RABSEL: The CERD Educational Journal

ISSN 2957-8019(Online) | ISSN 2077-4966(Print) |26(1) 37-53
Journal homepage: Journal.pce.edu.bt

Exploring the Relationship Between Student Health, Fitness, and Academic Achievement: A Case Study

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http//doi.org/10.17102/rabsel.25.07.0664728| Accepted June 2025 | Published November 2025

Abstract

This study explores the link between student health, fitness, and academic achievement through a six-month pilot programme conducted at a higher secondary school in Thimphu, Bhutan. A total of 1,322 students aged 9–21 participated in standardized health-related fitness tests (endurance, strength, flexibility, body composition) and skill-related tests (agility, speed, reaction, balance). Academic outcomes were measured using GPA, subject grades, and attendance. Participation was nearly balanced (648 males, 673 females), with involvement peaking in Year 8 (204 students). BMI analysis (N=1,288) revealed a mean of 20.10 (SD=3.89), with 25th, 50th, and 75th percentiles at 17.40, 19.39, and 22.09, respectively, indicating a generally healthy cohort but with underweight and obese outliers (range 11.67–37.49). Correlations between BMI and academic performance were minimal (high BMI r = –0.14; low BMI r = 0.00). Fitness–academic links varied: sprint performers achieved higher averages in English (62.3) and geography (55.6), while strength-focused students lagged in history (20). Heart rate analysis showed no consistent positive relationship with performance. Overall, structured activity improved classroom behavior, attention, and resilience, reinforcing that physical fitness is a catalyst for academic engagement. The findings recommend national curriculum integration, gender-inclusive programmes, teacher training, and a digital health database to sustain evidence-based interventions.

Key words: Fitness, physical activity, mental well-being, lifelong health, academic performance

Introduction

The growing emphasis on student health and fitness in Bhutanese schools reflects a global recognition that physical well-being is integral to academic achievement and holistic development (World Health Organization [WHO], 2024; Cale & Harris, 2019). A pilot initiative at a higher secondary school in Thimphu demonstrated this link through a structured fitness programme tailored to students' developmental stages, aligning with global research that connects regular physical activity to improved memory, concentration, and problem-solving (Corbin et al., 2016; Svensson et al., 2023).

With 34.68% of lifestyle disease cases in Bhutan affecting students (National Statistical Bureau [NSB], 2023), integrating fitness into education has become a national priority. This study explores how enhancing student health and fitness supports the broader goal of improving educational quality and cultivating a healthier school community (Ministry of Education and Skills Development [MoESD], 2024).

As highlighted by the WHO (2024), physical fitness strengthens both physical and mental well-being. Through joint initiatives between the MoESD and the Bhutan Olympic Committee, schools are now implementing national fitness benchmarks that promote endurance, strength, flexibility, and overall vitality – affirming that student fitness is essential for academic excellence and lifelong health.

Objectives:

- Promote regular physical activity and improve overall health among students.
- Develop students' fundamental athletic skills and knowledge through structured physical activities.
- Cultivate essential life skills – including teamwork, leadership, social-emotional learning, and resilience.
- Identify students with athletic potential and provide pathways for nurturing their talents.

Literature Review

Enhance Physical Health

Health, once defined merely as the absence of disease (Barrow, 2015), is now recognised as a dynamic state of wellness encompassing physical, mental, and social well-being (Corbin et al., 2016; Robinson, 2014). This holistic perspective is especially relevant for school-aged children, who are at a formative stage of development. Within this context, fitness extends beyond athletic performance to represent overall physical preparedness that enhances resilience, energy, and the capacity to engage fully in academic and daily activities (Dubos, 1965; Svensson et al., 2023). Physical activity is far more than just leisure or recreation; it is foundational to health and vitality (Corbin et al., 2016; Coakley, 2021). As Barrow (2015) cited Rudyard Kipling's poetic appeal, the call to "be fit" echoes a timeless truth: physical fitness transcends personal gain and touches every sphere of life, from personal well-being to societal strength.

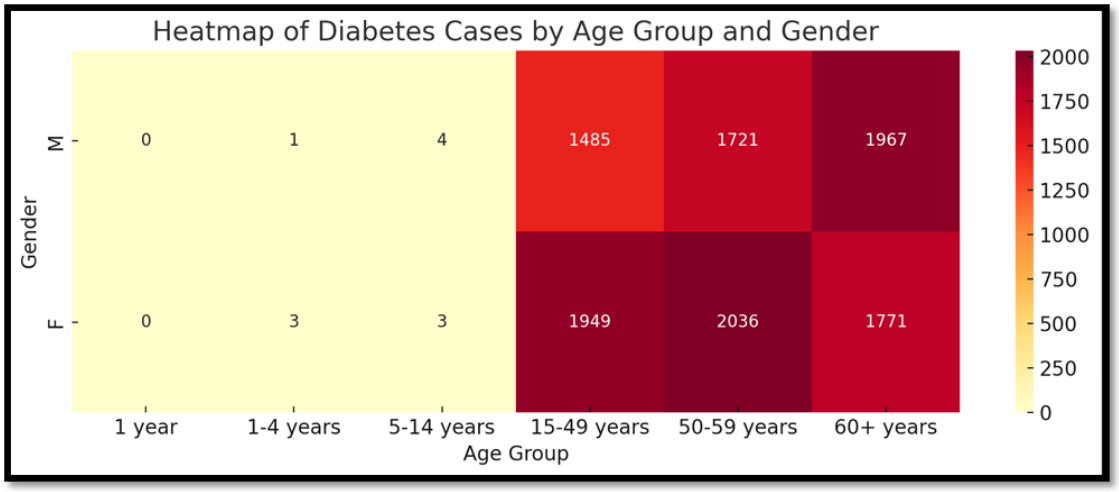
Nothing on earth—no Arts, no Gift, nor
graces— No Fame, no Wealth—outweighs the
want of it. This is the law which every law
embraces—
Be fit—be fit! In mind and body be fit!
This is the lesson at all Times and Places—
One changeless Truth on all things changing
writ for boys and girls, men, women, nations,
races, Be fit—be fit! And once again—Be fit!
(Barrow, 2015, p. 87)

