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Comparative study of TKPN test results based on gender among high school students in jambi province

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ABSTRACT
Problems: Differences in physical fitness based on gender are often reported, but variations between schools as a contextual factor in learning readiness have not been empirically explored at the high school level. This study examines these differences by considering the influence of school institutions. **Purpose**: To analyze differences in the results of the Nusantara Student Fitness Test (TKPN) based on gender and inter-school variations among high school students in Jambi Province. **Methods**: A comparative quantitative study with a cross-sectional design using data from 85 students (35 male, 50 female) in three high schools. The TKPN components included flexibility, abdominal muscle endurance, leg-arm muscle endurance, and cardiovascular endurance. Statistical analysis used Welch's t-test and two-way ANOVA (gender × school). **Results**: There was no significant difference in PFT composite scores between males (10.68±1.39) and females (10.74±2.27) ($p=0.879$). The effect of gender on each component was also insignificant ($p>0.05$). However, a strong school effect was found on the composite score ($F=18.07$; $p<0.001$; $\eta p^2=0.33$), with the highest mean at SMAN 5 Kota Jambi (11.97±1.35). **Conclusion**: Differences in fitness based on gender in this sample were not significant, while variations between schools showed an important contextual influence. This study has limitations in its generalizability due to the limited sample size. The contribution of this study provides an empirical basis for the development of school-based fitness interventions. Suggestions for future research include expanding the sample size and investigating specific school factors such as the quality of facilities and physical education learning.
Keywords: TKPN, physical fitness, gender, high school students, jambi province

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Introduction

Globally, adolescent physical fitness is viewed as an indicator of "functional health" that integrates cardiorespiratory capacity, muscle strength and endurance, flexibility, and body composition. A number of longitudinal studies show that muscle fitness/endurance in childhood and adolescence is associated with future health outcomes, making monitoring of fitness components important in early risk prevention (García-Hermoso et al., 2019). The World Health Organization states that adequate moderate to vigorous physical activity, limiting sedentary behavior, and strengthening fitness from school age are the foundation for preventing noncommunicable diseases throughout the life cycle (Bull et al., 2020). At the population level, declining fitness and low physical activity among 13- to 17-year-olds is also a cross-national issue because it impacts cardiometabolic health risks, mental health, and quality of life (Guthold et al., 2020). Thus, monitoring adolescent fitness is not only relevant to the field of sports but also to public health and human resource development.

In addition to health, physical fitness during adolescence is related to learning ability and school performance through physiological and psychosocial mechanisms (e.g., improved cognitive function,

emotional regulation, and self-confidence). A contemporary approach also encourages the integration of 24-hour movement behavior, which consists of physical activity, sedentary behavior, and sleep as interrelated determinants of health and fitness, where compliance with 24-hour guidelines is generally low and tends to be higher in males than females (Zhao et al., 2024). These findings reinforce the need for context-sensitive school-based fitness evaluations that account for students' characteristics.

In several high-income countries, including in Asia, gender-based disparities in adolescent physical activity have emerged as a consistent phenomenon. A cross-sectional analysis of 64 countries in the Global South shows that there is a gap in physical activity that is detrimental to adolescent girls, influenced by social environmental factors, cultural norms, and opportunities for activity (Ricardo et al., 2022). Physiologically, differences in biological maturation and body composition during puberty can affect performance on certain fitness tests, particularly cardiorespiratory and strength components (Tomkinson et al., 2017). However, the magnitude of these differences can vary according to the quality of physical education, physical activity habits, and social support at school and at home.

In the Indonesian context, research on physical activity and sedentary behavior among adolescents reveals challenges in policy implementation and limitations in the school ecosystem that supports an active lifestyle. A review of research mapping indicates that studies on physical activity among Indonesian adolescents are still dominated by cross-sectional designs and diverse measurement instruments, so that standards for monitoring and school interventions require methodological strengthening (Andriyani et al., 2020). At the same time, nutritional transition and urbanization are associated with an increasing prevalence of overweight, which can impact fitness performance and participation in physical activity (Oddo et al., 2019). Parental and peer support factors also play an important role in the physical activity of adolescents in Indonesia (Utomo et al., 2025; Yusuf et al., 2021).

