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RELATIONSHIP OF PHYSICAL ACTIVITY AND MENTAL TOUGHNESS WITH ACADEMIC BURNOUT OF COLLEGE STUDENTS IN PAKISTAN

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ABSTRACT

Academic burnout characterized by emotional exhaustion, cynicism, and reduced academic efficacy is an increasingly prevalent and serious concern among college students in Pakistan, where academic pressures, limited mental health support infrastructure, and competitive educational environments combine to create high burnout risk. Physical activity (PA) and mental toughness (MT) have been theoretically and empirically linked to burnout outcomes, yet their combined relationship with academic burnout in the Pakistani college context has not been systematically investigated. Methods: This cross-sectional, quantitative survey study recruited 1,900 college students (n = 1,900) from 49 Government Degree Colleges across the Sheikhupura region of Punjab, Pakistan. Physical activity was measured using the validated International Physical Activity Questionnaire Short Form (IPAQ-SF). Mental toughness was assessed via the 8-item Mental Toughness Index (MTI) on a 7-point Likert scale. Academic burnout was measured using the Maslach Burnout Inventory–Student Survey (MBI-SS), capturing emotional exhaustion, cynicism, and academic inefficacy. Data normality was confirmed through skewness and kurtosis analysis. Inferential analyses included Pearson correlation, simple linear regression, independent-samples t-tests, and one-way ANOVA, conducted using SPSS v.25. Results: Physical activity demonstrated a strong positive correlation with academic burnout ($r = .655$, $p < .001$), and significantly predicted academic burnout, accounting for 43% of its variance ($\beta = .655$, $R^2 = .429$,

F = 299.368, p < .001). Mental toughness demonstrated an even stronger positive correlation with academic burnout (r = .711, p < .001) and accounted for 51% of its variance (β = .711, R^2 = .506, F = 408.632, p < .001). No significant gender-based (p > .05) or program-based (p > .05) differences were found. Significant district-based differences were identified across all three variables (p < .05). Age-based differences were significant for physical activity and academic burnout (p < .05), but not for mental toughness (p = .371). Conclusions: Both physical activity and mental toughness are significant positive correlates and predictors of academic burnout in Pakistani college students, with mental toughness demonstrating a stronger predictive effect. These findings underscore the importance of integrating structured physical activity programs and evidence-based mental toughness development interventions into the academic welfare infrastructure of Pakistani government colleges, particularly in geographically diverse district settings.

Keywords: *Academic Burnout, Physical Activity, Mental Toughness, College Students, Pakistan, MBI-SS, IPAQ-SF, Punjab*

1. Introduction

1.1 Background

Academic burnout is a state of persistent psychological exhaustion, emotional detachment, and reduced sense of academic efficacy arising from sustained exposure to academic stressors has emerged as a significant and growing concern among college and university students worldwide (Maslach, Schaufeli & Leiter, 2001; Salmela-Aro, Savolainen & Holopainen, 2009). In Pakistan, the college education system encompassing two-year FA/FSc and four-year BS programs across government and private institutions exposes students aged 17 to 22 to intense academic demands including high-stakes examinations, competitive peer environments, workload pressure, limited contact with academic staff, and uncertain post-graduation employment prospects (Eriksson et al., 2011). These stressors operate within a social context characterized by limited mental health awareness, inadequate institutional welfare support, and strong socio-cultural pressure for academic achievement conditions that collectively elevate burnout risk and reduce help-seeking behavior among affected students.

Despite the well-documented adverse consequences of academic burnout including impaired academic performance, increased dropout risk, depressive symptomatology, and long-term occupational burnout (Salmela-Aro et al., 2009; Schaufeli, Leiter & Maslach, 2009) empirical investigation of academic burnout and its correlates among Pakistani college students remains sparse. Two constructs theoretically linked to burnout outcomes physical activity (PA) and mental toughness (MT) have received growing attention in the international sport science and educational psychology literature as potential protective factors, yet their combined relationship with academic burnout in the Pakistani college context has not been systematically studied.

Physical activity is widely recognized as a positive contributor to psychological wellbeing, emotional regulation, and cognitive performance (Naczenski et al., 2017). A systematic review of longitudinal studies found a significant inverse relationship between physical activity levels and burnout across diverse populations (Naczenski et al., 2017). In student populations, regular physical activity has been associated with reduced emotional exhaustion, improved sleep quality, and enhanced academic engagement (Ghrouz et al., 2019; Gerber et al., 2015). Within the Pakistani educational context, where structural provision for student physical activity remains limited at many government colleges, understanding the PA-burnout relationship has direct implications for institutional policy.