Literature demonstrates that student health including physical activity, mental well-being, nutrition, sleep, and other behaviours is closely linked to academic outcomes. Evidence from randomized trials, cohort studies, and systematic reviews indicates that promoting health in schools can enhance academic performance or, at minimum, does not compromise it. Thus, health promotion and academic goals are compatible and often mutually reinforcing (James et al., 2023; Muntaner-Mas et al., 2024).

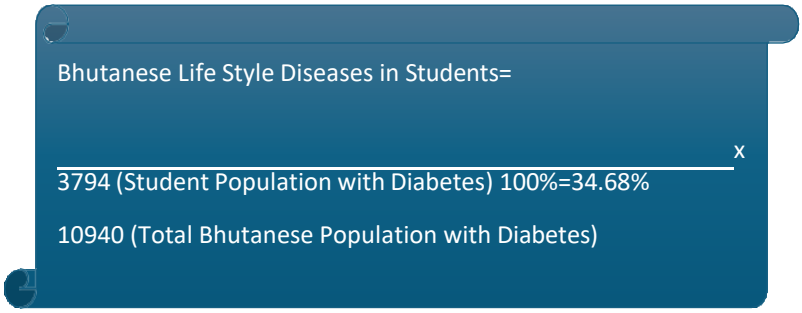
Combat Lifestyle Diseases Among Students

Although no Bhutan-specific, peer-reviewed studies have yet documented rising sedentary habits among children, emerging national data indicate this is an increasing concern. Ministry of Health advisories (2025) warn that excessive screen time reduces physical activity and poses developmental and health risks, while the 2015 STEPS Survey highlights urban trends toward sedentary lifestyles among adults. These patterns suggest that modernisation is shifting traditional activity behaviours, particularly among youth. Globally, technological advancements while convenient, can paradoxically undermine long-term health and vitality (Barrow, 2015; Stevenson, 2003; Dubos, 1965).

In response, a project at a higher secondary school in Thimphu integrated daily physical activities into the school routine to counteract inactivity and reduce risks of diabetes and other non-communicable diseases (MoESD, 2024; WHO, 2024). By embedding structured movement into education, the initiative addresses immediate health concerns while promoting sustainable, active lifestyles amid modernization.



The heatmap of diabetes cases in Bhutan reveals a notable surge from the 15 – 49 age group onward, with females slightly outnumbering males in several categories (National Statistical Bureau [NSB], 2023). Traditionally, rural lifestyles protected children from sedentary habits, but rapid urbanisation and modernisation have increased inactivity, particularly among students. The NSB (2023) reports that Bhutanese students aged 15 and above are now significantly affected by lifestyle diseases, with female students exceeding males in prevalence. Overall, Bhutan's population of 770,276 includes 10,940 individuals with lifestyle-related diseases, representing 1.42% of the population, and students rank second only to the elderly in disease prevalence despite the largely preventable nature of these conditions (Corbin et al., 2016). Notably, 34.68% of lifestyle disease cases occur among students, highlighting an urgent need for interventions promoting healthier habits and active lifestyles.



(National Statistical Bureau, 2023, p. 28).

This alarming prevalence underscores that lifestyle diseases among Bhutanese students are closely tied to what Corbin et al. (2016) and Stevenson (2003) describe as the consequences of technological civilisation.

Improve Cognitive and Educational Performance

Fundamental movement skills (FMS) form a crucial foundation for cognitive development, supporting functions such as memory, attention, spatial orientation, postural control, fine motor

skills, and visual processing (Robinson, 2014; Corbin et al., 2016). The New Zealand Kiwidex programme captures this principle with the maxim, "Learning to move and moving to learn," highlighting the integral role of movement in brain development (Robinson, 2014). Despite strong international evidence that structured physical activity enhances cognitive abilities and problem-solving (Cale & Harris, 2019; Corbin et al., 2016), physical activity in Bhutan is often perceived as secondary to academic pursuits. As Barrow (2015) notes, physical development and intellectual growth are inseparable.

Recognising rising sedentary behaviours and increased technology use among Bhutanese students (National Statistical Bureau [NSB], 2023; Svensson et al., 2023), the Bhutan Olympic Committee (BOC), in collaboration with the MoESD, has implemented school sports initiatives. These programmes aim to promote health, enhance academic achievement, and provide pathways toward professional youth sports in Bhutan (MoESD, 2024; Cale & Harris, 2019).

