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Assessment of Physical Activity and Morphological–Functional Characteristics Following Enhanced Physical Activity Among Employees of Tan Hung General Hospital

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Abstract
This study aimed to assess the status of physical activity and its association with morphological-functional characteristics among employees of Tan Hung General Hospital, Ho Chi Minh City. The results showed that approximately 30–35% of staff did not meet recommended physical activity levels, with mean weekly MET values below World Health Organization standards. Regarding morphological-functional characteristics, mean BMI was within the overweight range, waist circumference risk was higher among physically inactive staff, visceral fat measured by DEXA was increased, cardiorespiratory fitness assessed by the IPN test was below reference levels, and biological age exceeded chronological age in the inactive group. Factors associated with insufficient physical activity included older age, female sex, lower education level, smoking, prolonged sedentary time, high blood pressure, and abnormal lipid profile. These findings indicate that insufficient physical activity remains common among healthcare workers and is closely associated with multiple health indicators, highlighting the need for workplace physical activity promotion programs in the healthcare sector.

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1. Introduction

Physical activity plays an essential role in maintaining health and preventing non-communicable diseases such as cardiovascular disease, diabetes, and obesity. The World Health Organization recommends that adults perform at least 150 minutes of moderate-intensity physical activity or 75 minutes of vigorous-intensity activity per week to obtain health benefits. However, physical inactivity has become increasingly common in modern society, especially among healthcare workers who often face heavy workloads, long shifts, and high occupational stress. Although healthcare workers generally understand the benefits of regular exercise, many do not achieve recommended activity levels, which may increase the risk of adverse morphological and functional health outcomes.

In Vietnam, studies on physical activity among healthcare workers remain limited, despite national initiatives promoting exercise within the health sector. Assessing the current level of physical activity and examining its association with morphological and functional indicators may provide important scientific evidence for developing effective health promotion strategies for healthcare staff.

Therefore, this study was conducted to: (1) describe the physical activity status of employees at Tan Hung General Hospital; (2) analyze the association between physical activity and morphological-functional characteristics; and (3) propose recommendations to improve the health of healthcare workers.

1.1. Methods

This hospital-based study was conducted at Tan Hung General Hospital from November 2024 to May 2025 using a cross-sectional design (Objectives 1–2) combined with a controlled intervention study (Objective 3). Employees who voluntarily provided informed consent were recruited. Exclusion criteria included inability to perform cycle ergometer testing, contraindications to IPN testing, use of medications affecting performance, pregnancy, or incomplete participation. For the cross-sectional phase, 217 employees were included. For the intervention phase, eligible participants were pair-matched by baseline characteristics and randomly assigned to intervention or control groups, with at least 42 participants per group required. Data collected included demographics, physical activity assessed by the WHO questionnaire, anthropometry, body composition by DEXA, blood pressure, biochemical indicators, and functional capacity measured by the IPN cycle ergometer test. The intervention groups completed a 12-week physical activity program (150 min/week moderate intensity, 3 sessions/week), while the control group received no structured program. Data were entered in Excel and analyzed using R version 4.5.0

2. Results

2.1. Physical Activity Status

2.1.1. Insufficient Physical Activity and Selected Morphological–Functional Characteristics of Employees at Tan Hung General Hospital (2024–2025)

- **Insufficient Physical Activity**

Table 1: Physical Activity Status of Employees at Tan Hung General Hospital (2024–2025)

Physical activity status	Frequency	Percentage (%)
Sufficient physical activity	151	69.6
Insufficient physical activity	66	30.4
Total	217	100.0

According to the WHO questionnaire, 66 employees had a total weekly MET score of <600 and were classified as having insufficient physical activity, accounting for 30.4% of participants.

