




Explainable XGBoost Models for Predicting Burnout among Mental Health Professionals Using Compassion Fatigue, Psychological Capital, Self-Care, and Occupational Stress

Abdul-Wahab. Inusah¹, Ting. Yang², Mohammad Rahman. Washim^{3*}, Mohamad. Mustapa³

¹ Environmental Health Research Centre, Institute for Medical Research, National Institutes of Health, Ministry of Health Malaysia, Shah Alam 40170, Selangor, Malaysia

² Department of Psychological Medicine, Faculty of Medicine and Health Sciences, University Malaysia Sarawak, Malaysia



³ Department of Psychology, Faculty of Cognitive Sciences and Human Development, University Malaysia Sarawak, Malaysia

* Corresponding author email address: mrwashim@unimas.my

Editor

Saeid Motevalli¹
Associate Professor of Educational Psychology, Faculty of Social Sciences & Liberal Arts, UCSI University, Kuala Lumpur, Malaysia
Saeed@ucsiuniversity.edu.my

Reviewers

Reviewer 1: Aboutaleb Saadati Shamir¹
Associate Professor of Educational Psychology, Science and Research Branch, Islamic Azad University, Tehran, Iran. Email: seadatee@srbiu.c.ir
Reviewer 2: Musli Salleh Sahimi¹
Department of Psychiatry, Faculty of Medicine, National University of Malaysia, Kuala Lumpur, Malaysia. Email: muslisalleh@ppukm.ukm.edu.my

1. Round 1

1.1. Reviewer 1

Reviewer:

In the Introduction, paragraph 3, the manuscript states that “compassion fatigue is not an abstract construct but a measurable and consequential risk among professionals who provide care to individuals with severe or persistent psychological difficulties.” This is a strong claim, but it should be followed by a more explicit explanation of how compassion fatigue differs in psychiatric and psychological service settings compared with general healthcare settings. Since the sample consists specifically of mental health professionals, the introduction should more directly justify why this population has unique exposure patterns, such as repeated trauma narratives, suicidality, chronic therapeutic engagement, and emotional containment.

In the Introduction, paragraph 4, occupational stress is discussed broadly, but the manuscript should more clearly connect occupational stress to the Malaysian mental healthcare context. The article currently mentions Malaysia mainly near the end of

the Introduction, whereas contextualization should appear earlier. Please add a paragraph or several sentences describing the relevance of burnout prediction in Malaysia, including workforce demands, service accessibility, professional role diversity, institutional workload, and the need for locally grounded evidence.

In the Data Collection Tools subsection, the manuscript reports that several instruments have “excellent psychometric properties” or “satisfactory construct validity,” but reliability estimates from the present sample are not reported. Please add Cronbach’s alpha, McDonald’s omega, or composite reliability for each scale and subscale used in this study. Reporting reliability only from prior studies is insufficient, particularly in a Malaysian sample with possible linguistic, occupational, and cultural variation.

In the Methods and Materials section, the manuscript indicates that “missing values representing less than 5% of the dataset were imputed using median values for continuous variables and mode imputation for categorical variables.” Please report the exact percentage of missing data per variable and justify the imputation strategy. Median and mode imputation are simple but may reduce variance and distort associations. The authors should consider sensitivity analyses using multiple imputation or at least report whether model performance remained stable when complete-case analysis was compared with imputed-data analysis.

Authors revised and uploaded the document.

1.2. Reviewer 2

Reviewer:

In the Introduction, the sentence “Explainable predictive modeling is therefore well suited to advancing this agenda by translating complex psychological data into actionable occupational insights” is conceptually valuable, but the manuscript should explain why XGBoost was selected over other machine learning models. Please briefly compare XGBoost with alternative approaches such as logistic regression, random forest, support vector machine, and neural networks, emphasizing its suitability for nonlinear structured data, interaction detection, robustness, and compatibility with SHAP-based explainability.

In the final paragraph of the Introduction, the aim is clearly stated; however, the study gap should be sharpened immediately before the aim. The current text says that “fewer studies have examined their combined predictive value using explainable machine learning,” but it should specify whether the gap concerns Malaysian mental health professionals, the simultaneous inclusion of risk and protective predictors, or the use of SHAP-interpretable XGBoost models. A more precise gap statement would strengthen the rationale and make the study’s originality more explicit.

In the Methods and Materials section, under “Study Design and Participants,” the manuscript states that “A total of 742 mental health professionals participated in the study.” Please provide a sample size justification. Because this is a predictive machine learning study, the manuscript should explain whether the sample size was determined through power analysis, events-per-variable considerations, machine learning learning-curve stability, class balance requirements, or practical feasibility. Without sample size justification, readers cannot determine whether 742 participants were sufficient for model development, validation, and subgroup sensitivity analyses.

In the Methods and Materials section, the participant recruitment strategy is described as “stratified convenience sampling,” but the strata are not sufficiently defined. Please specify exactly which strata were used, such as profession, healthcare sector, geographical region, or institutional type. It is also necessary to state how many participants were recruited from each stratum, whether proportional allocation was used, and whether recruitment differed between public hospitals, community mental health centers, university counseling services, and private clinics.

In the Methods and Materials section, the inclusion criteria state that participants had to be “proficient in English or Malay,” but the manuscript does not clarify whether the instruments were administered in English, Malay, or both. Please specify the language of administration and, if Malay versions were used, describe translation, back-translation, cultural adaptation, and psychometric validation procedures. This is essential because measurement equivalence directly affects the validity of burnout, compassion fatigue, psychological capital, self-care, and occupational stress scores.

In the Data Collection Tools subsection, burnout was assessed using the MBI-HSS, while compassion fatigue was assessed using the ProQOL-5, which itself includes a burnout subscale. This raises a construct overlap concern. The sentence “For the purposes of the present study, the Compassion Fatigue construct was represented primarily through the Burnout and Secondary Traumatic Stress dimensions” should be revised, because using the ProQOL burnout dimension to predict MBI-HSS burnout may introduce criterion contamination. Please clarify whether the ProQOL burnout subscale was excluded, retained, or combined with secondary traumatic stress, and justify this decision methodologically.

Authors revised and uploaded the document.

2. Revised

Editor’s decision after revisions: Accepted.

Editor in Chief’s decision: Accepted.