Responding to the need for more systematic monitoring of student fitness, the Nusantara Student Fitness Test (TKPN) provides a series of field tests to assess several components of fitness in a practical manner at school. In line with international recommendations, simple and inexpensive field tests such as the pacer/20 m shuttle run are still widely used for cardiorespiratory fitness surveillance (Tomkinson et al., 2017), although their interpretation requires caution because fitness estimates are not always identical to laboratory-measured cardiorespiratory capacity (Welsman & Armstrong, 2019). In Jambi Province, TKPN data from senior high schools has the potential to provide an initial picture of fitness profiles and differences based on gender. Therefore, this study aims to compare TKPN results based on gender among senior high school students in Jambi Province and explore variations between schools (Pratiwi et al., 2025).

Method

This study is a comparative quantitative study with a cross-sectional design. This design is suitable for evaluating differences in average fitness test performance between groups (e.g., gender) at a single point in time, while also describing variations between schools within a region.

The data came from the TKPN recapitulation of 10th grade students at three high schools in Jambi Province: SMAN 1 Batang Hari, SMAN 5 Tanjab Timur, and SMAN 5 Kota Jambi. The total sample consisted of 85 students (35 males and 50 females). The demographic variables used included age and gender, as well as body mass index (BMI), which was calculated from weight (kg) divided by height squared (m^2).

The TKPN instruments in this data include: (1) flexibility using the sit and reach (cm), (2) abdominal muscle endurance using 60-second sit-ups (repetitions), (3) lower limb–arm muscle endurance using the 30-second squat thrust (repetitions), and (4) cardiorespiratory endurance using the pacer test. This type of field test battery is commonly used in school fitness monitoring because it is practical, inexpensive, and can be applied to large numbers of participants (Marques et al., 2021; Tomkinson et al., 2017). The use of cross-country fitness norms also supports the interpretation of student performance positions relative to a broader population distribution (Pratiwi et al., 2025; Tomkinson et al., 2018).

Each TKPN component on the data sheet already has a performance category based on internal norms (e.g., very low to very good). To form composite indicators, the categories are converted into points from 1 to 5 (very low = 1, low = 2, fair = 3, good = 4, very good/excellent = 5) and added up so that the total score ranges from 4 to 20. Composite scores are used to facilitate group comparisons while capturing multi-component fitness profiles.

Data analysis includes descriptive statistics (mean, standard deviation, and category distribution), visualization (boxplot, category bar chart, and interaction graph), and hypothesis testing. To compare the means of males and females, the Welch's t-test was used, which is recommended when the variances between groups are not identical or the sample sizes are not balanced (Delacre et al., 2017). Effect sizes were reported using Hedges' g. To assess inter-school variation and the possibility of gender×school

interactions, a two-way ANOVA (factors: gender and school) was used, with partial eta squared (ηp^2) reported as a measure of effect. The composite scores were analyzed using a complete-case approach (only respondents with complete data on the four components). The significance level was set at $\alpha=0.05$, and the reporting of effects followed the principle of inferential transparency (Lakens, 2017).

Results

A total of 85 students from three high schools were analyzed. Table 1 shows the distribution of the sample by school and gender. A small portion of the data was incomplete for certain components, so the TKPN composite score was calculated for 80 students who had complete categories for all four components.

Table 1. Distribution of samples by school and gender

School	Male (n)	Female (n)	Total (n)
SMAN 1 Batang Hari	11	19	30
SMAN 5 Kota Jambi	7	23	30
SMAN 5 Tanjab Timur	17	8	25
Total	35	50	85

Table 2 presents descriptive statistics of TKPN components and Welch's t-test results based on gender. It should be noted that the sample size (n) in Table 2 represents cases with valid data for each variable, so it may be smaller than the total sample size in Table 1 (N=85). In the female group, there were 4 incomplete data (n=46), and in the total TKPN composite score, there was 1 male data that could not be calculated (n=34). In general, the difference in means between genders was in the small range ($|g|\leq0.34$) and did not reach statistical significance ($p>0.05$) in all components and composite scores.