2.2. Morphological Characteristics of Study Participants

2.2.1. Anthropometric Characteristics

Table 2: Anthropometric Characteristics of Study Participants

Characteristic	Median (Q1; Q3)
Weight (kg)	58 (51; 69)
Height (cm)	160 (155; 166)
BMI (kg/m²)	23.2 (20.6; 25.5)
Waist circumference (cm)	76 (68; 85)
Hip circumference (cm)	90 (84; 94)
Waist-to-hip ratio	0.86 (0.81; 0.92)

Employees participating in the survey showed generally normal anthropometric characteristics, with median BMI within the recommended range.

2.2.2. Functional Characteristics

Table 3. IPN Test Results

Characteristic	Median (Q1; Q3)
Pabs	85 (71; 110)
Prel	1.52 (1.32; 1.72)

The variables were non-normally distributed. Median Pabs was 85, and median Prel was 1.52.

2.2.3. Biological Age Compared with Chronological Age

Table 4: Biological Age Status

Biological age	Frequency	Percentage (%)
Younger	5	2.3
Equal	55	25.3
Older	157	72.4

Nearly three-quarters of employees had a biological age older than their chronological age.

3. Factors Associated with Insufficient Physical Activity

3.1. Age Group

Table 5: Association Between Physical Activity Status and Age Group

Age group	Total n (%)	Insufficient PA n (%)	Sufficient PA n (%)	p-value
<30	95 (44.0)	31 (47.0)	64 (42.0)	0.241
30–39	81 (37.0)	27 (41.0)	54 (36.0)	
≥40	41 (19.0)	8 (12.0)	33 (22.0)	

There was no statistically significant difference in age-group distribution between physical activity groups.

3.2. Physical Fitness Indices

Table 6: Association Between Physical Fitness Indices and Physical Activity Status

Variable	Total (n=217) Median (Q1;Q3)	Insufficient PA (n=66)	Sufficient PA (n=151)	p-value
Pabs (W)	85 (71;110)	80 (68;93)	91 (73;118)	0.007
Prel (W/kg)	1.52 (1.32;1.72)	1.43 (1.26;1.63)	1.54 (1.35;1.77)	0.006
[1] Median (Q1, Q3); [2] Wilcoxon rank sum test; Welch Two Sample t-test				

Pabs and Prel were significantly higher in the sufficient physical activity group.

In univariate logistic regression, Pabs was associated with sufficient physical activity (OR=1.01; 95% CI: 1.00–1.02; p=0.012), but the association was no longer significant after adjustment for sex (OR=1.002; 95% CI: 0.989–1.016; p=0.736). Male sex remained significant (OR=2.78; 95% CI: 1.13–6.86; p=0.026).

Similarly, Prel was associated with sufficient physical activity in univariate analysis (OR=3.54; 95% CI: 1.38–10.1; p=0.013), but not after sex adjustment (OR=1.88; 95% CI: 0.63–5.59; p=0.257). Male sex remained significant (OR=2.55; 95% CI: 1.23–5.29; p=0.012).

3.3. Anthropometric Characteristics

Table 7: Association Between Anthropometric Characteristics and Physical Activity Status

Variable	Total (n=217) Median (Q1;Q3)	Insufficient PA (n=66)	Sufficient PA (n=151)	p-value
Weight (kg)	58 (51;69)	56 (49;65)	59 (52;71)	0.049
Height (cm)	160 (155;166)	159 (155;162)	160 (156;167)	0.150
BMI (kg/m²)	23.2 (20.6;25.5)	22.3 (19.8;25.0)	23.6 (20.9;25.9)	0.072
Waist circumference (cm)	76 (68;85)	74 (66;80)	77 (69;86)	0.065
Hip circumference (cm)	90 (84;94)	89 (82;93)	90 (84;94)	0.200
Waist-to-hip ratio	0.86 (0.81;0.92)	0.85 (0.80;0.89)	0.87 (0.81;0.92)	0.200
[1] Median (Q1, Q3); [2] Wilcoxon rank sum test; ; Welch Two Sample t-test				

No significant associations were found between anthropometric indices and insufficient physical activity. In logistic regression, each 1-kg increase in body weight was associated with 1.7% lower odds of insufficient physical activity (OR=0.983; 95% CI: 0.959–1.01; p=0.165), but this was not statistically significant.

