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Research Article

Physical fitness, body mass index, and physical activity among senior secondary students: A cross-sectional study in an Indonesian Islamic secondary school

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ABSTRACT

Background: Physical fitness is a fundamental component of adolescent health and contributes to academic performance, mental well-being, and lifelong health outcomes. Following the COVID-19 pandemic and the rise in sedentary behavior, evidence on the fitness profiles of Indonesian senior secondary students—particularly in Islamic secondary schools (Madrasah Aliyah)—remains scarce. Objective: To assess the physical fitness level of Madrasah Aliyah students and to examine its association with body mass index (BMI) and self-reported physical activity. Methods: A cross-sectional survey was conducted among 35 students (18 male, 17 female; aged 15–19 years) at MA Raudlatul Irfan, South Tangerang, using purposive sampling. Physical fitness was measured using the Indonesian Physical Fitness Test (TKJI) for ages 16–19, comprising five items (60-m sprint, pull-up/flexed-arm hang, sit-up, vertical jump, and 1200-m/1000-m run). Habitual physical activity was assessed using the IPAQ Short Form (IPAQ-SF), and BMI was derived from anthropometric measurements. Data were analyzed using descriptive statistics, the Mann–Whitney U test for between-sex comparisons, and Spearman's rank correlation for associations among variables ($\alpha = 0.05$). Result: Most students were classified in the low-income (45.7%) or moderate (34.3%) fitness category, with only 5.7% in the very good category. The mean TKJI score was 13.46 (SD = 3.12). Male students achieved significantly higher scores than female students (15.28 vs. 11.53; Mann–Whitney U, $p = 0.003$). BMI was negatively correlated with fitness ($r_s = -0.521$; $p = 0.001$), while physical activity was positively correlated with fitness ($r_s = 0.634$; $p < 0.001$). Conclusion: Physical fitness among Madrasah Aliyah students was predominantly below the national standard, with cardiorespiratory endurance as the weakest component. BMI and physical activity emerged as significant correlates of fitness. Structured physical activity programs, improved sport facilities, and integrated nutrition education are needed. Future longitudinal and intervention studies are recommended to establish causal pathways and to evaluate the effectiveness of school-based fitness programs in Islamic secondary schools.

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Introduction

Physical fitness is widely recognized as a key marker of health during childhood and adolescence and an important predictor of cardiometabolic and mental health outcomes in adulthood (Ortega et al., 2008; da Silva et al., 2020). For senior secondary students, who are simultaneously navigating biological maturation, academic demands, and the development of long-term health behaviors, fitness

has direct implications for cognitive performance, psychosocial well-being, and future productivity (Janssen & LeBlanc, 2010; Warburton et al., 2006).

Globally, however, adolescent fitness has declined over recent decades, a trend further accelerated by pandemic-related restrictions and the increasing penetration of digital media (Tremblay et al., 2011; Guthold et al., 2020). In Indonesia, Riskesdas 2023 indicated that approximately 26.1% of the population aged 15 years and above was classified as physically inactive (Riset Kesehatan Dasar, 2023), and post-pandemic studies have reported reductions in habitual physical activity and fitness among Indonesian adolescents (Andriyani et al., 2021).

Madrasah Aliyah (MA) represents a distinct setting within the Indonesian senior secondary system, combining the national curriculum with an intensive religious program. Students at MA typically face a dense schedule of religious instruction, Quranic memorization, and faith-based extracurricular activities, while only 2 lesson hours per week are allocated to physical education (PJOK). The World Health Organization recommends at least 60 minutes of moderate-to-vigorous physical activity per day for individuals aged 5–17 years (World Health Organization, 2020); the structural and cultural conditions of MA may make achieving this benchmark particularly challenging, especially among female students (Amrullah & Putra, 2023).