Mental toughness is defined as the natural or developed psychological capacity to cope effectively with competitive demands, maintain focus and confidence under pressure, and persist through adversity (Jones, Hanton & Connaughton, 2007; Gucciardi et al., 2015) has been extensively studied in sporting contexts but has received increasing attention in academic settings. Research consistently demonstrates that students with higher mental toughness levels exhibit better academic performance, greater academic engagement, and lower burnout symptomatology (Crust et al., 2014; Lin et al., 2017; Haghighi & Gerber, 2019). Given the demanding and uncertain educational environment facing Pakistani college students, mental toughness represents a potentially modifiable psychological resource with significant protective value against academic burnout.

1.2 Research Problem

The present study addressed the following central problem: what is the relationship between physical activity, mental toughness, and academic burnout among government college students in Punjab, Pakistan? More specifically, the study examined whether PA and MT demonstrate significant associations with and predictive effects on academic burnout, and whether these relationships differ across demographic variables including gender, academic program, district of study, and age group. Addressing this problem is essential for generating evidence-based recommendations for academic welfare policy, physical education provision, and mental health support programs in Pakistan's government college system.

1.3 Objectives

The study pursued five objectives as follows;

(1) To identify the association between physical activity and academic burnout
(2) To identify the association between mental toughness and academic burnout
(3) To determine the impact of physical activity on academic burnout
(4) To determine the impact of mental toughness on academic burnout
(5) To examine group, mean differences in student opinions regarding study variables by gender, academic program, district, and age.

1.4 Research Hypotheses

Eight hypotheses guided the study as;

H1: There is a significant association between physical activity and academic burnout
H2: There is a significant association between mental toughness and academic burnout
H3: Physical activity has a significant positive impact on academic burnout
H4: Mental toughness has a significant positive impact on academic burnout
H5: There is significant gender-based group mean differences in study variables
H6: There are significant program-based group mean differences in study variables
H7: There are significant district-based group mean differences in study variables
H8: There are significant age-based group mean differences in study variables.

1.5 Significance

This study makes a timely and contextually relevant contribution to the emerging evidence base on student wellbeing in Pakistan. Its findings carry practical significance for policymakers at the Higher Education Commission of Pakistan (HEC), college principals, curriculum designers, sports science practitioners, and student counselling services. By identifying PA and MT as significant predictors of academic burnout in a large-scale sample of Pakistani government college students, the study provides an empirical foundation for designing targeted interventions including

structured physical activity programs, sport-based mental toughness training, and burnout awareness initiatives within the government college system.

2. LITERATURE REVIEW

2.1 Academic Burnout: Conceptualization and Measurement

Burnout was initially conceptualized by Freudenberger (1974) in the context of professionals working in high-demand helping roles, characterized by chronic stress, depleted energy, and a loss of dedication. Maslach and Jackson (1981) subsequently formalized the construct through the Maslach Burnout Inventory (MBI), defining burnout as a tripartite syndrome comprising emotional exhaustion, depersonalization, and reduced personal accomplishment. Maslach, Schaufeli and Leiter (2001) confirmed these three dimensions with high emotional exhaustion, high cynicism (depersonalization), and low efficacy characterizing the burnout syndrome across professional and student contexts.

The adaptation of the MBI to student populations produced the Maslach Burnout Inventory Student Survey (MBI-SS; Schaufeli et al., 2002), which reconceptualizes the three dimensions for academic contexts: emotional exhaustion (feelings of depletion from study demands), cynicism (detachment and disengagement from academic work), and academic inefficacy (perceived inability to contribute effectively in academic settings). The MBI-SS has demonstrated robust factorial validity across multiple cultural contexts, including Pakistani and Asian educational settings (Hu & Schaufeli, 2009), making it the instrument of choice for the present study.

Among Pakistani college students, multiple academic stressors contribute to burnout risk. These include excessive workload, time pressure from frequent examinations, competitiveness, inadequate faculty contact, socio-economic pressures, and limited access to extra-curricular or recreational outlets (Moneta, 2011; Rahmati, 2015). Burnout develops progressively through stages identified by Piatkowska (2014): from initial compulsive over-dedication, through increasing physical and psychological fatigue, to eventual cynicism and disengagement a trajectory directly relevant to the high-demand, low-support environment characterizing many Pakistani government colleges.

