

PHYSICAL PERFORMANCE BEFORE, DURING, AND AFTER RAMADAN AMONG MALAYSIAN UNIVERSITY STUDENTS: A REPEATED-MEASURES STUDY

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Abstract: *This study examined changes in physical performance surrounding Ramadan fasting and whether trajectories differed between male and female university students. In a repeated-measures observational study, 69 students (25 male, 44 female) completed assessments one week before Ramadan, in Ramadan weeks 1 and 3, and one week after Ramadan. Body mass index (BMI), Harvard Step Test score, standing broad jump, wall squat duration and sit-and-reach distance were analysed using mixed analysis of variance with time and gender as factors. Time effects were observed for BMI ($p = .029$), cardiovascular endurance score ($p < .001$), broad jump ($p < .001$), wall squat duration ($p = .042$) and flexibility ($p = .004$). The step-test score, broad jump and flexibility were lower during Ramadan and increased after Ramadan. Time $\times$ gender interactions were observed for broad jump ($p = .011$) and wall squat duration ($p = .009$). Male wall squat duration rose across assessments, whereas female values fell during Ramadan and returned towards baseline afterward. These associations indicate distinct temporal patterns across fitness components; without a non-fasting control group, the changes cannot be attributed solely to fasting.*

Keywords: *Ramadan fasting; university students; physical performance; repeated measures; gender; Malaysia*

Introduction

During Ramadan, Muslims abstain from food and fluids between dawn and sunset. Eating, sleep and activity schedules may shift while academic and physical demands continue. Reviews indicate that many athletic performance measures remain unchanged, although declines have been reported for some outcomes and exercise conditions (Chaouachi et al., 2009; Abaïdia et al., 2020; Trabelsi et al., 2024). Endurance and jump outcomes, for example, have differed among trained runners and football players (Aziz et al., 2010; Meckel et al., 2008; Kirkendall et al., 2008; Zerguini et al., 2008).

Most published performance data concern athletes. University students may encounter a different combination of study schedules, recreational activity and fasting routines. Research among student-athletes has documented sleep disruption (Kerkeni et al., 2024) and practical challenges during Ramadan (Amjad et al., 2024). A separate cohort of female university students reported changes in food choices and daytime sleepiness during early Ramadan (Abu Farha et al., 2026). Measurements taken only before and after Ramadan may miss changes during the fasting month. Evidence on anthropometry likewise suggests that the timing of assessment matters (Fernando et al., 2019; Al-Jafar et al., 2023; Wulandari et al., 2025).

This study examined BMI and four field measures of physical performance at four occasions before, during and after Ramadan among Malaysian university students. It also assessed whether the observed trajectories differed between male and female participants.

Methodology

Design and Participants

A repeated-measures observational study was conducted at Universiti Teknologi MARA, Pahang. The same 69 students, aged 18–21 years, were assessed approximately one week before Ramadan (T1), in the first week (T2), in the third week (T3) and approximately one week after Ramadan (T4). The sample comprised 25 participants recorded as male and 44 as female, with complete measurements at all four occasions. Students with chronic conditions, musculoskeletal injuries or disabilities that could interfere with the tests were excluded. Participant consent forms were provided.

Measurements and Procedures

Weight was measured using an Omron HBF-352 scale; BMI was calculated as weight in kilograms divided by squared height in metres. Cardiovascular performance was represented by the recorded Harvard Step Test score after a three-minute stepping protocol and recovery pulse measurements. The standing broad jump assessed lower-body power, and the best of three recorded distances was used. Wall squat duration, measured in seconds, represented lower-body muscular endurance. Flexibility was measured with the sit-and-reach test using the best of three attempts. Tests were conducted at the same site and testing period across sessions.

