Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Fitness and Its Occupational Correlates: A Single-Center Cross-Sectional Study of Clinical Healthcare Professionals

Di Ye
Renmin Hospital of Wuhan University
Jieru Xu
Central Hospital of Wuhan
Yihao Li
1205169538@qq.com

Renmin Hospital of Wuhan University

Research Article

Keywords: Cardiorespiratory fitness, Healthcare professionals, Occupational health, Sleep quality, Cardiopulmonary exercise testing, Sedentary behavior

Posted Date: March 12th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-8798181/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Cardiorespiratory fitness (CRF) is a strong predictor of cardiovascular health and all-cause mortality. Healthcare professionals are commonly perceived as a health-conscious population; however, occupational stressors and lifestyle constraints may compromise their own fitness levels. Evidence based on objective physiological assessment in this population remains limited.

Methods

A cross-sectional study was conducted involving 54 staff members. CRF was objectively measured using Cardiopulmonary Exercise Testing (CPET). Occupational factors (workload, sedentary ratio) and sleep quality (PSQI) were assessed via questionnaires. Multiple linear regression was used to identify independent predictors.

Results

The mean PeakVO2pred% was lower than expected, with significant gender differences in absolute values. Multiple regression revealed that poor sleep quality (β=-0.33), long weekly work hours (β=-0.29), high sedentary work ratio (β=-0.25), and excessive screen time (β=-0.22) were independent negative predictors of CRF.

Conclusions

Despite high exercise literacy, healthcare professionals exhibited suboptimal cardiorespiratory fitness, reflecting a potential “health paradox.” Modifiable occupational and lifestyle factors, particularly sleep quality, workload, and sedentary behavior, play a critical role in shaping CRF. These findings highlight the need for workplace-level public health interventions to preserve cardiorespiratory fitness and promote long-term health among healthcare professionals.

Background

Clinical healthcare professionals are the cornerstone of the medical system. Despite their dedication to patient health, they often face a "health paradox" Due to occupational stressors—such as high pressure, long working hours, and rotating shifts—combined with personal lifestyle factors, their own health status may not necessarily be superior to that of non-medical professionals. Cardiorespiratory fitness (CRF) refers to the capacity of the circulatory and respiratory systems to supply oxygen to skeletal muscles during sustained physical activity. High CRF indicates that the body can efficiently provide energy for exercise and daily tasks, thereby reducing fatigue. The American Heart Association has highlighted low CRF as a potent predictor of cardiovascular disease and a critical factor in cardiometabolic and mental health[1]. Currently, research on healthcare workers focuses primarily on mental health or musculoskeletal disorders, while investigations into their cardiorespiratory fitness remain scarce.

Healthcare professionals in the Department of Rehabilitation Medicine are generally perceived to have higher exercise literacy due to their professional background and work content. However, it remains unclear whether this cognitive advantage translates into superior CRF reserves. Different roles within this department (physicians, therapists, and nurses) exhibit distinct work patterns, providing an ideal model to explore the impact of occupational behavior on CRF. This study aims to objectively assess CRF levels in this population using Cardiopulmonary Exercise Testing (CPET) and analyze the impact of modifiable factors, such as workload and sleep patterns.

Materials and Methods

1. Study Design

This was a single-center, observational, cross-sectional study.

2. Participants

A convenience sample of full-time staff (physicians, therapists, and nurses) and rotating trainees (residents and interns) from the Rehabilitation Medicine Department of a tertiary hospital was recruited between March and June 2025.

- Inclusion Criteria: 1) Age ≥ 18 years; 2) Full-time work or study in the rehabilitation department; 3) Voluntary participation with signed informed consent.
- Exclusion Criteria: 1) Absolute contraindications for CPET (e.g., acute myocardial infarction, unstable angina, uncontrolled arrhythmia); 2) Severe orthopedic or neurological conditions preventing cycling; 3) Pregnancy or lactation.