Despite the growing body of literature on adolescent fitness in Indonesia, three specific gaps remain. First, most prior studies have focused on general senior high schools (SMA), with comparatively little evidence from Madrasah Aliyah, where curricular structures, gendered participation norms, and time allocation for physical activity differ substantially from those in secular schools. Second, many existing reports are descriptive, providing fitness percentages without examining the relationship between fitness, BMI, and habitual physical activity within the same sample using inferential analyses appropriate for non-normal, ordinal-like data. Third, evidence specific to the South Tangerang region—an urban–suburban area characterized by high screen exposure and limited school sports facilities—is virtually absent. The novelty of the present study lies in addressing these gaps by jointly examining fitness category distribution, sex differences, and the associations of BMI and physical activity with TKJI performance in a Madrasah Aliyah setting, using non-parametric methods (Mann–Whitney U and Spearman's correlation) suited to the sample characteristics.

Accordingly, this cross-sectional study aims to: (1) describe the physical fitness profile of MA Raudlatul Irfan students based on TKJI; (2) compare fitness levels between male and female students; and (3) examine the associations between fitness, BMI, and physical activity. The findings are intended to inform school administrators, PJOK teachers, and policymakers in designing context-appropriate fitness interventions for Islamic secondary schools.

Method

Research Design

This study used a cross-sectional, quantitative design with a school-based survey approach. The cross-sectional design was selected because the objective was to describe the physical fitness profile of students and to examine its associations with BMI and physical activity at a single point in time, without manipulating variables (Setia, 2016).

Participants

The population comprised all 120 students enrolled at MA Raudlatul Irfan in South Tangerang in the 2024/2025 academic year. Participants were recruited through purposive sampling using the following inclusion criteria: (1) actively enrolled students; (2) aged 15–19 years; (3) free of chronic diseases or conditions contraindicating physical exertion; and (4) willing to complete all test items. Students with acute injuries, recent surgery, or medical exemption from physical education were excluded.

A final sample of 35 students (18 male, 17 female) participated in all measurements. Sample size adequacy was estimated for the primary correlational analysis (BMI vs. TKJI; physical activity vs. TKJI).

Using G*Power 3.1 with α = 0.05, power (1−β) = 0.80, and a moderate expected effect size (ρ = 0.45) based on previous adolescent fitness studies (Nasrulloh et al., 2021; Dewi et al., 2021), the minimum required sample was 33 participants for a two-tailed test. The recruited sample of 35, therefore, exceeded this threshold and was considered adequate for the planned non-parametric correlational and between-sex comparisons. All participants and their parents/guardians provided written informed consent in accordance with the Declaration of Helsinki.

Ethical Approval Statement

Ethical approval for the study was granted by the Research Ethics Committee of UIN Syarif Hidayatullah Jakarta (approval number LP2M/UIN/2024/0089). Participation was voluntary, and participants were informed of their right to withdraw at any time without penalty.

Procedures

Data were collected on the school sports field over three consecutive days during morning sessions (07:00–09:30) to minimize heat-related fatigue. Standardized warm-ups (5–10 minutes) preceded each testing session. Testers were trained physical education researchers, and at least two raters were present at each station to ensure protocol fidelity. Anthropometric measurements and IPAQ-SF administration were carried out before fitness testing.

Research Instruments

Physical fitness was measured using the Indonesian Physical Fitness Test (TKJI) for the 16–19 age group (Kementerian Pendidikan dan Kebudayaan, 2010), which comprises five items administered in a fixed sequence: (1) 60-m sprint; (2) pull-up (males) or flexed-arm hang (females) for 60 seconds; (3) sit-up for 60 seconds; (4) vertical jump; and (5) 1200-m run (males) or 1000-m run (females). Each item is scored on a 1–5 scale according to the official norms, yielding a composite score ranging from 5 to 25, classified as very poor, poor, moderate, good, or very good. The TKJI has been used as a standardized physical fitness assessment instrument for Indonesian adolescents aged 13–18 years, with normative scoring categories established across age and sex groups (Boleng et al., 2023).

Habitual physical activity over the previous seven days was assessed using the Indonesian-language version of the International Physical Activity Questionnaire–Short Form (IPAQ-SF), which has been validated for use among Indonesian adolescents and adults (Craig et al., 2003; Hagströmer et al., 2006). The IPAQ-SF was selected because it is brief, suitable for school settings, and allows estimation of total weekly MET-minutes across walking, moderate, and vigorous activity. Although the original framing of the issue emphasized physical inactivity, the IPAQ-SF was preferred because it captures both the intensity and volume of habitual activity, which is methodologically more informative than a binary active/inactive classification when examining dose–response relationships with fitness.

