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Algorithmic Identification of Academic Burnout: Integrating Wearable Sensor Data and School Performance Metrics via Gradient Boosted Decision Trees

Jacinto dos Santos. Lino[1], Thiago. Moreira[2*], Justas. Rimkus[3]

[1] Department of Applied Social Sciences, State University of Southwest Bahia, State of Bahia, Brazil
[2] Department of Social Psychology, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil
[3] Department of Health Psychology, Lithuanian University of Health Sciences, Kaunas, Lithuania

*** Corresponding author email address**: thiago.moreira@ufrj.br

Editor	Reviewers
Ahmad Amani Associate Professor, Counseling Department, University of Kurdistan, Sanandaj, Iran a.amani@uok.ac.ir	**Reviewer 1:** Paul Peters-Boselie Clinical Psychology, Open University, 6401 DL, Heerlen, Netherlands. Email: paul.peters-boselie@ou.nl **Reviewer 2:** Stephanie Flores Carrera Department of Psychology, Iowa State University, Ames, Iowa, US. Email: step.flores-carrera@gmail.com

1. Round 1

1.1. Reviewer 1

Reviewer:

The machine learning methodology is generally sound, with GBDT, cross-validation, and hyperparameter tuning, but important details are missing for a rigorous evaluation: please clarify how class imbalance (burnout vs. non-burnout) was handled, whether any nested cross-validation was used to avoid optimistic performance estimates, and report confidence intervals for key metrics (accuracy, F1, AUC) along with a confusion matrix to make the model's error profile transparent.

The model evaluation currently focuses on global performance metrics, yet for real-world deployment in universities the choice of operating threshold is crucial; I strongly encourage you to include ROC and precision–recall curves, discuss sensitivity–specificity trade-offs explicitly, and argue for a plausible decision threshold (e.g., prioritizing high sensitivity vs. limiting false alarms) in the context of early burnout detection and resource allocation.

The ethical and practical implementation discussion is a valuable component, but it currently remains somewhat optimistic; I recommend adding a more critical examination of privacy, informed consent, data governance, and potential coercive or discriminatory uses of continuous monitoring (e.g., surveillance by administrators, stigmatization of flagged students), along

with concrete safeguards such as differential access rights, data minimization, and involvement of student governance in system design.

Authors uploaded the revised manuscript.

1.2. Reviewer 2

Reviewer:

The interpretation of feature importance usefully highlights SDNN, sleep, and academic behavior, but the analysis could be deepened by employing more interpretable ML tools such as SHAP or partial dependence plots; these would allow you to visualize non-linear relationships, examine potential interaction effects (e.g., HRV × missed lectures), and support stronger claims about how specific physiological and behavioral patterns jointly signal burnout risk.

The conceptual integration with psychological constructs (perfectionism, fear of failure, alexithymia, intolerance of uncertainty, neuroticism) is rich, yet empirically these variables are not included in the predictive model; the discussion should more clearly distinguish between theoretically inferred mechanisms and directly measured predictors, and ideally either temper causal language or outline a concrete plan for integrating these psychometric constructs into future multimodal modeling.

While the limitations section correctly notes constraints regarding generalizability and observational design, it would be useful to more explicitly discuss cultural and contextual factors related to the specific Brazilian university setting (e.g., grading systems, academic pressure norms, socioeconomic factors) and how these may affect model transportability to other countries, institutional types, or less demanding academic tracks such as community colleges or humanities programs.

Authors uploaded the revised manuscript.

2. Revised

Editor’s decision after revisions: Accepted.
Editor in Chief’s decision: Accepted.

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