Foster Essential Life Skills

Physical activity and fitness are vital for developing cognitive, physical, and social competencies in children. Regular engagement enhances executive functions such as self-regulation, decision-making, and cognitive flexibility, supporting academic achievement and life skills (Smith et al., 2024). Structured activities also improve gross motor skills and overall fitness, enabling effective interaction with the environment (Johnson & Lee, 2024). Beyond cognitive and motor benefits, physical activity fosters social competence, resilience, and emotional regulation, with even casual activities linked to reduced anxiety and depression during adolescence (Edwards, 2023).

Integrating movement into educational settings, including active lessons and school-based programmes, enhances attention, classroom behaviour, and self-regulation while promoting teamwork, communication, and leadership (Miller & Davis, 2023; Hermens et al., 2017). Historically and culturally, sports have been recognised as a platform for leadership development (Barrow, 2015), highlighting the potential for Bhutanese schools to simultaneously advance physical health, education, and essential life skills (Cale & Harris, 2019).

Identify and Nurture Athletic Talent

School sports provide a vital platform for identifying and nurturing athletic talent. Since the launch of Bhutan's school sports programme in 1997, progress has been slow, constrained by persistent perceptions that sports distract from academic priorities (MoESD, 2024; Cale & Harris, 2019). This challenge mirrors trends in other developing nations, despite international evidence highlighting the benefits of early talent identification and structured support systems (Svensson et al., 2023; Corbin et al., 2016).

To advance Bhutan's sporting future, schools must function as hubs for talent development and fitness, recognising students as social capital and coaches as key agents of national sports success (MoESD, 2024). While some improvements have emerged through private sports clubs and enhanced infrastructure, institutional and public commitment remains crucial. As Coakley (2021, p. 437) warns, global trends show that sports institutions often prosper financially while

coaches and athletes remain undercompensated – a pitfall Bhutan must consciously avoid to ensure sustainable and equitable sports development.

Method and Approaches

This quantitative study examined the physical fitness levels of students at a higher secondary school in Thimphu. It involved a comprehensive assessment of health and fitness among children and adolescents aged 9 to 21 years over a six-month period. A total of 1,322 students from diverse educational backgrounds participated, providing a representative sample for analysis.

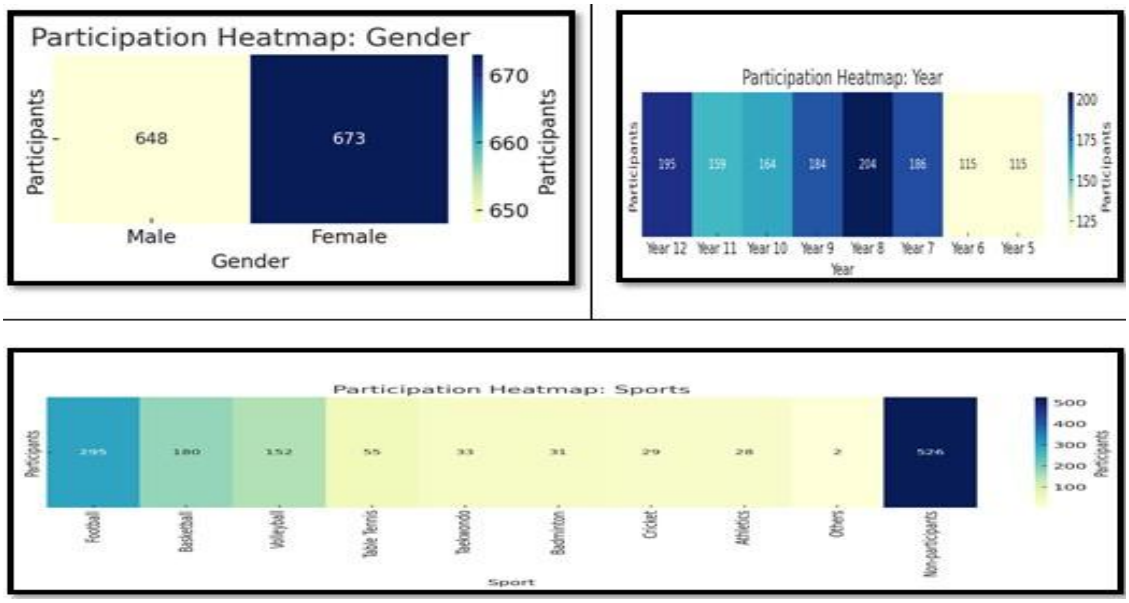
Data were analysed using the Statistical Package for the Social Sciences (SPSS). Demographic variables were measured on nominal scales, while fitness test results were recorded on ordinal and scale measurements. The study investigated the relationship between physical fitness and academic performance, exploring whether higher fitness levels were associated with improved cognitive and academic outcomes. Physical fitness was assessed through standardised tests:

- Cardiorespiratory fitness: Shuttle run test
- Muscular endurance: Push-ups and sit-ups
- Flexibility: Sit-and-reach test

Academic performance was evaluated using GPA, subject grades, and attendance records obtained from verified school data. Control variables, including socioeconomic status, sleep patterns, nutrition, and extracurricular involvement were collected to strengthen validity.