Body mass was measured to the nearest 0.1 kg using a calibrated digital scale, and standing height to the nearest 0.1 cm using a portable stadiometer, with participants wearing light clothing and no shoes. BMI was calculated as weight (kg) divided by height squared (m^2) and interpreted using WHO age- and sex-specific reference standards for adolescents.

Data Analysis

Data were analyzed using IBM SPSS Statistics version 26.0. Descriptive statistics (mean, standard deviation, minimum, maximum, frequency, and percentage) were used to summarize fitness categories and component scores. The Shapiro–Wilk test indicated that TKJI scores and IPAQ MET-minute values were not normally distributed ($p < 0.05$); therefore, non-parametric tests were used. Sex differences in fitness were examined using the Mann–Whitney U test, and the associations of fitness with BMI and physical activity were examined using Spearman's rank-order correlation (rs). The level of significance was set at α = 0.05 (two-tailed).

Results and Discussion

Results

Of the 35 participants, 18 (51.4%) were male, and 17 (48.6%) were female. Mean age was 17.2 years (SD = 0.9). The overall mean TKJI score was 13.46 (SD = 3.12; range 10–23), corresponding to the poor classification.

Table 1. Distribution of Physical Fitness Categories by Sex (n = 35)

Category	Male n (%)	Female n (%)	Total n (%)	Score Range
Very good	2 (11.1)	0 (0.0)	2 (5.7)	22–25
Good	4 (22.2)	1 (5.9)	5 (14.3)	18–21
Moderate	7 (38.9)	5 (29.4)	12 (34.3)	14–17
Poor	5 (27.8)	11 (64.7)	16 (45.7)	10–13
Very poor	0 (0.0)	0 (0.0)	0 (0.0)	5–9
Total	18 (100)	17 (100)	35 (100)	—

As shown in Table 1, the majority of students (80.0%) fell into the poor or moderate categories, while only 5.7% achieved the very good classification. Notably, no female student reached the very good category, and 64.7% of female students were classified as poor.

Table 2. Mean Scores of Indonesian Physical Fitness Test (TKJI) Components by Sex

TKJI Component	Male Mean (SD)	Female Mean (SD)	Overall Mean (SD)	Max Score
60-m sprint	3.39 (0.85)	2.82 (0.81)	3.11 (0.86)	5
Pull-up / flexed-arm hang	3.06 (0.94)	2.41 (0.71)	2.74 (0.89)	5
Sit-up (60 s)	3.22 (0.81)	2.65 (0.79)	2.94 (0.84)	5
Vertical jump	2.83 (0.86)	2.47 (0.72)	2.66 (0.80)	5
1200-m / 1000-m run	2.78 (0.81)	2.06 (0.66)	2.43 (0.82)	5
Composite TKJI	15.28 (2.79)	11.53 (2.43)	13.46 (3.12)	25

Table 3. Mann–Whitney U Test for Sex Differences in Composite TKJI Score

Group	n	Mean Rank	*U*	p-value
Male	18	23.42	64.5	p =.003*
Female	17	12.29		

*Note. *Significant at α = 0.05 (two-tailed). The Mann–Whitney U test indicated that male students had significantly higher composite TKJI scores than female students.*

A notable finding was the substantial sex difference in overall physical fitness, with male students achieving a higher composite TKJI score (15.28) than female students (11.53) (Table 2). The largest disparity appeared in the endurance component (1200-m/1000-m run), where male students outperformed females by 0.72 points, indicating comparatively lower cardiorespiratory endurance

among female participants. Overall, the findings suggest that endurance and upper-body strength remain the weakest fitness domains among students.