Table 2. Descriptive statistics and difference tests (Welch) based on gender

Name	n (M)	Mean (M)	SD (M)	n (F)	Mean (F)	SD (F)	t	p	Hedges'g
VSR	35	15.36	7.08	46	13.77	7.26	0.99	0.327	0.22
Sit Up	35	32.51	7.34	46	30.11	6.8	1.51	0.136	0.34
Squat Thrust	35	14.2	4.29	46	15.91	6.65	-1.4	0.164	-0.29
Pacer Test	35	26.29	15.86	46	24.87	15.82	0.4	0.691	0.09
Total TKPN	34	10.68	1.39	46	10.74	2.27	-0.15	0.879	-0.03

Note. n = number of valid cases (complete data for each variable). M = male; F = female. VSR = V sit-and-reach (cm). SD = standard deviation. t = Welch's t statistic; p = p value. Hedges' g = standardized mean difference (effect size). TKPN = Tes Kebugaran Pelajar Nusantara; Total TKPN = composite score (sum of four component-point categories; range = 4–20), calculated only for participants with complete data on all components (M: n = 34; F: n = 46).

Two-way ANOVA analysis of composite scores showed no main effect of gender ($p=0.302$) and no interaction between gender and school ($p=0.144$). However, there was a significant main effect of school ($F=18.07$; $p<0.001$; $\eta p^2=0.33$), indicating differences in composite fitness levels between schools (Table 3). The highest composite score average was found at SMAN 5 Kota Jambi (11.97±1.35), followed by SMAN 5 Tanjab Timur (10.54±1.44) and SMAN 1 Batang Hari (9.42±2.04).

Table 3. Two-way ANOVA (gender × school) for TKPN composite scores

Effect	F	p	ηp^2
Gender	1.08	0.302	0.01
School	18.07	<0.001	0.33
Gender$_X$School	1.99	0.144	0.05

Note: ηp^2 = partial eta squared (effect size) from two-way ANOVA. As a practical guide, $\eta p^2 \approx 0.01$ (small), 0.06 (medium), and 0.14 (large).

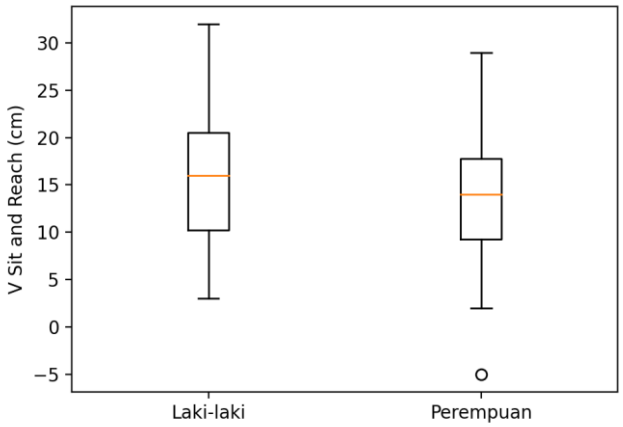

Figure 1. Boxplot of V Sit and Reach scores by gender.

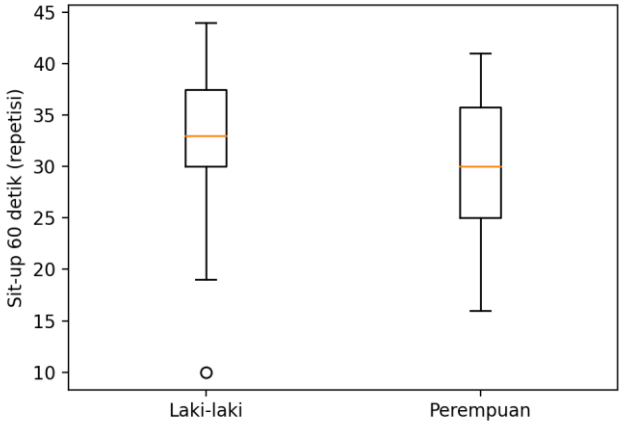

Figure 2. Boxplot of 60-second sit-up scores by gender.