3. Data Collection and Methodology

Cardiopulmonary Exercise Testing (CPET):

Testing was performed using the Schiller AT-104 HS-ERGO system with a cycle ergometer. A ramp protocol was utilized, with peak power predicted via the Wasserman formula to ensure a test duration of 8–12 minutes. Participants maintained a pedaling frequency of 55–65 rpm until reaching symptom-limited maximal effort. Success was determined by a Respiratory Exchange Ratio (RER) ≥ 1.10 or a Heart Rate (HR) ≥ 85% of the predicted value. Continuous monitoring included 12-lead ECG, blood pressure, minute ventilation, oxygen uptake (VO_2), and carbon dioxide output (VCO_2).

Outcome Measures:

- Primary: Percentage of predicted peak oxygen uptake (peakVO_2pred%).
- Secondary: Absolute peak oxygen uptake (VO_2 peak), Anaerobic Threshold (AT) determined via V-slope and ventilatory equivalent methods, percentage of predicted AT (ATpred%), peak heart rate, and peak RER.

Questionnaires and Measurements:

A structured questionnaire was completed within one week post-CPET, covering demographics, occupational characteristics (role, title, hours, night shifts), the Pittsburgh Sleep Quality Index (PSQI), occupational physical activity patterns (sitting/standing/walking ratios), and lifestyle habits (screen time, exercise frequency, smoking/drinking) (This questionnaire was partly based on the Pittsburgh Sleep Quality Index and was specifically designed for this study, the questionnaire is available in Supplementary Material 1).Height and weight were measured to calculate Body Mass Index (BMI).

4. Statistical Analysis

Data were analyzed using Prism 10. Quantitative data are presented as mean ± standard deviation ($\bar{x} \pm s$) and analyzed using t-tests or Mann-Whitney U tests. Categorical data are expressed as frequencies and percentages. Multi-group comparisons were performed using ANOVA or Kruskal-Wallis tests. Pearson or Spearman correlation and multiple linear regression were used to identify independent predictors of peakVO2pred%, with significance set at $\alpha = 0.05$.

Results

1. Participant Characteristics

The sample (N = 54) consisted of 15 males and 39 females, with a mean age of 26.0 ± 6.3 years and a mean BMI of 21.7 ± 3.6 kg/m^2. Nurses (38.9%) and therapists (37.0%) were the primary roles. Trainees and junior staff accounted for 83.3% of the cohort. Participants worked an average of 5.6 ± 0.5 days per week and 8.7 ± 0.9 hours per day. Notably, 16.7% reported sleep disorders (PSQI > 7), and only 14.8% maintained regular exercise habits.

2. Cardiorespiratory Fitness Reserves

Men showed significantly higher absolute values for VO_2peak (L/min) and AT compared to women ($P < 0.001$). However, women had a higher peakVO_2 pred% (82.8% ± 14.8%) than men (74.5% ± 14.3%), though this difference was not statistically significant ($P = 0.068$).(Table 1)

Table 1
Comparison of VO_2 and AT by Gender

Indicator	Male (n = 15)	Female (n = 39)	*t/Z* Value	*P*-value
VO_2peak (L/min)	2.24 ± 0.16	1.49 ± 0.35	5.894	< 0.001
PeakVO_2 pred%	74.5%±14.3%	82.8%±14.3%	-1.861	0.068
AT (L/min)	1.29 ± 0.32	0.96 ± 0.22	4.417	< 0.001
ATpred%	51.6%±8.6%	54.3%±11.2%	-0.803	0.426

3. Correlation and Regression Analysis

peakVO_2 pred% was significantly negatively correlated with total weekly working hours, PSQI scores, sedentary work ratio, and daily screen time. Conversely, it was positively correlated with the ratio of walking/moving during work.(Table 2)

Table 2
Occupational and Lifestyle Correlates of peakVO_2 pred%

Factor	PeakVO2 pred% (r/ρ)	*P*-value
Weekly Work Hours	-0.336	0.013*
Sleep Quality (PSQI)	-0.345	0.010*
Sedentary Work Ratio (%)	-0.312	0.022*
Daily Screen Time	-0.271	0.047*
Walking/Moving Work Ratio (%)	0.298	0.029*