A cross-sectional design was employed, with fitness data obtained through supervised testing and academic data retrieved from official school records. Key challenges included maintaining test consistency across age groups, controlling confounding variables, ensuring data reliability, and safeguarding participant privacy through informed consent.

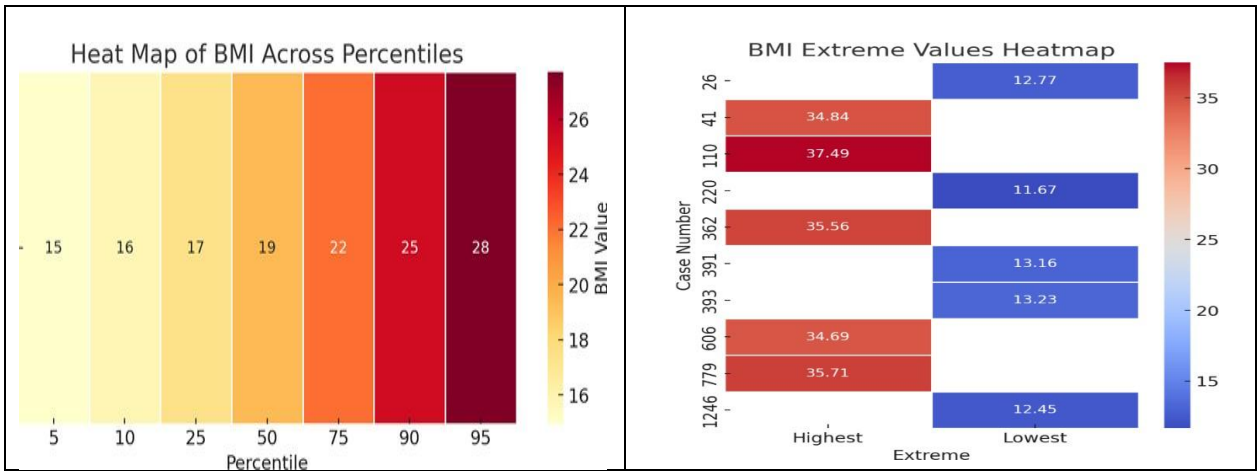
Results Demographic



The demographic heatmaps provide a detailed overview of student participation in health and fitness activities, highlighting trends across gender, school year, and sport type. Gender participation is nearly balanced, with 648 male and 673 female students, indicating inclusive engagement and supporting equitable outcomes in studies linking physical fitness to academic performance. Participation by school year increases from Year 5 (115 students) to a peak in Year 8 (204 students) and remains consistently high through Year 12, suggesting greater involvement among middle and upper secondary students, possibly due to better-organised programmes and heightened awareness of fitness benefits.

Sport-specific data reveal that football (295 participants) and basketball (180 participants) attract the highest engagement, while athletics (28), cricket (29), and "others" (2) show lower participation, reflecting preferences for mainstream, team-based sports influenced by culture, facilities, or school priorities. Collectively, these heatmaps offer a comprehensive picture of student engagement, inform the relationship between physical activity and academic outcomes, and highlight opportunities to diversify participation for a more inclusive school fitness culture.

Enhance Physical Health

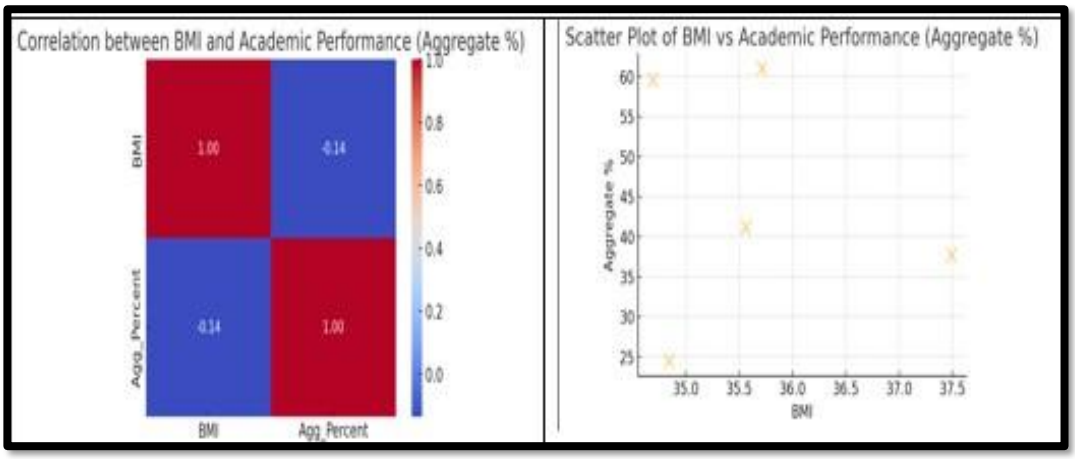


The analysis of Body Mass Index (BMI) for 1,288 students (34 missing) shows a mean of 20.10 (SD = 3.89), with values ranging from 11.67 to 37.49. Most participants fell within the normal range, as indicated by the 25th percentile at 17.40, the median at 19.39, and the 75th percentile at 22.09. The distribution was slightly right-skewed (1.041) with moderate peakedness (kurtosis = 1.439), and the tight confidence interval (19.89–20.31) confirmed reliability. Extreme values highlighted outliers: the lowest BMI of 11.67 (female) suggested undernutrition, while the highest BMI of 37.49 (female) indicated obesity. Height (M = 1.55 m, N = 1303) and weight (M = 49.45 kg, N = 1294) were typical for adolescents. The interquartile range of 4.70 reinforced moderate variability. While the sample largely trended toward healthy ranges, the clustering of low BMI among females and isolated high BMI cases suggested areas needing nutritional and health interventions.