Statistical Analysis

Values are reported as mean $\pm$ standard deviation. Separate two-way mixed analyses of variance were performed for each outcome, with occasion as the within-participant factor and recorded gender as the between-participant factor. Sphericity was evaluated with Mauchly's test, and Greenhouse–Geisser degrees of freedom were used for BMI, cardiovascular score, broad jump and flexibility because this assumption was violated. The uncorrected repeated-measures degrees of freedom were retained for wall squat duration. Bonferroni adjustment was applied

to six pairwise occasion comparisons; significant interactions were interpreted using within-gender comparisons. Partial eta squared (η^2) describes the size of ANOVA effects. Tests were two-sided with $\alpha = .05$. Analyses were performed using IBM SPSS Statistics, version 30.0 (IBM Corp., Armonk, NY, USA).

Results

Participant Characteristics

All 69 records contained observations at all four occasions. Baseline characteristics are shown in Table 1.

Table 1: Baseline Characteristics of Participants

Characteristic	Overall (n = 69)	Male (n = 25)	Female (n = 44)
Age (years)	19.86 ± 1.02	19.72 ± 1.10	19.93 ± 0.97
Weight (kg)	56.04 ± 10.94	64.74 ± 9.16	51.10 ± 8.57
BMI (kg/m ²)	21.27 ± 3.24	22.00 ± 3.17	20.86 ± 3.24

Changes across Assessment Periods

Table 2 presents all outcome means, and Table 3 summarises the mixed ANOVA. The BMI change was small in absolute terms. Mean BMI declined by 0.18 and 0.20 kg/m² from T1 to T2 and T3, respectively (Bonferroni-adjusted $p < .001$ and $p = .024$), and T4 did not differ significantly from T1.

Table 2: Physical Performance before, during and after Ramadan

Outcome	Before T1	Week 1 T2	Week 3 T3	After T4
BMI (kg/m ²)	21.27 ± 3.24	21.09 ± 3.26	21.07 ± 3.23	21.17 ± 3.25
Step-test score	66.12 ± 15.10	59.58 ± 10.31	60.22 ± 9.25	64.28 ± 12.28
Broad jump (m)	1.74 ± 0.41	1.62 ± 0.38	1.62 ± 0.37	1.76 ± 0.41
Wall squat (s)	116.96 ± 46.42	110.20 ± 45.79	118.07 ± 55.51	127.58 ± 50.81
Sit-and-reach (cm)	16.62 ± 8.35	15.37 ± 8.38	15.34 ± 8.23	16.94 ± 9.32

The step-test score was lower at T2 and T3 than at T1 and T4 (all adjusted $p < .001$), while T1 and T4 did not differ ($p = .617$). Broad jump was also lower at T2 and T3 than at T1 and T4 (all adjusted $p < .001$ overall); T1 and T4 did not differ. Sit-and-reach distance was lower at T2 and T3 than at T1 (both adjusted $p < .001$), and T4 exceeded T2 ($p = .039$) and T3 ($p = .048$). Its T1 and T4 values were similar.

Table 3: Mixed ANOVA Effects for Five Outcomes

Outcome	Time p (η^2)	Gender p	Time × gender p (η^2)
BMI	.029 (.055)	.137	.285 (.018)
Step-test score	< .001 (.286)	.385	.282 (.019)
Broad jump	< .001 (.299)	< .001	.011 (.058)
Wall squat	.042 (.040)	.089	.009 (.056)
Sit-and-reach	.004 (.093)	.029	.144 (.030)

Gender Related Trajectories

The time $\times$ gender interactions for broad jump and wall squat indicated different trajectories by recorded gender. Table 4 provides the corresponding means. Both groups showed lower jump distances during Ramadan and higher values after Ramadan; the magnitude differed. Within each group, T1 exceeded T2 and T3, and T4 exceeded T2 and T3 after Bonferroni adjustment; T1 did not differ from T4.