Table 4. Spearman's Rank-Order Correlations Between TKJI, BMI, and Physical Activity

Variable Pair	ρ (rho)	p-value	Direction
TKJI score × BMI	−0.521	$p < .001$*	Negative, moderate
TKJI score × Physical activity (MET-min/week)	0.634	$p < .001$*	Positive, strong
BMI × Physical activity	−0.298	$P = .082$	Negative, weak (n.s.)

*Note. *Significant at α = 0.05 (two-tailed); n.s. = not significant.*

As presented in Table 3, the Mann–Whitney U test revealed a significant difference in composite TKJI scores between male and female students (U = 64.5, p = .003). Male students demonstrated substantially higher mean ranks than female students, indicating better overall physical fitness performance among males. This finding suggests that sex-related differences remain evident across multiple fitness domains assessed in the TKJI, particularly in components requiring muscular endurance and cardiorespiratory capacity.

Table 4 shows that physical fitness was significantly associated with both BMI and physical activity. TKJI scores were moderately and negatively correlated with BMI ($r_s = −0.521$, p = .001), indicating that students with higher BMI tended to demonstrate lower fitness performance. In contrast, physical activity showed a strong positive correlation with TKJI scores ($r_s = 0.634$, $p < .001$), suggesting that more physically active students generally achieved better fitness outcomes. Meanwhile, the relationship between BMI and physical activity was weak and not statistically significant (p = .082), indicating that activity level alone may not directly correspond to BMI variation among participants.

Discussion

This cross-sectional study found that the majority of MA Raudlatul Irfan students (80.0%) were classified in the poor or moderate fitness category, with cardiorespiratory endurance as the weakest component. Sex differences were marked: male students outperformed female students on every TKJI item, and 64.7% of female students were classified as poor. BMI was inversely and moderately associated with fitness, whereas physical activity showed a strong positive association. These findings extend the limited literature on adolescent fitness in Islamic secondary schools and provide a reference for designing context-sensitive interventions.

The dominance of poor and moderate fitness categories is broadly consistent with regional evidence. Allsabah et al. (2022) reported that the majority of senior secondary school students in Kediri showed poor fitness and high sedentary behaviour, and Dewi et al. (2021) documented that Indonesian adolescent girls consistently scored lower on physical fitness tests than boys, with cardiorespiratory endurance as the weakest component. Post-pandemic declines in adolescent fitness have also been documented internationally (Tremblay et al., 2011; Guthold et al., 2020). The convergence between our findings and these prior studies suggests that low fitness is a structural rather than purely incidental issue, reflecting reduced opportunities for physical activity in both school and community contexts.

Why was fitness particularly low in this sample? Several mechanisms are plausible. First, only two PJOK lesson hours per week are scheduled at MA, well below the WHO recommendation of at least 60 minutes of moderate-to-vigorous activity per day for adolescents (World Health Organization, 2020). Second, school sports facilities at MA Raudlatul Irfan are limited; Yunus et al., (2025) reported that facility availability accounted for over a third of the variance in adolescent fitness in Indonesian schools. Third, the strong positive correlation between physical activity and TKJI in our sample (rs = 0.634) supports the interpretation that low habitual activity—rather than test-day performance variability—is a primary

driver of low fitness scores. The non-significant correlation between BMI and physical activity (rs = −0.298, p = 0.082) further suggests that BMI and activity contribute partly independently to the fitness profile.

The marked sex difference observed (males 15.28 vs. females 11.53; p = 0.003) reflects both biological and sociocultural factors. Biologically, post-pubertal increases in lean mass and hemoglobin concentration favor male performance in strength and endurance tasks (Pal et al., 2020). Socioculturally, gender norms in Islamic school environments may constrain female students' participation in vigorous outdoor activities, including coeducational sports and competitive games (Amrullah & Putra, 2023). Higher gadget exposure has also been linked to greater reductions in physical activity among female adolescents (Handayani et al., 2021). These mechanisms operate concurrently, and the sex gap should be interpreted as a structural inequity rather than as an inherent biological ceiling.