Multiple linear regression confirmed that PSQI score, weekly work hours, sedentary work ratio, and daily screen time were all independent predictors of CRF levels.(Table 3)

Table 3
Multiple Linear Regression Analysis for peakVO_2 pred%

Variable	Standardized *β*	*t* Value	*P*-value	Relative Contribution
Sleep Quality (PSQI)	-0.33	-2.75	0.008	1
Weekly Work Hours	-0.29	-2.42	0.019	2
Sedentary Work Ratio (%)	-0.25	-2.18	0.034	3
Daily Screen Time	-0.22	-2.01	0.049	4

Discussion

This cross-sectional study objectively assessed Cardiorespiratory Fitness (CRF) among healthcare professionals working in a rehabilitation department using cardiopulmonary exercise testing (CPET) and explored its associations with occupational and lifestyle factors. The principal findings are threefold. First, despite their professional background and presumed high exercise literacy, rehabilitation healthcare professionals demonstrated suboptimal CRF reserves relative to age- and sex-predicted values. Second, poor sleep quality, prolonged working hours, high sedentary work ratio, and excessive screen time were independently associated with lower CRF. Third, a higher proportion of walking or movement during work was positively correlated with CRF, suggesting a potential protective role of occupational non-exercise physical activity.

The “Health Paradox” in Healthcare Professionals

Healthcare professionals are commonly regarded as a health-conscious population; however, accumulating evidence indicates a paradox in which those responsible for promoting health may themselves experience compromised physical health. Our findings extend this concept by demonstrating that even rehabilitation professionals—who are expected to possess superior exercise-related knowledge and awareness—do not necessarily exhibit adequate cardiorespiratory reserves. This discrepancy underscores an important public health implication: health literacy alone may be insufficient to counteract the adverse physiological effects of occupational stressors and unfavorable work environments.

From a public health perspective, CRF is a well-established predictor of cardiovascular morbidity, all-cause mortality, and long-term functional capacity. Suboptimal CRF in young and predominantly early-career healthcare workers, as observed in this study, may represent an early marker of future cardiometabolic risk if left unaddressed. Therefore, improving CRF in this population is not only an individual health issue but also a workforce sustainability concern.

Sleep Quality as a Modifiable Determinant of CRF

Among all examined factors, sleep quality emerged as the strongest independent predictor of CRF. Poor sleep is highly prevalent among healthcare workers due to shift work, long hours, and psychological stress. Experimental and epidemiological studies suggest that sleep deprivation may impair CRF through mechanisms including autonomic imbalance, heightened sympathetic activation, hormonal dysregulation, and mitochondrial dysfunction[2, 3, 4]. Our findings provide objective physiological evidence supporting the critical role of sleep in maintaining cardiorespiratory reserves.

Importantly, sleep quality represents a modifiable target at both individual and organizational levels. Interventions such as optimized shift scheduling, sleep health education, and workload management may yield measurable improvements in CRF and overall health. These results support the inclusion of sleep hygiene as a core component of workplace health promotion programs.

Occupational Sedentary Behavior and Fragmented Physical Activity

Sedentary behavior during work and prolonged weekly working hours were independently associated with lower CRF. While healthcare work is often perceived as physically demanding, modern clinical workflows increasingly involve prolonged sitting, electronic documentation, and screen-based tasks. Our findings align with growing evidence that occupational sedentary behavior exerts deleterious health effects independent of leisure-time physical activity.

Conversely, a higher proportion of walking or movement during work was positively associated with CRF, highlighting the potential importance of Non-Exercise Activity Thermogenesis (NEAT)[5]. Unlike

structured exercise, occupational movement is embedded in daily routines and may be more feasible for healthcare workers facing time constraints. From a public health standpoint, environmental and organizational strategies that promote incidental movement—such as workflow redesign, active workstations, or task-based mobility—may represent practical approaches to improving CRF at the population level.

Strengths and Limitations

A key strength of this study is the use of CPET to objectively assess CRF, reducing the measurement bias inherent in self-reported physical activity or fitness estimates. Additionally, focusing on a rehabilitation workforce allowed for the exploration of the disconnect between exercise knowledge and physiological fitness.