Table 4: Power and Muscular Endurance by Recorded Gender

Outcome	Before T1	Week 1 T2	Week 3 T3	After T4
Jump, male (m)	2.05	1.85	1.86	2.04
Jump, female (m)	1.56	1.49	1.48	1.59
Wall squat, male (s)	113.32	116.48	139.08	145.80
Wall squat, female (s)	119.02	106.64	106.14	117.23

For wall squat, the within-male effect of occasion was significant ($F[3, 72] = 4.08, p = .010$), and the T1-T4 difference remained at the significance boundary after Bonferroni adjustment ($p = .050$). The corresponding within-female effect was not significant ($F[3, 129] = 1.89, p = .134$). This contrast is interpreted through the significant overall interaction, rather than from comparing significance labels between groups.

Discussion

Four assessments revealed changes that a simple pre-post comparison would conceal. Step-test score, standing broad jump and flexibility were lower at the two Ramadan measurements and rose again afterward. The absence of a significant T1-T4 difference is consistent with recovery toward baseline, but it does not establish equivalence. The lower step-test score is an association across occasions; without a non-fasting control group, it cannot be interpreted as a measured change in aerobic capacity caused by fasting.

The literature reports varied exercise outcomes during Ramadan. An endurance-running experiment identified a small decrement in a fasting condition (Aziz et al., 2010), while a study of young footballers found no adverse effect on objective tests and suggested that training and familiarity explained observed improvement (Kirkendall et al., 2008). A study in adolescent soccer players reported reductions in aerobic running, repeated-sprint and jumping outcomes, but not single-sprint speed (Meckel et al., 2008). Reviews found that most performance measures were unchanged, while some exercise conditions, particularly high-intensity testing, showed declines (Abaïdia et al., 2020; Trabelsi et al., 2024). The present cohort consisted of university students undertaking field tests, which limits direct comparison with trained athlete samples.

Broad jump and wall squat showed significant time $\times$ gender interactions. Although male and female jump distances followed the same broad decline-and-rebound shape, their magnitudes of change differed. Male wall squat durations tended to increase at later sessions, while female values were lower during Ramadan and returned towards baseline afterward. The interaction is more informative than a single pooled wall squat mean or separate within-group p values. Related studies among female handball players have found stable short-duration physical ability despite changes in sleep (Guembri et al., 2024), underscoring the need to avoid a uniform fasting-performance narrative.

Observed changes may reflect several unmeasured influences. Sleep disruption has been documented in physically active men (Boukhris et al., 2019) and student-athletes (Kerkeni et al., 2024); food choices changed during early Ramadan in a cohort of female university students (Abu Farha et al., 2026). Muslim student-athletes have also described challenges fitting sport participation into Ramadan routines (Amjad et al., 2024). These factors were not quantified here; they are possible explanations rather than demonstrated mechanisms. Practice with repeated testing is another possible influence, as highlighted in football research (Kirkendall et al., 2008).

BMI fell by only about 0.2 kg/m² during Ramadan. Its statistical significance should be distinguished from its small absolute size. Reviews and prospective work indicate that anthropometric changes during Ramadan can be modest and depend on the measurement period (Fernando et al., 2019; Al-Jafar et al., 2023; Wulandari et al., 2025). BMI alone does not establish a change in body composition.

Several limitations govern interpretation. Participants were recruited from one campus without a non-fasting comparison group. Diet, hydration, sleep, habitual activity and menstrual timing were not systematically documented, and male and female sample sizes differed. It was also unclear how periods of non-fasting among female participants were handled at each occasion. These issues, and possible familiarisation, preclude attributing change exclusively to Ramadan fasting. A strength is that the same 69 participants completed four assessments, allowing both within-month variation and later measurements to be described.

Conclusion

Among these university students, step-test scores, broad-jump distances and sit-and-reach distances were lower during Ramadan than before it and rose after Ramadan. BMI changed only slightly. Broad jump and wall squat trajectories differed by recorded gender. These findings describe temporal associations and support assessing more than one point during Ramadan when studying physical performance.

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