The negative association between BMI and TKJI score (rs = −0.521) reinforces the well-established inverse relationship between excess adiposity and fitness performance (Bouchard et al., 2012; Aditya et al., 2022). In the present setting, however, several confounding variables that we could not measure may shape this association. Dietary patterns, particularly the high consumption of energy-dense foods commonly observed among urban adolescents, can elevate BMI and reduce aerobic capacity simultaneously. Sleep duration and quality, increasingly compromised by late-night digital media use, are linked with both adiposity and impaired exercise tolerance (Chaput et al., 2016). Socioeconomic status influences access to nutritious food, structured sports, and safe spaces for physical activity. Future studies should incorporate dietary assessment, validated sleep measures, and household socioeconomic indicators to clarify these pathways.

The positive correlation between physical activity and fitness (rs = 0.634) is consistent with prior Indonesian and international findings (Dewi et al., 2021) and indicates that even modest increases in habitual activity may yield meaningful fitness gains in this population. Programmed aerobic training has been shown to improve VO2max in Indonesian adolescents (Nasrulloh et al., 2021), and integrated, activity-based PJOK models have been linked with broader fitness improvements (Allsabah et al., 2022). For Madrasah Aliyah specifically, interventions need to fit within the dense religious schedule—for example, short morning movement sessions before classes, gender-sensitive after-school programs for female students, and fitness-oriented adaptations of existing extracurriculars.

Limitations of Study

Several limitations should be acknowledged. First, the cross-sectional design precludes inference about causal direction; whether low physical activity drives low fitness, or vice versa, cannot be determined from these data. Second, the sample was drawn from a single Madrasah Aliyah in South Tangerang using purposive sampling, which limits generalizability to other Islamic secondary schools or to the broader adolescent population in Indonesia. Third, physical activity was self-reported using the IPAQ-SF, which is subject to recall and social desirability bias; objective measures, such as accelerometers, were not feasible in this setting. Fourth, several plausible confounders—dietary intake, sleep duration and quality, screen time, household socioeconomic status, and pubertal stage—were not measured and may partly account for the observed associations. Fifth, the modest sample size (n = 35), although adequate for the planned non-parametric correlations, limited the use of multivariable models that could simultaneously adjust for multiple covariates. Future research should employ multi-site sampling, objective activity measurement, and longitudinal or quasi-experimental designs to strengthen causal inference and inform school-based intervention strategies.

Conclusions

This cross-sectional study showed that physical fitness among MA Raudlatul Irfan students was predominantly below the national standard, with 45.7% in the poor and 34.3% in the moderate category. Cardiorespiratory endurance and upper-body strength were the weakest components, and

male students achieved significantly higher composite scores than female students. BMI was moderately and inversely associated with TKJI performance. At the same time, habitual physical activity was strongly and positively associated with fitness, indicating that both body composition and habitual physical activity are meaningful correlates of fitness in this Madrasah Aliyah population.

Based on these findings, schools and policymakers are encouraged to implement structured physical activity sessions of at least three times per week beyond regular PJOK hours, expand and improve the quality of school sports facilities, integrate nutrition and sleep education into student counseling, design gender-sensitive programs that promote female participation, and consider digital tools (e.g., wearable devices or activity-tracking apps) to monitor adherence. Future research should adopt longitudinal and intervention designs, include objective measures of physical activity and sleep, and assess dietary and socioeconomic confounders to clarify causal pathways and identify the most effective school-based strategies for improving adolescent fitness in Islamic secondary schools.

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Authors' contributions

IPH, ARN, and AF contributed to the research concept and design. ARN and TAP contributed to the collection and/or assembly of data. IPH, AF, and IBE contributed to the data analysis and interpretation. IPH, ARN, AF, and TAP contributed to writing the article. IBE also contributed to the critical revision of the article. All authors contributed to the final approval of the article.

Competing interests

The authors declare no competing interests.

AI Disclosure Statement

During the preparation of this manuscript, the author used Scite AI to assist in searching for scientific references. All results have been critically reviewed, verified, and edited by the author to ensure scientific accuracy, clarity of presentation, and compliance with academic standards. The author takes full responsibility for the integrity and content of this manuscript.

Data Availability Statement

The data supporting the findings of this study are available upon request to the corresponding author. The data are not publicly available to protect the privacy of the study participants.

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