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Predicting Adolescent Depressive Symptom Severity from Rumination, Sleep Variability, and Heart-Rate Variability Using Multimodal Deep Learning

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1. Round 1

1.1. Reviewer 1

Reviewer:

The introduction is impressively comprehensive and up-to-date, but it reads more like an extended narrative review than a focused rationale for the specific study; it would benefit from tighter synthesis that explicitly converges on the precise research gap (i.e., lack of integrated multimodal deep learning models combining rumination, sleep variability, and HRV in adolescents) and states clear, testable hypotheses or research questions rather than a broad aim only.

The literature review on rumination is rich and well referenced, yet the inclusion of diverse clinical populations (e.g., infertile women, anger/unforgiveness, adult ADHD) somewhat dilutes the adolescent focus; the authors should more clearly distinguish which findings are directly relevant to adolescents and which are extrapolated, and explicitly justify the transferability of these mechanisms to the target age group.

The deep learning architecture is described in broad strokes (LSTM branch for time series, MLP branch for static data, late fusion, Adam optimizer, cosine annealing, MSE loss), but for a methods-oriented audience the description is incomplete: key details such as network depth, number of units per layer, activation functions, dropout rates, batch size, number of epochs,

early stopping criteria, hardware/resources, and implementation framework (e.g., PyTorch, TensorFlow) should be provided for reproducibility.

Authors uploaded the revised manuscript.

1.2. Reviewer 2

Reviewer:

The description of sleep and autonomic factors is conceptually strong, but the transition from adult and cardiac populations to adolescents is not always clearly signposted; the manuscript would be strengthened by citing more adolescent-specific HRV and sleep-variability studies (if available) or, if not, explicitly framing this as a key novelty and limitation of the current evidence base.

The methods section suggests a study conducted in Lagos, Nigeria, which appears inconsistent with the authors' institutional affiliations in Iran; this discrepancy needs to be clarified (e.g., is this a multi-country collaboration, a typographical error, or a hypothetical dataset?) and the sampling frame and cultural context should be described more transparently, as they substantially affect generalizability.

The sampling strategy (purposeful school selection followed by stratified random sampling of students) is appropriate in principle, but the description is insufficiently detailed for replication: the authors should specify strata (e.g., school type, SES, gender), response rates, exclusion rates, and how potential selection biases (e.g., refusal to wear devices, missing consent) may have influenced the final analytic sample of 418 adolescents.

The measurement section is generally sound but remains underspecified in crucial aspects: the authors should report the exact versions, language, and psychometric properties (e.g., reliability coefficients, prior validation in Nigerian/adolescent samples) of the Ruminative Responses Scale and PHQ-A used, and explain any cultural or linguistic adaptations undertaken for the target population.

The operationalization of sleep variability and HRV is technically plausible yet somewhat opaque; more detail is needed on device brand/model, validation evidence for adolescent actigraphy/PPG use, sampling frequency, artifact detection, HRV calculation windows (e.g., 5-min epochs, full-night segments), and whether analyses focused on time-domain or frequency-domain indices beyond RMSSD and SDNN.

Authors uploaded the revised manuscript.

2. Revised

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

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