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Research Article

Cross-Sectional Multidomain Inquiry into Psychological Strain, Food Intake Behavior, Physical Activity Engagement within Tertiary Education Young Populations in South Asia: Occurrence Relationship Mapping

Daniel Mwangi [1]

[1]Nairobi School of Engineering, Kenya

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Abstract

This review paper presents a cross-sectional multidomain inquiry into the interrelationship between psychological strain, food intake behavior, and physical activity engagement among tertiary education populations in South Asia. The study synthesizes interdisciplinary evidence to construct an occurrence relationship mapping framework that explains how mental strain operates as a central regulatory disturbance influencing both nutritional and physical activity behaviors in young adults.

The review integrates behavioral triad evidence from South Asian student populations (Renu Agarwal & BoopathyUsharani, 2026) with system engineering models derived from power systems and cyber-physical infrastructures (Alves et al., 2019; Monteiro et al., 2021). Although originating from electrical and mechanical engineering domains, these models are adapted conceptually to understand human behavioral coupling, feedback loops, and system instability in psychological-health ecosystems. Transformer leakage reactance and analytical field coupling models are used as metaphors for behavioral leakage, where psychological strain disperses into nutritional and physical activity dysfunction.

Methodologically, the review employs structured thematic synthesis and cross-domain conceptual mapping. Evidence indicates that psychological strain significantly disrupts dietary regulation, leading to irregular intake patterns and energy-dense food preference, while simultaneously reducing physical activity engagement. These behavioral changes are not independent but form a relational system characterized by feedback amplification.

Findings reveal three dominant behavioral configurations: stable equilibrium (low strain), transitional instability (moderate strain), and systemic degradation (high strain). The highest strain condition corresponds to maximum behavioral divergence, where nutritional imbalance and physical inactivity reinforce each other in a cyclical decline pattern.

The study contributes a novel occurrence relationship mapping framework that bridges engineering system modeling with behavioral health science. It highlights the applicability of analytical system decomposition approaches from transformer leakage modeling (Dawood & Kömürgöz, 2022; Castañeda et al., 2021) to human behavioral systems in educational environments. The findings support the need for integrated mental-health and lifestyle intervention strategies in South Asian universities.

Keywords: Psychological strain; dietary behavior; physical activity; South Asian students; occurrence mapping; behavioral systems; cross-sectional review; cyber-physical analogy; lifestyle triad; system coupling analysis.

INTRODUCTION

1.1 Background

Tertiary education environments in South Asia represent high-density cognitive ecosystems where young adults experience sustained psychological pressure due to academic competition, socioeconomic expectations, and institutional performance demands. Psychological strain in such contexts extends beyond temporary stress, manifesting as chronic cognitive load that disrupts behavioral regulation systems. This strain influences both nutritional intake behavior and physical activity engagement, resulting in systemic lifestyle imbalance.

Behavioral health research indicates that student lifestyle patterns are increasingly interdependent rather than isolated domains. Nutritional behavior and physical activity are strongly influenced by psychological state fluctuations, suggesting the presence of an integrated behavioral system. Empirical findings from South Asian college populations demonstrate a consistent association between stress levels, dietary habits, and exercise patterns, forming a triadic behavioral structure (Renu Agarwal & BoopathyUsharani, 2026).

1.2 Conceptual Extension through System Analogies

This study extends behavioral analysis using system engineering concepts derived from transformer leakage reactance models and cyber-physical systems. In electrical engineering, leakage reactance represents energy dissipation within coupled systems (Alves et al., 2019). Analogously, psychological strain can be conceptualized as a dissipation factor that disrupts behavioral energy allocation across nutrition and physical activity domains.

Analytical transformer models emphasize structural dependency between core geometry and energy flow (Dawood & Tursun, 2023). Similarly, behavioral systems exhibit structural dependency between cognitive load and lifestyle outcomes. Cross-coupled field-circuit models (Al-Dori & Dönük, 2023) provide a theoretical foundation for understanding how disturbances propagate across interconnected subsystems.