	*Structured physical activities contribute to both physical fitness and cognitive development. Through sports and movement programs, students improve memory, concentration, and problem-solving, which directly support academic performance. These benefits extend beyond the playing field, shaping resilience and focus essential for success in learning. By embedding regular, purposeful exercise into school routines, educators foster holistic growth where physical and mental development reinforce each other, laying a strong foundation for academic achievement, lifelong wellness, and the development of essential life skills.*

High BMI and Academic Performance - Correlation Studies

The analysis examined the relationship between extreme high Body Mass Index (BMI) and academic performance among five students. The correlation matrix revealed a very weak negative

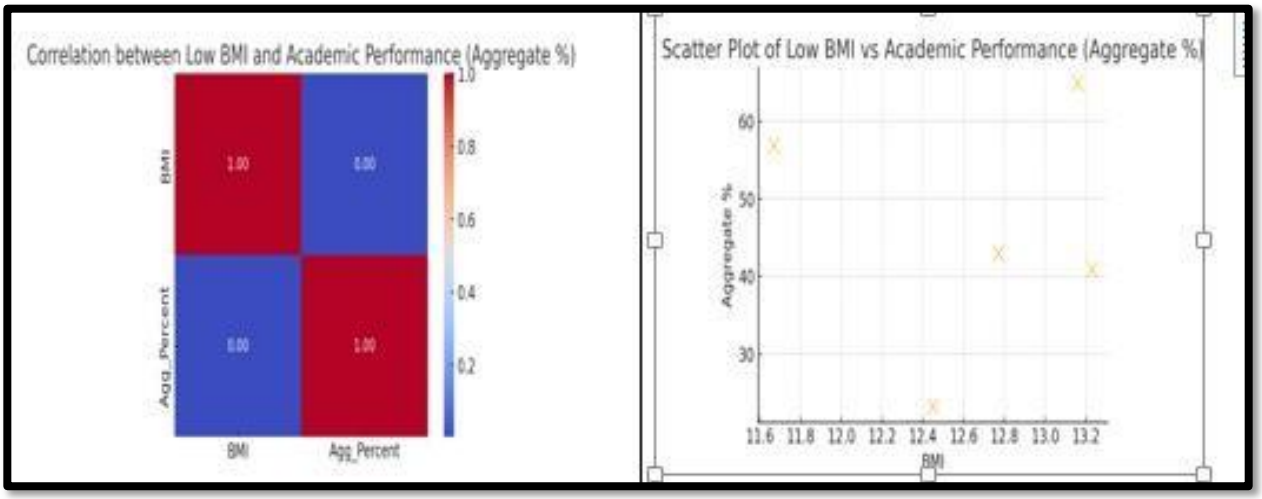


relationship (r = –0.14) between BMI and aggregate percentage, indicating only a slight, non-predictive association. Scatter plot visualisation confirmed wide variation in academic outcomes among students with similar BMI values, demonstrating that BMI alone is insufficient to explain performance differences.

Among the students, UW (BMI 35.71) and DP (BMI 34.69) achieved 61.05% and 59.55% respectively, illustrating that high BMI did not impede success. In contrast, PL (BMI 35.56), DNW (BMI 37.49), and YTW (BMI 34.84) recorded lower aggregates (41.17%, 37.71%, and 24.43%), reflecting struggles in specific subjects and foundational learning gaps rather than BMI influence.

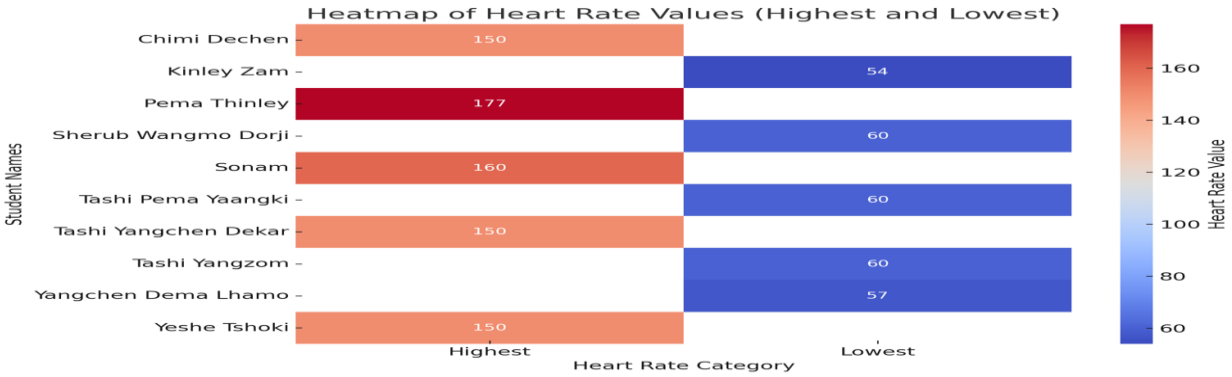
These profiles underscore that academic outcomes are shaped by multiple factors including motivation, learning environment, and individualised support rather than BMI alone. The findings highlight the importance of tailoring interventions to students' unique needs to foster equitable academic success.