Several limitations should be acknowledged. The single-center design and relatively small sample size may limit generalizability. Behavioral variables were partially self-reported, introducing potential recall bias. Furthermore, the cross-sectional nature of the study precludes causal inference. Nonetheless, the identification of consistent and biologically plausible associations between modifiable occupational factors and objectively measured CRF supports the relevance of the findings and provides a rationale for future longitudinal and interventional studies.

Public Health Implications

The present study highlights that modifiable occupational and lifestyle factors substantially influence CRF among healthcare professionals, even in early adulthood. From a public health perspective, workplace-based interventions targeting sleep quality, sedentary behavior, and workload management may be essential to preserve cardiorespiratory reserves in this critical workforce. Addressing these factors may not only improve individual health outcomes but also enhance workforce resilience and healthcare system sustainability.

Conclusion

Despite high exercise literacy, healthcare professionals exhibited suboptimal cardiorespiratory fitness, reflecting a potential “health paradox.” Modifiable occupational and lifestyle factors, particularly sleep quality, workload, and sedentary behavior, play a critical role in shaping CRF. These findings highlight the need for workplace-level public health interventions to preserve cardiorespiratory fitness and promote long-term health among healthcare professionals.

Abbreviations

AT
Anaerobic Threshold

ATpred%
percentage of predicted AT
BMI
Body Mass Index
CPET
Cardiopulmonary Exercise Testing
CRF
Cardiorespiratory fitness
HR
Heart Rate
NEAT
Non-Exercise Activity Thermogenesis
peakVO_2pred%
Percentage of predicted peak oxygen uptake
PSQI
Pittsburgh Sleep Quality Index
RER
Respiratory Exchange Ratio
VCO_2
Carbon Dioxide Output
VO_2 peak
Absolute peak oxygen uptake
VO_2
Oxygen Uptake

Declarations

Author Contributions

Yihao Li was responsible for the conceptualization and methodology of the study, as well as writing the original draft, supervising the project, administering the project, and managing resources. Di Ye conducted the investigation and curated the data, while Jieru Xu performed the formal analysis, validation, software tasks, and visualization. All authors contributed to the review and editing of the manuscript and have read and approved the final version.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Renmin Hospital of Wuhan University (Approval No. WDRY2026-K032). All procedures were conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrollment.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

The authors received no specific funding for this work.

Authors' contributions

YL conceptualized and designed the study, supervised the project, and drafted the manuscript. DY was responsible for data collection and investigation. JX performed the statistical analysis, data validation, and visualization. All authors contributed to manuscript revision, read, and approved the final version.

Acknowledgements

The authors would like to thank all healthcare professionals who voluntarily participated in this study and contributed their time and effort.

Authors' information (optional)

Not applicable

References

1. Cardoso FJ, Victor DR, Silva JRD, Guimarães AC, Leal CA, Taveira MR, et al. Physical fitness level and the risk of severe COVID-19: A systematic review. Sports Med Health Sci. 2023;5(3):174–80. 10.1016/j.smhs.2023.07.010.
2. Sousa ARC, Mourão JIB. Burnout em anestesiologia [Burnout in anesthesiology]. Braz J Anesthesiol. 2018 Sep-Oct;68(5):507–17. 10.1016/j.bjan.2018.04.002.
3. Montoya JL, Jankowski CM, O'Brien KK, Webel AR, Oursler KK, Henry BL, et al. Evidence-informed practical recommendations for increasing physical activity among persons living with HIV. AIDS. 2019;33(6):931–9. 10.1097/QAD.0000000000002137.
4. Saner NJ, Bishop DJ, Bartlett JD. Is exercise a viable therapeutic intervention to mitigate mitochondrial dysfunction and insulin resistance induced by sleep loss? Sleep Med Rev.

2018;37:60–8. 10.1016/j.smrv.2017.01.001.
5. Levine JA. Non-exercise activity thermogenesis (NEAT). Best Pract Res Clin Endocrinol Metab. 2002;16(4):679–702. 10.1053/beem.2002.0227.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Supplementarymaterial1.pdf