2.2 Physical Activity and Academic Burnout

The relationship between physical activity and psychological wellbeing including burnout has been extensively theorized and empirically examined. Naczenski et al. (2017) conducted a systematic review of the association between physical activity and burnout, identifying four longitudinal studies and concluding that higher physical activity levels were associated with lower burnout risk across populations. The hypothesized mechanisms include PA-induced reduction in stress hormones (cortisol, adrenaline), enhancement of mood-regulating neurotransmitters (serotonin, dopamine, endorphins), improvement in sleep quality, and development of self-efficacy through mastery experiences.

In student populations specifically, Gerber et al. (2015) found that physical activity moderated the relationship between burnout and mental health in Swiss vocational students — with physically active students demonstrating significantly lower burnout levels even under high academic stress. Ghrouz et al. (2019) reported substantial correlations between physical activity levels and both sleep quality and mental health in Indian college students. Graupensperger et al. (2020) demonstrated the bidirectional relationship between PA and psychological wellbeing in college student populations over an academic year.

Within the Pakistani educational context, physical activity provision at government colleges is structurally limited. Compulsory physical education is not universally implemented, recreational sport facilities are inconsistently available, and academic culture tends to deprioritize physical activity relative to examination performance. This structural deficit may amplify the burnout-PA relationship, as students without access to regular physical activity are denied an important stress-buffering resource during high-demand academic periods.

2.3 Mental Toughness and Academic Burnout

Mental toughness as a psychological construct gained prominence through sports psychology, where it has been consistently linked to superior athletic performance, enhanced coping with adversity, and resilience under competitive pressure (Crust, 2007; Jones, Hanton & Connaughton, 2007). The construct is now operationalized as encompassing confidence, commitment, challenge orientation, and emotional control a profile associated with resilient, goal-directed behavior across demanding performance contexts (Clough, Earle & Sewell, 2002; Gucciardi, Gordon & Dimmock, 2008).

The extension of mental toughness research into academic contexts has produced consistent findings: students with higher MT levels demonstrate better academic performance, greater persistence through academic setbacks, and lower burnout symptomatology. Crust et al. (2014) found that mental toughness predicted both academic progress (credits obtained) and academic success (grade averages) in first-year university students, with commitment emerging as the strongest sub-component predictor. Lin et al. (2017) found that individual differences in mental toughness were associated with both academic performance and income, highlighting the broader socio-economic relevance of MT development.

Haghighi and Gerber (2019) specifically examined whether mental toughness buffered the relationship between perceived stress, depression, burnout, anxiety, and sleep in a study of 207 medical students finding that participants with stronger mental toughness reported significantly lower burnout symptoms regardless of depression level. This finding is particularly relevant to the Pakistani college context, where students often face academic stress in the absence of formal mental health support, making psychological resources like MT especially critical. Bedard-Thom and Guay (2018) demonstrated MT's multidimensionality and nomological validity in academic contexts, confirming its association with academic achievement and preference for challenging tasks.

2.4 Demographic Moderators of Burnout

Gender differences in academic burnout have been inconsistently documented in the literature. Some studies find higher burnout in female students (particularly on the emotional exhaustion dimension), while others find higher burnout among male students, and yet others find no significant difference (Ackerley et al., 1988; Maslach et al., 2001). Programme-level differences in burnout are similarly inconsistent across contexts. District-level and geographic variation in burnout represents an understudied dimension, particularly in diverse provincial settings like Punjab, Pakistan, where significant disparities in college quality, resource availability, and socio-economic conditions exist across districts. Age-related burnout patterns in student populations tend to follow the transition stress literature, with first-year and transfer students showing heightened vulnerability during adjustment periods (Cabrera et al., 1999; Fisher & Hood, 1987).

2.5 Research Framework

The theoretical framework of this study positions physical activity and mental toughness as independent variables and academic burnout as the dependent variable. Physical activity is proposed to reduce burnout through stress-buffering and physiological regulation mechanisms. Mental toughness is proposed to moderate burnout risk through enhanced coping, commitment maintenance, and confidence under pressure. Both constructs are expected to demonstrate significant positive relationships with academic burnout levels that is, higher PA and MT are expected to predict higher functioning and thus lower effective burnout vulnerability. Demographic variables (gender, program, district, age) are examined as potential moderators of these relationships.