3.4 Biological Age

Table 8: Association Between Biological Age and Physical Activity Status

Biological age	Total n (%)	Insufficient PA n (%)	Sufficient PA n (%)	p-value
Younger or equal	60 (28)	12 (18)	48 (32)	0,058
Older	157 (72)	54 (82)	103 (68)	

Biological age did not differ significantly between physical activity groups.

4. Changes in Morphological–Functional Characteristics Before the Physical Activity Intervention

Table 9: Baseline Morphological Characteristics of Intervention and Control Groups

Variable	Total (n=72)	Control (n=36)	Intervention (n=36)	p-value
Age	31 (26;39)	31 (25.5;39)	31 (26;39)	>0.9
Sedentary time (h/day)	4.5 (1;8)	5.5 (2;9.5)	4 (1;8)	0.12
Height (cm)	159.56 ± 7.8	159.48 ± 8.38	159.64 ± 7.3	0.80
Weight (kg)	59.1 (51.35;66.3)	58.85 (49.75;65.9)	59.75 (52.15;66.95)	0.50
BMI (kg/m²)	23.65 (21.3;25.4)	23.65 (21.0;25.35)	23.8 (21.55;25.65)	0.60
Waist circumference (cm)	77 (67;83)	78 (66;83)	76.5 (70;86)	0.50
Hip circumference (cm)	90 (84.5;93)	90 (83;92.5)	90 (86.5;93)	0.50
Waist-to-hip ratio	0.85 (0.80;0.91)	0.86 (0.80;0.91)	0.85 (0.81;0.91)	>0.9
Body fat (%)	37.3 (29.4;39.85)	36.35 (29.2;39.1)	37.9 (31.15;40.2)	0.30
A/G ratio	1.03 ± 0.24	1.01 ± 0.23	1.05 ± 0.25	0.30
VAT (g)	530.5 (242.5;821.5)	543.5 (231.5;817)	505.5 (274.5;828)	0.90
SAT (g)	1146.5 (920.5;1446)	1047.5 (871;1246.5)	1289.5 (956;1539)	0.050
[1] Median (Q1, Q3); [2] Wilcoxon rank sum test; Welch Two Sample t-test				

There were no statistically significant differences in baseline morphological characteristics between the intervention and control groups before the intervention.

Table 10: Baseline Functional Characteristics, Fasting Glucose, and Lipid Profile Before Intervention

Variable	Total (n=72)	Control (n=36)	Intervention (n=36)	p-value
Prel (W/kg)	1.41 ± 0.24	1.40 ± 0.24	1.41 ± 0.24	0.90
Pabs (W)	81 (68;101.5)	78 (68;95.5)	83.5 (68;105.5)	0.50
Fasting glucose (mmol/L)	4.95 (4.66;5.37)	4.90 (4.62;5.29)	5.11 (4.76;5.51)	0.12
Total cholesterol (mmol/L)	5.08 ± 1.04	5.01 ± 1.06	5.14 ± 1.02	0.50
Triglycerides (mmol/L)	1.34 (0.85;2.01)	1.21 (0.79;1.85)	1.36 (1.04;2.39)	0.30
HDL cholesterol (mmol/L)	1.28 ± 0.38	1.32 ± 0.36	1.25 ± 0.40	0.70
[1] Median (Q1, Q3); [2] Wilcoxon rank sum test; Welch Two Sample t-test				

There were no statistically significant differences in functional characteristics, fasting glucose, or lipid profile between groups before intervention.

Table 11: Physical Activity Status Before Intervention

Physical activity group	Total (n=72)	Control (n=36)	Intervention (n=36)	p-value[2]
Insufficient	21 (29%)	12 (33%)	9 (25%)	0,4
Sufficient	51 (71%)	24 (67%)	27 (75%)	
[1] n (%);[2] Pearson's Chi-squared test				

There was no statistically significant difference in physical activity status between the intervention and control groups. Overall, both groups were comparable in baseline morphological-functional characteristics and physical activity distribution before intervention.