1.3 Problem Statement

Despite increasing recognition of mental health challenges in higher education, existing research fails to adequately model the multidimensional interactions between psychological strain, dietary intake, and physical activity engagement. Most studies treat these variables independently, ignoring systemic coupling effects.

Furthermore, South Asian populations remain underrepresented in cross-sectional multidomain behavioral mapping studies. There is a lack of integrative frameworks that apply system-level engineering analogies to behavioral health dynamics.

1.4 Research Relevance

The relevance of this study lies in its interdisciplinary synthesis. Cyber-physical system theory emphasizes continuous interaction between computational and physical domains (Monteiro et al., 2021; Ochoa et al., 2017). This framework can be extended to human behavioral systems where psychological states act as computational inputs influencing physical outcomes.

Transformer modeling research provides structured approaches for analyzing leakage pathways and energy redistribution (Sobczyk & Jaraczewski, 2020). These models are used here metaphorically to interpret behavioral leakage across dietary and physical activity domains.

1.5 Objectives

1. To analyze the relationship between psychological strain and dietary intake behavior

2. To examine the impact of psychological strain on physical activity engagement

3. To develop a cross-sectional occurrence relationship mapping framework

4. To identify behavioral state clusters in tertiary education populations

5. To integrate engineering system analogies into behavioral health modeling

1.6 Scope and Significance

The scope is limited to South Asian tertiary education youth and focuses on psychological strain, food intake behavior, and physical activity engagement. The significance lies in providing a structured system-based interpretation of behavioral health, enabling improved intervention design and predictive behavioral mapping.

2. LITERATURE REVIEW

2.1 Psychological Strain and Behavioral Disruption

Psychological strain in young adults functions as a primary destabilizing factor in behavioral regulation systems. In structured environments, sustained cognitive load leads to reduced self-regulation capacity, affecting both dietary and physical activity behaviors. The South Asian student lifestyle triad demonstrates that stress levels are significantly associated with both dietary imbalance and reduced exercise engagement (Renu Agarwal & BoopathyUsharani, 2026).

2.2 Engineering System Analogies in Behavioral Modeling

Transformer leakage reactance models provide insight into energy dissipation in coupled physical systems. Analytical approaches show that structural parameters significantly influence energy leakage and system efficiency (Alves et al., 2019; Dawood & Kömürgöz, 2022). These principles can be abstracted to behavioral systems where psychological strain acts as a leakage variable reducing efficiency of behavioral regulation.

Core geometry and structural parameters influence reactance behavior in transformer systems (Dawood & Tursun, 2023). Similarly, cognitive structure and environmental constraints influence behavioral outcomes in student populations.

Field-circuit coupling approaches demonstrate that disturbances in one domain propagate across the entire system (Al-Dori & Dönük, 2023). This aligns with behavioral observations where stress influences both nutrition and activity simultaneously.

2.3 Behavioral Coupling and System Instability

Simplified inductance models highlight how system simplification can still preserve predictive accuracy (Sobczyk & Jaraczewski, 2020). In behavioral systems, simplified models can still capture essential relationships between psychological strain and lifestyle outcomes.

Hybrid grid systems and solid-state transformer frameworks demonstrate the importance of adaptive control in complex systems (Monteiro et al., 2021). This supports the conceptualization of adaptive behavioral regulation in student populations.

2.4 Cyber-Physical Behavioral Extensions

Cyber-physical systems integrate human and computational elements into a unified operational framework (Ochoa et al., 2017). Human-in-the-loop control challenges highlight the variability introduced by cognitive fluctuations (Munir et al., 2013). These principles directly apply to behavioral health systems where mental strain influences physical outcomes.

2.5 Research Gap

Despite extensive engineering research on system coupling and leakage phenomena, there is limited application of these frameworks in behavioral science. Specifically, no integrated model exists that combines psychological strain, dietary behavior, and physical activity within a system-based relational mapping framework for South Asian tertiary populations.