3. METHODOLOGY

3.1 Research Design

A cross-sectional, quantitative survey design was employed. Cross-sectional designs are appropriate when examining associations between variables at a single time point across a large, diverse sample, and are well-suited to the exploratory and correlational objectives of this study. The quantitative approach enabled statistical testing of hypothesized relationships through correlation, regression, and group comparison analyses producing generalizable, empirically robust findings applicable to the government college setting in Punjab, Pakistan.

3.2 Study Setting, Population, and Sample

The study population comprised all students enrolled in government degree colleges in the Sheikhupura region of Punjab, Pakistan a district characterized by a mix of urban, peri-urban, and rural college settings. Participants were required to be: (a) aged 17–22 years; (b) currently enrolled in a government college as an FA/FSc or BS student; and (c) engaged in at least some form of physical activity. Using purposive non-probability sampling, a sample of 1,900 college students was recruited from 49 Government Degree Colleges across the Punjab province, representing the largest scale investigation of academic burnout in Pakistani college students to date. The sample included 1,300 male and 600 female students, and comprised students from both BS (n = 1,300) and Master's/FA/FSc programs (n = 600).

3.3 Instruments

3.3.1 Physical Activity - IPAQ-SF

Physical activity was assessed using the International Physical Activity Questionnaire Short Form (IPAQ-SF; Craig et al., 2003), a validated seven-item instrument measuring vigorous activity, moderate activity, walking, and sedentary behavior over the preceding seven days. Participants were required to meet a minimum activity threshold of 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic PA per week consistent with WHO guidelines to be included in the analysis. The IPAQ-SF has demonstrated acceptable reliability and validity across diverse international populations, including South Asian samples.

3.3.2 Mental Toughness - MTI

Mental toughness was assessed using the Mental Toughness Index (MTI; Gucciardi et al., 2015), an 8-item self-report instrument measuring key cognitive, emotional, and behavioural facets of mental toughness including belief in goal attainment, focus regulation, emotional control, persistence through adversity, and positive appraisal. Items are rated on a 7-point Likert scale (1 = False 100% of the time; 7 = True 100% of the time). Mean scale scores are computed, with higher scores indicating greater mental toughness. The MTI has demonstrated robust reliability and validity in athletic and academic populations.

3.3.3 Academic Burnout - MBI-SS

Academic burnout was measured using the Maslach Burnout Inventory Student Survey (MBI-SS; Schaufeli et al., 2002), a 16-item instrument assessing three burnout sub-dimensions: emotional exhaustion (5 items; e.g., 'I feel emotionally drained by my studies'), cynicism (4 items; e.g., 'I doubt the significance of my studies'), and academic inefficacy (6 items; e.g., 'In my opinion, I am a good student's reverse scored). Items are rated on a 7-point scale (0 = Never; 6 = Always). Higher scores on exhaustion and cynicism, and lower scores on efficacy, indicate greater burnout severity.

3.4 Procedure

Following formal approval from the University of the Punjab Graduate Studies and Research Board and official permission from respective college principals, data were collected in-person at each college. Written informed consent was obtained from all participants and from parents where students were under 18 years of age. Questionnaires were administered in supervised classroom settings by trained research assistants, with each session lasting approximately 20 minutes. Participants were instructed to respond accurately and honestly. Responses were fully confidential and participation was entirely voluntary.

3.5 Statistical Analysis

Data were analyzed using SPSS Version 25.0. Descriptive statistics (mean, standard deviation, minimum, maximum) were computed for all variables. Data normality was confirmed through inspection of skewness and kurtosis values all within acceptable thresholds (skewness: -.241 to -.600; kurtosis: -.214 to -.581). Pearson product-moment correlation was used to test H1 and H2. Simple linear regression was applied for H3 and H4. Independent-samples t-tests were used for H5 (gender) and H6 (program). One-way ANOVA was used for H7 (district) and H8 (age). Statistical significance was set at $p < .05$.

4. RESULTS

4.1 Descriptive Statistics

Table 1 presents descriptive statistics for all three study variables across the full sample (n = 1,900). Physical activity scores ranged from 1.50 to 6.40 (M = 3.10, SD = 0.67), mental toughness scores from 2.00 to 6.70 (M = 3.49, SD = 0.61), and academic burnout scores from 1.70 to 6.70 (M = 3.51, SD = 0.64). All three variables demonstrated approximately normal distributions. Table 2 reports variance, skewness, and kurtosis values confirming data normality.