Low BMI and Academic Performance - Correlation Studies



The correlation analysis between extreme low BMI and academic performance revealed no measurable relationship, with a coefficient of 0.00. The scatter plot reinforced this, showing wide variation: for example, YT (BMI 13.16) excelled with 64.86%, while DJL (BMI 12.45) scored only 23.28%. Other students, such as SKZ and TS, clustered in the mid-range despite similar BMI values. These results confirm that low BMI alone does not determine achievement; broader factors like environment, motivation, and resilience play stronger roles.

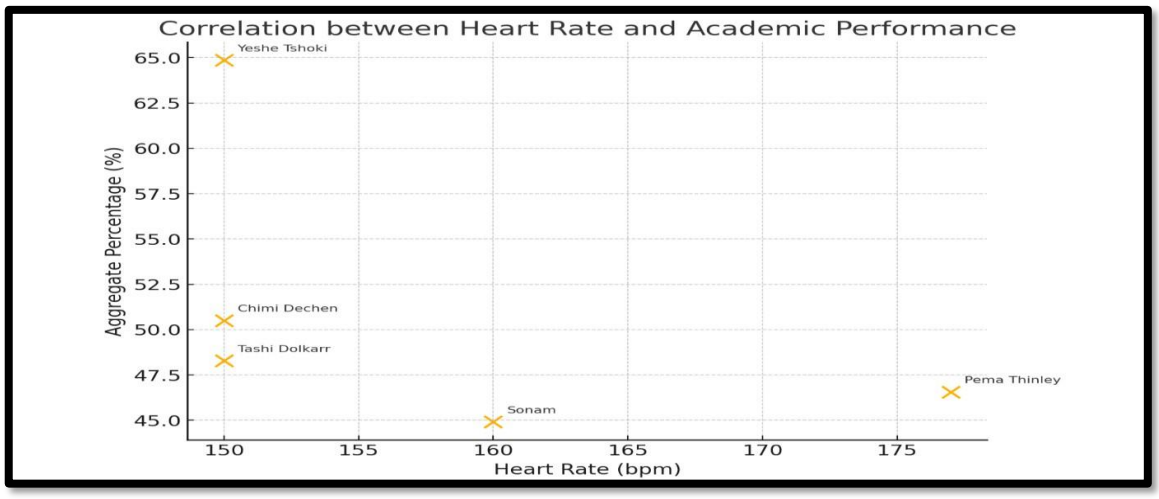
Establish a Health and Fitness Database



The heatmap visually compares students' highest and lowest heart rates during a physical activity assessment using a colour gradient from blue (low) to red (high). Peak heart rates reflect cardiovascular response during activity, while lowest values indicate resting or recovery levels.

PT exhibited the highest heart rate at 177 bpm, shown in deep red, indicating intense exertion. In contrast, KZ and YDL recorded the lowest rates at 54 and 57 bpm, represented in blue, suggesting effective recovery. Several students, including CD, TYD, and YT, peaked around 150 bpm, while TNW reached 160 bpm. Most resting heart rates ranged from 54 to 60 bpm, consistent with healthy norms for young individuals. The heatmap thus provides a clear, immediate overview of cardiovascular responses across the group, highlighting variations in exertion and recovery among students.

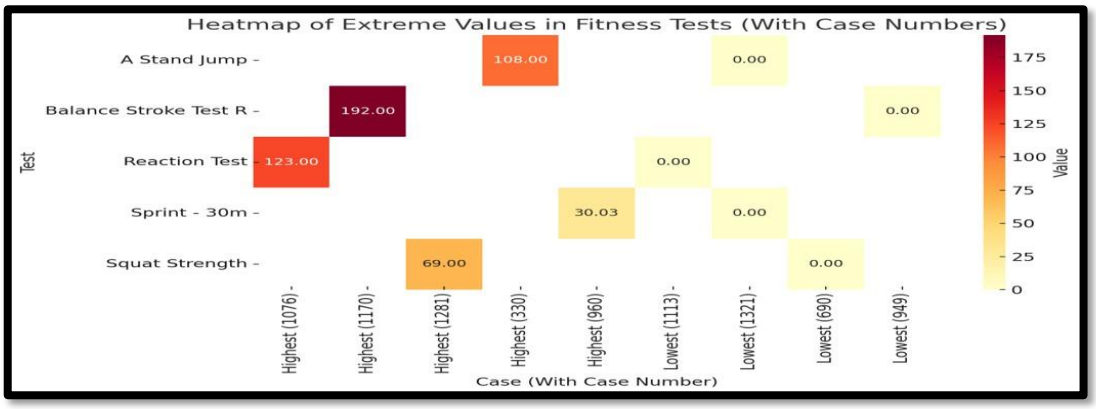
Heart rate and academic performance



Among the five students observed, no clear relationship emerges between heart rate and academic performance. YT achieved the highest academic score (64.86%) despite a moderate heart rate of 150 bpm, whereas PT, with the highest heart rate of 177 bpm, recorded a lower score of 46.56%. Similarly, SM (160 bpm) and TD (150 bpm) fell into the lower academic range, with scores of 44.91% and 48.28%, respectively. CD displayed a balanced profile, with a heart rate of 150 bpm and a score of 50.5%.