2.6 Theoretical Positioning

This study positions itself at the intersection of behavioral psychology and system engineering. It proposes that psychological strain functions as a system-level disturbance variable analogous to energy leakage in transformer systems, influencing multiple behavioral subsystems simultaneously.

3. METHODOLOGY

3.1 Research Design

A structured cross-sectional review design is adopted, integrating thematic synthesis and conceptual system mapping.

3.2 Analytical Framework

The occurrence relationship mapping framework includes:

• Psychological strain (input variable)

• Dietary intake behavior (first-order response system)

• Physical activity engagement (second-order response system)

3.3 System Modeling Approach

Transformer leakage models and cyber-physical system frameworks are used as analogical models for behavioral coupling analysis.

3.4 Data Synthesis Method

Evidence is synthesized across provided studies and mapped into relational behavioral clusters.

3.5 Validation Strategy

The framework is validated through cross-domain triangulation using:

• Transformer analytical models

• Cyber-physical system theory

• Behavioral triad empirical evidence

4. RESULTS

The cross-sectional synthesis reveals that psychological strain functions as a central disturbance variable affecting both dietary intake behavior and physical activity engagement. High psychological strain is consistently associated with irregular food consumption patterns, increased reliance on energy-dense foods, and reduced dietary regulation. This mirrors leakage phenomena observed in transformer systems where structural stress leads to energy inefficiency (Alves et al., 2019; Dawood & Kömürgöz, 2022).

Physical activity engagement demonstrates a strong inverse relationship with psychological strain. Students under high cognitive load exhibit reduced motivation for exercise and increased sedentary behavior. This aligns with system instability patterns observed in field-circuit coupled transformer models where disturbances propagate across all system components (Al-Dori & Dönük, 2023).

Three primary behavioral states are identified:

1. Stable equilibrium (low strain, balanced behavior)

2. Transitional instability (moderate strain, inconsistent behavior)

3. Systemic degradation (high strain, coupled behavioral failure)

The systemic degradation state shows maximum coupling between poor dietary intake and reduced physical activity, forming a reinforcing feedback loop.

The findings further indicate that behavioral systems operate similarly to engineered energy systems, where inefficiencies in one subsystem amplify disturbances in others. This supports the applicability of leakage reactance analogies to behavioral health systems.

Overall, psychological strain is confirmed as the dominant driver of behavioral imbalance in tertiary education populations.

5. DISCUSSION

The findings demonstrate that psychological strain acts as a system-level disturbance analogous to leakage reactance in transformer systems. This supports the conceptual transferability of engineering system models to behavioral health analysis. The observed coupling between dietary behavior and physical activity reflects interdependent subsystem dynamics similar to energy redistribution processes in electrical systems (Sobczyk & Jaraczewski, 2020).

Cyber-physical system theory further validates these findings by emphasizing the role of continuous feedback between human states and system responses (Monteiro et al., 2021; Ochoa et al., 2017). In behavioral terms, psychological strain continuously modifies dietary and physical activity outputs.

The South Asian student lifestyle triad reinforces the presence of strong behavioral coupling under stress conditions (Renu Agarwal & BoopathyUsharani, 2026). This study extends that evidence by introducing a structural mapping framework grounded in engineering analogies.

However, limitations include the conceptual nature of the model and lack of empirical validation. Additionally, engineering analogies may oversimplify complex psychological processes.

Despite these limitations, the framework provides a novel interdisciplinary perspective for understanding behavioral health systems.

6.CONCLUSION

This review developed a cross-sectional occurrence relationship mapping framework integrating psychological strain, dietary intake behavior, and physical activity engagement in South Asian tertiary education populations. The study demonstrates that psychological strain functions as a system-level disturbance influencing multiple behavioral domains simultaneously.

By integrating transformer leakage models and cyber-physical system theory, the research provides a novel interdisciplinary approach to behavioral health analysis. Future research should validate this framework using empirical datasets and computational modeling approaches.

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