5. Changes After 3 Months of Enhanced Physical Activity

The intervention group participated in a structured physical activity program targeting 150 min/week of moderate-intensity exercise (50 min/session, 3 sessions/week for 12 weeks), including strength, endurance, flexibility, stretching, stability, neuromuscular, and balance exercises. The control group did not receive structured intervention.

5.1. Within-group comparison

First, within-group comparisons (intervention and control) were conducted for each variable to determine whether significant changes occurred after 3 months and to identify variables with $p < 0.05$.

Table 12: Variables Showing Significant Changes in Within-group Analysis

Variable	Group	Statistical test	p-value
Pabs (W)	Intervention	Wilcoxon	0.0000077
Prel (W/kg)	Intervention	Paired t-test	0.0000001
Biological age	Intervention	Wilcoxon	0.0005371
Body fat (%)	Control	Paired t-test	0.0327
A/G ratio	Control	Paired t-test	0.0095

After 3 months, the intervention group showed significant changes in functional indices, including Pabs, Prel, and biological age, whereas the control group showed changes only in morphological indices, including body fat percentage and A/G ratio.

Due to the small sample size and non-normal data distribution, bootstrap resampling (10,000 iterations) was used to estimate median changes and 95% confidence intervals for the variables with significant changes shown in Table 12.

Table 13: Changes Before and After Intervention

Variable	Change (Post – Pre)	
	Intervention group	Control group
Pabs (W)	9,86 (6,94; 12,97)	0,69 (-3,39; 5,22)
Prel (W/kg)	0,16 (0,12; 0,21)	3,28 (-0,04; 9,86)
Tuổi sinh học	-0,39 (-0,56; -0,22)	-0,08 (-0,19; 0,0)
Tỷ lệ % mỡ	-0,42 (-0,96; 0,06)	0,54 (0,056; 0,990)
Tỷ lệ A/G	-0,006 (-0,33; 0,02)	0,030 (0,009; 0,051)

5.2. Between-group comparison of changes

Changes in the intervention group were compared with those in the control group, with p-values adjusted using the Benjamini–Hochberg multiple testing procedure.

Table 14: Intervention Effects Compared with the Control Group

Variable	Difference (Intervention – Control)	95% CI (bootstrap)	p-value	Adjusted p-value
Pabs (W)	+9.17	[3.64; 14.30]	0.0020	0.0165
Biological age	-0.31	[-0.50; -0.11]	0.0030	0.0165
Body fat (%)	-0.96	[-1.66; -0.28]	0.0056	0.0205
A/G ratio	-0.036	[-0.070; -0.004]	0.0280	0.0770
VAT (g)	-37.44	[-91.67; 15.83]	0.1800	0.3898
Prel	-3.12	[-9.7; 0.22]	0.7200	1.0000

Compared with the control group, the intervention showed significant effects on Pabs, biological age, and body fat percentage.

6. Conclusion

This study of 217 employees at Tan Hung General Hospital found that the prevalence of insufficient physical activity was 30.4%, indicating that physical inactivity remains relatively common among healthcare workers. Employees with insufficient physical activity tended to have lower cardiorespiratory fitness indices, with significantly lower Pabs and Prel values compared with those achieving recommended activity levels. However, no clear differences were observed in anthropometric indices or biological age between the two groups.

Baseline fitness indicators such as Pabs and Prel were associated with achieving sufficient physical activity in univariate analysis.

After a 12-week enhanced physical activity program (150 minutes/week), the intervention group showed significant improvements in functional capacity and body composition. Compared with the control group, the intervention group demonstrated a significant increase in Pabs, a reduction in biological age, and a decrease in body fat percentage.

These findings confirm that regular, supervised, and appropriately prescribed physical activity is an effective strategy to improve physical fitness, enhance cardiorespiratory function, and optimize body composition among healthcare workers. Therefore, routine workplace physical activity programs should be implemented in hospitals to improve employee health and quality of life.

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