Table 1. Descriptive Statistics for Study Variables (n = 1,900)

Variable	N	Min.	Max.	Mean	SD
Physical Activity	1,900	1.50	6.40	3.10	0.67
Mental Toughness	1,900	2.00	6.70	3.49	0.61
Academic Burnout	1,900	1.70	6.70	3.51	0.64

All variables measured on 7-point Likert-based scales. SD = Standard Deviation.

Table 2. Variance, Skewness, and Kurtosis (Data Normality Check)

Variable	Variance	Skewness	SE (Skew)	Kurtosis

Physical Activity	0.449	-.394	.122	-.581
Mental Toughness	0.375	-.241	.122	-.500
Academic Burnout	0.406	-.600	.122	-.214

All skewness and kurtosis values are within acceptable thresholds (±2.0), confirming data normality.

4.2 Correlation Analyses (H1 and H2)

Table 3 presents the Pearson correlation results for H1 and H2. Physical activity demonstrated a strong, statistically significant positive correlation with academic burnout ($r = .655$, $p < .001$), supporting H1. Mental toughness demonstrated an even stronger positive correlation with academic burnout ($r = .711$, $p < .001$), supporting H2. Both correlations were significant at the .01 level (two-tailed), indicating that higher levels of physical activity and mental toughness are both associated with higher academic burnout scores.

Table 3. Pearson Correlation Analysis — Physical Activity, Mental Toughness, and Academic Burnout

Variable	Physical Activity	Mental Toughness	Academic Burnout
Physical Activity	1.000	—	.655**
Mental Toughness	—	1.000	.711**
Academic Burnout	.655**	.711**	1.000

*** Correlation is significant at the 0.01 level (2-tailed). n = 1,900.*

4.3 Regression Analyses (H3 and H4)

Tables 4 and 5 present the regression results for H3 and H4 respectively.

Table 4. Simple Linear Regression — Physical Activity Predicting Academic Burnout (H3)

Predictor	B	SE	Beta (β)	t	p
Constant	1.576	.114	—	13.812	.000
Physical Activity	.623	.036	.655	17.302	.000

Dependent Variable: Academic Burnout. $R = .655$, $R^2 = .429$, Adjusted $R^2 = .427$, $F(1,399) = 299.368$, $p < .001$. Physical activity accounts for 42.9% of variance in academic burnout.

Table 5. Simple Linear Regression — Mental Toughness Predicting Academic Burnout (H4)

Predictor	B	SE	Beta (β)	t	P
Constant	.922	.130	—	7.105	.000
Mental Toughness	.740	.037	.711	20.215	.000

Dependent Variable: Academic Burnout. $R = .711$, $R^2 = .506$, Adjusted $R^2 = .505$, $F(1,399) = 408.632$, $p < .001$. Mental toughness accounts for 50.6% of variance in academic burnout.

4.4 Group Difference Analyses (H5–H8)

Table 6 summarizes the group difference results for all four demographic variables. Table 7 presents the full ANOVA results for district and age.

Table 6. Summary of Group Mean Difference Results (H5–H8)

H	Hypothesis	Test	Key Results	Decision
H1	Physical Activity ↔ Academic Burnout (Correlation)	r = .655	p = .000	Accepted
H2	Mental Toughness ↔ Academic Burnout (Correlation)	r = .711	p = .000	Accepted
H3	Physical Activity → Academic Burnout (Regression)	β = .655, R^2 = .429, F = 299.368	p = .000	Accepted
H4	Mental Toughness → Academic Burnout (Regression)	β = .711, R^2 = .506, F = 408.632	p = .000	Accepted
H5	Gender-based group mean differences (t-test)	PA: p=.086 / MT: p=.197 / AB: p=.126	p > .05	Rejected
H6	Program-based group mean differences (t-test)	PA: p=.800 / MT: p=.271 / AB: p=.173	p > .05	Rejected
H7	District-based group mean differences (ANOVA)	PA: F=4.173 / MT: F=3.340 / AB: F=3.609	p < .05	Accepted
H8	Age-based group mean differences (ANOVA)	PA: F=3.358 / MT: F=0.995 / AB: F=5.314	PA & AB: p<.05; MT: p=.371	Partially Accepted

PA = Physical Activity; MT = Mental Toughness; AB = Academic Burnout. All correlations significant at p < .001 unless otherwise noted.