These patterns suggest that higher heart rates during physical activity do not predict better academic outcomes; if anything, the data indicate a slight inverse trend. This highlights the complex interaction between physiological and academic indicators and underscores the need for further investigation into how physical factors may influence student performance.

Fundamental athletic skills and knowledge to improve cognitive function



The visualized heatmap, titled "Heatmap of Extreme Values in Fitness Tests (With Case Numbers)," paints a vivid picture of the physical fitness landscape across different student participants. This heatmap is designed not merely to showcase numbers but to tell the story of

variation, potential, and gaps in student performance across five essential fitness domains: Balance Stroke Test R, Reaction Test, Squat Strength, Sprint (30 meters), and A Stand Jump.

Balance Stroke Test R: Spotlight on Stability

In this test of balance, Case 1170 emerges as a clear standout with a peak performance of 192.00, a number blazing in deep red. This striking result likely reflects the culmination of skill, training, and focus, often associated with upper school years such as Year 11. In contrast, Case 949 registered a flat 0.00, an underperformance. The vivid difference between the highest and lowest scorers here hints at developmental progression but also underscores the need for foundational balance training in the earlier years.

Reaction Test: Speed and Precision

The Reaction Test reveals a similarly compelling story. Case 1076 leads with 123.00, lighting up the map, while Case 1113 falls to zero. Interestingly, this contrast may reflect not just raw ability but also individual differences in reaction speed and attentiveness. The map tells us that while some students are primed and reactive, others may lack exposure or need more practice to develop these critical quick-response skills.

Squat Strength: Power Unveiled

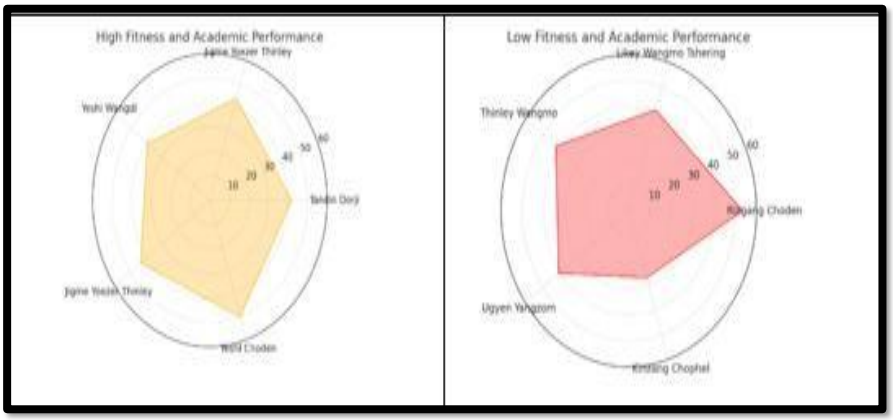
Shifting to raw muscular power, Case 1281 peaks with a score of 69.00, the highest strength result recorded on the chart. Yet again, Case 690 lingers at the bottom with 0.00. The stark divide suggests that while older or more physically mature students demonstrate robust strength, there remains a gap to bridge for younger or less physically active peers. The heatmap thus visually urges an investment in strength conditioning across all levels.

Sprint – 30 Meters: Speed on Display

In the sprint, Case 960 flashes a commendable 30.03, marking the highest speed, with its deep hue reflecting energy and agility. The lowest, Case 1321, marks another zero, contributing to a recurring pattern of low performance. The pattern across tests reveals that speed may come naturally to some students but remains elusive for others, reinforcing the need for both sprint technique and endurance-building drills.

