visceral or trunk fat storage, while high BMI could be from high fat deposit or greater muscle mass. In this study, subjects with high BMI were three times (OR 3.3, 95%CI 1.0 to 10.5) more likely to have adequate physical activity, while those with abnormal waist circumference were 20% less likely to have adequate physical activity (OR 0.8, 95% CI 0.2 to 2.5), which corroborates with the assumption. However, our finding that subjects with high body fat composition were more likely to have adequate physical activity (OR 2.0, 95% CI 0.7 to 5.8) has created confusion. The reverse association between dyslipidemia and physical activity (OR 0.7, 95% CI 0.3 to 1.8) might be due to easy access to medical care among hospital staff. We did not have the approval to access data on the medication of subjects to prove this. It is, therefore, necessary to conduct another prospective study to correctly determine these associations.

This study had the advantage of collecting data among hospital employees where health is a common concern. However, findings were variously biased from cross-sectional design. Using Feelfit allows us to collect objective data of physical activity at work. The disagreement between data from Feelfit and data from the IPAQ creates a concern on further use of subjective data. MET minutes of hospital employee subjects collected in this study could be used to augment the Thai Physical Activity Guideline.

Mahidol University has developed the Thai Physical Activity Guideline (TPAG) in order to document levels of physical activity by job types.[57] Experts in Thailand have taken a compendium of Western society[58] and adjusted it to suit the context of Thai society. This has been utilized to promote physical activity and exercise for Thai people. However, the guidelines have not included medical services job categories. Findings from this study will contribute to adding more categories of Physical Activity levels of hospital employees in the guidelines.

Conclusions

The majority of hospital employee subjects (257/301, 85.4%) had adequate physical activity at work. Male subjects were 2.2 times, and the older age group was 1.4 times more likely to have adequate physical activity. Significantly, operational or clinical subjects were 9.8 times more likely to have adequate physical activity at work than back-office counterparts.

Among 156 subjects with normal Body Mass Index (BMI), 54 (34.6%) had abnormal fat composition. On the other hand, among 124 subjects with high BMI (23 or more), 20 (16.1%) had normal fat composition, suggesting the additional value of using fat composition on top of BMI and body weight. Subjects with high blood pressure, fasting blood sugar of 100 mg% or more, having metabolic syndrome, and having high body fat composition were positively associated with having adequate physical activity at work, while subjects with dyslipidemia were less likely to have adequate physical activity at work. These findings indicate possible confounders related with access to medical care among hospital employees.

The relationship between adequate physical activity in terms of MET minutes and having high blood pressure, abnormal fasting blood sugar, dyslipidemia and high body fat composition is inconclusive probably because of insufficient sample size. A larger study is required for a more reliable conclusion.

Ethical Review

This project was approved by BDMS Institutional Review Board (IRB), IRB Protocol No. BMC-IRB 2017-06-015 COA. No.2017-038 and was approved on 5 August 2017, renewal on 26 July 2018 and closed out on 9 April 2019.

Conflict of Interest

The authors declare no conflict of interest in relation with materials, device and equipment used in this study.

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