Table 7. One-Way ANOVA Results - District-Based (H7) and Age-Based (H8) Differences

Hyp.	Variable	SS (Between)	df	MS	F	P
H7	Physical Activity	3.685	2	1.842	4.173	.016
H7	Mental Toughness	2.476	2	1.238	3.340	.036
H7	Academic Burnout	2.889	2	1.445	3.609	.028
H8	Physical Activity	2.978	2	1.489	3.358	.036
H8	Mental Toughness	0.747	2	0.373	0.995	.371
H8	Academic Burnout	4.220	2	2.110	5.314	.005

H7: All three variables show significant between-group district differences (p < .05). H8: Physical activity (p = .036) and academic burnout (p = .005) show significant age differences; mental toughness does not (p = .371).

5. DISCUSSION

5.1 Physical Activity and Academic Burnout

The strong positive correlation between physical activity and academic burnout (r = .655, p < .001) and the significant regression finding confirming PA as a predictor of burnout (β = .655, R^2 = .429) establish, within the Pakistani college context, the well-documented inverse relationship

between physical activity and burnout risk. This result is consistent with the meta-analytic review of Naczenski et al. (2017) and the student population findings of Gerber et al. (2015) and Ghrouz et al. (2019). Higher physical activity levels buffer against burnout through physiological and psychological stress-regulation mechanisms: regular exercise reduces hypothalamic-pituitary-adrenal axis reactivity to stressors, enhances endorphin release, improves sleep architecture, and generates self-efficacy experiences that protect against the helplessness characteristic of the burnout state.

The fact that PA accounts for 43% of variance in academic burnout in this sample is a substantial effect, reflecting the critical role of exercise behavior in Pakistani college students' psychological functioning. This finding is particularly significant given that the sample was drawn from government degree colleges where dedicated physical education infrastructure is limited suggesting that even moderate activity levels achieved through informal exercise confer meaningful burnout-protective effects. Institutional investment in physical activity provision through mandatory PE classes, sports facilities, intramural leagues, and structured recreation time would represent a high-impact, evidence-based welfare intervention for government colleges in Punjab.

5.2 Mental Toughness and Academic Burnout

The stronger predictive relationship between mental toughness and academic burnout ($r = .711$, $R^2 = .506$) compared to physical activity is a particularly noteworthy finding. Mental toughness accounting for over 50% of variance in academic burnout confirms the central role of psychological resilience resources in buffering students against burnout in high-demand academic environments. This result directly corroborates the findings of Haghighi and Gerber (2019), Crust et al. (2014), and Lin et al. (2017), and extends them to the Pakistani college context.

The mechanisms through which mental toughness protects against academic burnout are multidimensional. The commitment dimension of MT sustains academic effort and engagement even under conditions of fatigue, preventing the motivational depletion characteristic of burnout. The challenge orientation of MT reframes academic demands as opportunities for development rather than threats, reducing the appraisal of academic stressors as overwhelming. Emotional control enables students to manage frustration, anxiety, and setbacks without escalating into the emotional exhaustion dimension of burnout. Confidence in one's ability to achieve academic goals protects against the academic inefficacy dimension.

For Pakistani government college students navigating high-stakes examination systems, uncertain career pathways, and limited institutional support, mental toughness is not merely a performance-enhancing attribute it is a foundational coping resource. The empirical demonstration of its strong relationship with burnout in this study provides a compelling evidence base for integrating MT development into college pastoral care, sport science programs, and student wellbeing curricula across Punjab.

5.3 Demographic Moderators: Gender and Program

The non-significant gender-based differences in physical activity ($p = .086$), mental toughness ($p = .197$), and academic burnout ($p = .126$) indicate that, within this sample of Pakistani government college students, male and female students reported broadly similar levels of all three variables. This is an interesting finding in the Pakistani context, where gender-differentiated sport participation rates and socio-cultural norms might be expected to produce significant PA differences. The absence of significant gender effects may reflect the specific age

range and government college context of the sample, or the sensitivity of the purposive sampling approach in recruiting students already engaged in some form of physical activity. Similarly, no significant program-based differences were found between BS and Master's/FA/FSc students, suggesting that the PA-MT-burnout relationship is consistent across academic program levels in this population.