A Stand Jump: Explosive Talent

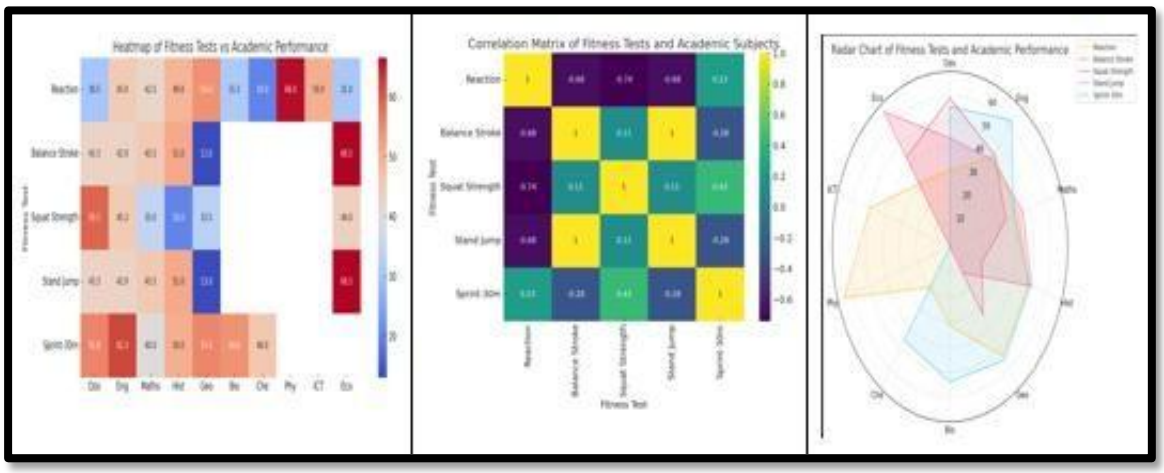
Perhaps most fascinatingly, in the A Stand Jump, we see a tie for top performance: Case 330 and Case 1170 both leap to 108.00. This result is particularly exciting, as Case 330 belongs to a younger year (likely Year 6), showing that raw talent and explosive strength can emerge even in early years. On the flip side, Case 1321 records zero again, a pattern seen across multiple tests, raising questions about participation, physical challenges, or data recording consistency.



The two radar charts paint an intriguing picture of the relationship between physical fitness and academic performance among students.

In the high fitness group, YC leads with an aggregate academic score of 50.17%, followed by TD at 41.91%. Notably, YW, despite strong physical fitness, records a lower score of 39.51%, while JYT maintains consistent mid-40% outcomes across two entries. These patterns suggest that high fitness supports steady academic performance but does not guarantee excellence.

The low fitness group shows greater variability. RC achieves the highest academic score overall (53.5%) despite the lowest fitness rating, demonstrating resilience. TW and LWT maintain scores in the low 40% range, while KC records both the lowest fitness and academic score (27.04%), indicating that low fitness may coincide with poor academic performance in some cases. Collectively, these findings highlight that academic outcomes are influenced by multiple factors, and physical fitness alone is not a reliable predictor of academic success.



The analysis of fitness test groups across academic subjects reveals distinct patterns. The Sprint-30m group consistently achieved high marks, excelling in English (62.3), Dzongkha (55.8), geography (55.6), and biology (54), suggesting that speed and agility align with stronger academic performance. In contrast, the Reaction group peaked in physics (66) and ICT (50) but fell sharply in chemistry (20) and economics (31), showing uneven outcomes. Balance Stroke and Stand Jump groups mirrored each other, with high economics scores (66.5) but poor results in BMT (13) and

no data in sciences, reflecting narrow strengths. The Squat Strength group performed moderately well in Dzongkha (59.3) and English (45.3) but dropped in history and BMT (20 each). Correlation analysis confirmed a mild positive link between sprint ability and overall achievement, while strength and reaction skills showed negative associations. Radar chart profiles further illustrated that speed corresponded with broader, consistent academic success, while strength and balance remained limited or uneven.

Discussion, Reports and Recommendations

The study at a higher secondary school in Thimphu provides compelling evidence that physical health and fitness are closely linked to academic achievement, corroborating global findings in the Bhutanese context. By assessing health-related fitness (cardiorespiratory endurance, muscular strength, flexibility) and skill-related fitness (agility, coordination, reaction time), the study demonstrated how student well-being underpins educational success.

Key insights include the interdependence of physical and cognitive functions. Active students exhibited improvements in classroom behaviour, attention, and performance, affirming the notion that movement is central to intellectual engagement (Barrow, 2015; Robinson, 2014). Participation increased from Years 5 to 12, highlighting the effectiveness of structured, culturally contextualised programmes. Gender-balanced engagement was observed, with boys preferring competitive sports and girls responding better to inclusive activities (Lorraine, Cale, & Harris, 2019), emphasising the need for mixed-gender programmes and female role models. BMI analysis indicated generally healthy students, though some females faced undernutrition risks, underscoring the importance of nutrition education alongside fitness initiatives. Heart rate and fitness test data revealed variations in exertion and recovery, highlighting both resilience and areas needing individualised support.

The study also demonstrated innovative practices such as integrating fitness breaks into lessons and leveraging community facilities, aligning with WHO (2024) guidelines. Recommendations include embedding structured physical activity into the national curriculum, promoting gender-inclusive programmes, enhancing teacher training, investing in facilities, implementing nutrition campaigns, establishing talent identification pathways, scaling the digital fitness database, and integrating mental health modules. Longitudinal research is needed to evaluate the sustained impact of fitness initiatives on academic outcomes and life trajectories.

Conclusion

This case study demonstrates that student health and fitness are inseparable from academic success, shaping both engagement and performance. Evidence from the study shows that inclusive and culturally relevant physical activities enhance not only physical well-being but also cognitive skills, resilience, and leadership. The use of digital data and fitness assessments provides a strong evidence base while highlighting gaps such as undernutrition and unequal access to facilities. By embedding health and fitness into school curricula through policy integration, teacher training, and infrastructure development, Bhutan can scale these benefits nationally. Ultimately, investing in student fitness is an investment in a healthier, more resilient, and academically thriving generation.

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