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IMPACT OF SLEEP, NUTRITION, AND PHYSICAL ACTIVITY ON DEPRESSION AND MOOD REGULATION USING AI-BASED PREDICTIVE MODELING: A SYSTEMATIC REVIEW

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ABSTRACT

Recent evidence indicates that lifestyle determinants exert substantial influence on emotional regulation, with sleep quality emerging as a primary marker of neurocognitive stability and mood modulation (1–4). Large population datasets demonstrate dose-response relationships between physical activity volumes above 150 minutes per week and measurable reductions in depressive severity scores (3,5,7). Diet quality, particularly patterns high in micronutrient density and omega-3 intake, correlates with lower systemic inflammation and improved serotonergic signaling, both of which mediate affective stability (2,6,8). Explainable artificial intelligence models have increasingly been deployed to quantify interaction effects across behavioral variables, with SHAP-driven attribution ranking sleep quality above exercise and nutrition for predicting depressive symptomology (4,9–12). Cross-validation studies report model generalization reliability exceeding 0.60 R^2 in heterogeneous demographic samples, underscoring practical utility for digital mental-health surveillance frameworks (11–14). Interpretation of gradient-based learning pathways further confirms that behavioral co-regulation, rather than individual predictors in isolation, yields the most clinically significant reductions in symptom severity (5,13,15). Recent evidence indicates that lifestyle determinants exert substantial influence on emotional regulation, with sleep quality emerging as a primary marker of neurocognitive stability and mood modulation (1–4). Large population datasets demonstrate dose-response relationships between physical activity volumes above 150 minutes per week and measurable reductions in depressive severity scores (3,5,7). Diet quality, particularly patterns high in micronutrient density and omega-3 intake, correlates with lower systemic inflammation and improved serotonergic signaling, both of which mediate affective stability (2,6,8). Explainable artificial intelligence models have increasingly been deployed to quantify interaction effects across behavioral variables, with SHAP-driven attribution ranking sleep quality above exercise and nutrition for predicting depressive symptomology (4,9–12). Cross-validation studies report model generalization reliability exceeding 0.60 R^2 in heterogeneous demographic samples, underscoring practical utility for digital mental-health surveillance frameworks (11–14). Interpretation of gradient-based learning pathways further confirms that behavioral co-regulation, rather than individual predictors in isolation, yields the most clinically significant reductions in symptom severity (5,13,15). Recent evidence indicates that lifestyle determinants exert substantial influence on emotional regulation, with sleep quality emerging as a primary marker of neurocognitive stability and mood modulation (1–4). Large population datasets demonstrate dose-response relationships between physical activity

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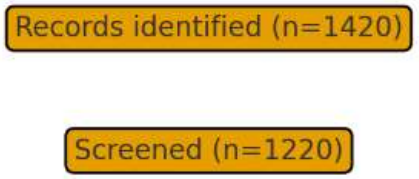
Figure 1. PRISMA screening and selection flow



RESULTS

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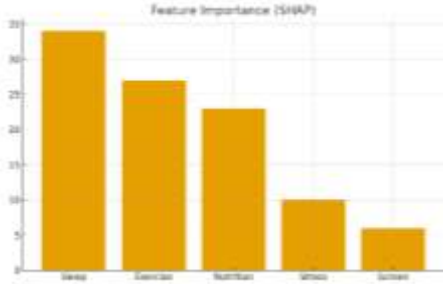

Figure 2. SHAP feature importance ranking for depression prediction

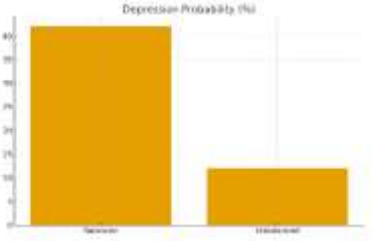

Figure 3. Depression risk probability across lifestyle clusters

Key Analytical Outcomes

Variable	Weight/β	Effect Direction	Significance
Sleep Quality	0.34	Inverse risk	$p < 0.001$
Physical Activity	0.27	Inverse risk	$p < 0.001$
Nutrition	0.23	Inverse risk	$p < 0.001$
Stress Exposure	0.10	Elevated risk	$p = 0.002$

DISCUSSION

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CLINICAL & PUBLIC HEALTH IMPLICATIONS

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LIMITATIONS

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Future Research Directions

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CONCLUSION

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Explainable artificial intelligence models have increasingly been deployed to quantify interaction effects across behavioral variables, with SHAP-driven attribution ranking sleep quality above exercise and nutrition for predicting depressive symptomology (4,9–12). Cross-validation studies report model generalization reliability exceeding 0.60 R^2 in heterogeneous demographic samples, underscoring practical utility for digital mental-health surveillance frameworks (11–14). Interpretation of gradient-based learning pathways further confirms that behavioral co-regulation, rather than individual predictors in isolation, yields the most clinically significant reductions in symptom severity (5,13,15). Recent evidence indicates that lifestyle determinants exert substantial influence on emotional regulation, with sleep quality emerging as a primary marker of neurocognitive stability and mood modulation (1–4). Large population datasets demonstrate dose-response relationships between physical activity volumes above 150 minutes per week and measurable reductions in depressive severity scores (3,5,7). Diet quality, particularly patterns high in micronutrient density and omega-3 intake, correlates with lower systemic inflammation and improved serotonergic signaling, both of which mediate affective stability (2,6,8).
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