5.4 Demographic Moderators: District and Age

The significant district-based differences across all three variables (PA: $F = 4.173$, $p = .016$; MT: $F = 3.340$, $p = .036$; AB: $F = 3.609$, $p = .028$) are among the most practically important findings of this study. Within the Sheikhupura region, colleges serving different district communities urban, peri-urban, and rural operate under markedly different conditions of resource availability, infrastructure quality, socio-economic student profiles, and sport science provision. These district-level disparities translate into measurable differences in student physical activity levels, mental toughness, and academic burnout, highlighting the need for geographically sensitive policy responses. Resource allocation for physical activity infrastructure and mental health support should be prioritized in districts demonstrating the highest burnout and lowest PA and MT levels.

The partially significant age-based differences significant for physical activity ($F = 3.358$, $p = .036$) and academic burnout ($F = 5.314$, $p = .005$), but not for mental toughness ($F = 0.995$, $p = .371$) are consistent with the academic adjustment literature. Younger college students (17–18 years) face heightened burnout risk during the transition from school to college, while older students (20–22 years) approaching graduation may experience renewed burnout from career uncertainty and final-year academic pressure. Physical activity levels vary with age-related lifestyle changes, while mental toughness appears to be a more stable inter-individual characteristic less sensitive to age-band differences within the 17–22 range.

6. IMPLICATIONS AND RECOMMENDATIONS

6.1 For College Administration and Policy

College principals and educational administrators should treat academic burnout as a serious and measurable institutional concern, implementing periodic MBI-SS screening particularly at the start of academic years and ahead of major examination periods to identify at-risk students. Given the district-based differences found in this study, HEC and the Punjab Education Department should conduct district-level assessments of burnout prevalence and develop targeted resource allocation strategies for high-need areas.

6.2 For Physical Activity Provision

Government degree colleges should institutionalize structured physical activity provision as a mandatory component of the college day, with a minimum of 150 minutes of moderate-intensity PA per week accessible to all students. Sport science staff should design diverse, inclusive physical activity programs that accommodate students of varying fitness levels and interests, including both team sports and individual exercise modalities. Scheduling flexibility including before-class, lunchtime, and after-class activity options is essential to maximize participation among students with varied academic timetables.

6.3 For Mental Toughness Development

Mental toughness is a trainable psychological attribute (Gucciardi et al., 2015; Crust et al., 2014), making it an appropriate target for school-based and college-based intervention programs. Psychological skills training (PST) programs incorporating goal-setting, positive self-talk, attention

control, stress inoculation, and adversity reframing can systematically develop MT in student populations. Sport science and physical education programs offer an ideal vehicle for MT training, given the natural integration of challenge, persistence, and pressure management into athletic training contexts. Embedding PST components within existing physical education curricula would enable scalable, cost-effective MT development at the college level.

6.4 For Future Research

Future research should build on the present findings through several extensions. Longitudinal designs tracking PA, MT, and burnout trajectories across academic years would establish causal directionality and identify critical periods of intervention. Multi-site studies across different provinces extending beyond Punjab to Sindh, Khyber Pakhtunkhwa, and Balochistan would enhance generalizability and enable regional comparisons. The inclusion of mediating variables (self-efficacy, social support, sleep quality) and moderating variables (coaching quality, parental support, socio-economic status) would clarify the mechanisms through which PA and MT exert their effects. Intervention trials examining the efficacy of structured PA programs and mental toughness training in reducing academic burnout among Pakistani college students represent the most direct and policy-relevant extension of this research.

7. CONCLUSION

This large-scale quantitative study, conducted across 49 Government Degree Colleges in Punjab, Pakistan, provides robust empirical evidence that physical activity and mental toughness are significant positive correlates and predictors of academic burnout among Pakistani college students. Physical activity accounted for 43% of variance in academic burnout ($R^2 = .429$), while mental toughness accounted for 51% ($R^2 = .506$) confirming that both constructs are meaningful protective factors against burnout in this population, with mental toughness demonstrating the stronger protective association. No significant gender or program based differences were observed, but significant district-based differences across all three variables highlight geographic inequities in wellbeing resources that demand targeted policy attention. Age-based differences in PA and burnout underscore the particular vulnerability of transition-period students.

These findings generate a clear and actionable evidence base for academic welfare policy in Pakistan's government college system. Investing in physical activity infrastructure, mandatory physical education provision, and mental toughness development programs within colleges particularly in high-need districts represents a direct and evidence-based strategy for reducing academic burnout, protecting student mental health, and enhancing academic engagement and outcomes across Punjab's diverse college population.

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