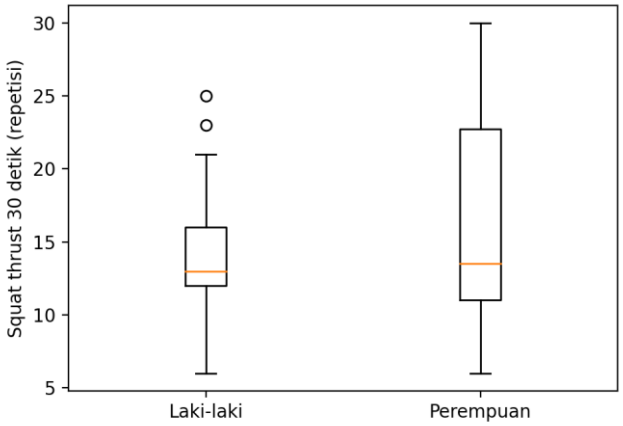

Figure 3. Boxplot of 30-second squat thrust scores by gender.

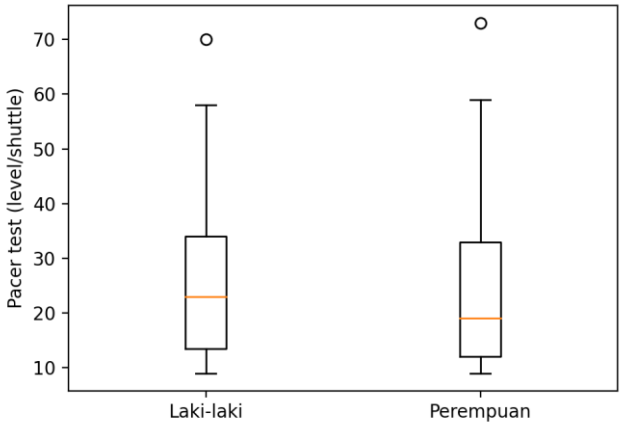

Figure 4. Boxplot of Pacer test scores by gender.

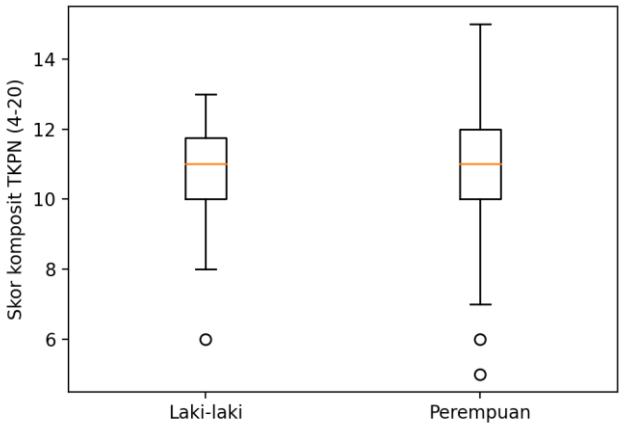

Figure 5. Boxplot of TKPN composite scores by gender.

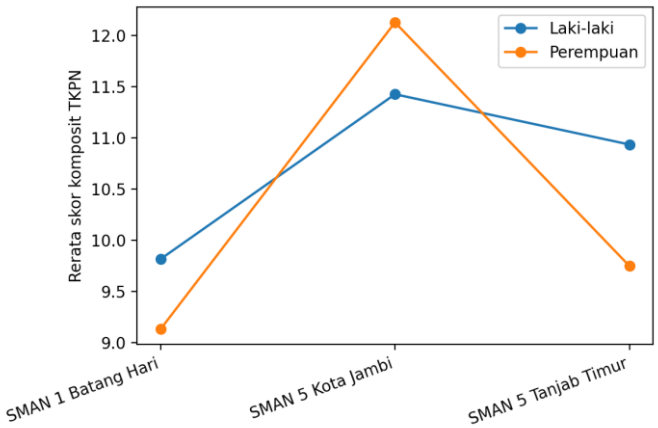

Figure 6. Average TKPN composite scores by school and gender (interaction graph).

Discussion

This study shows that the difference in TKPN results between males and females among high school students in Jambi Province is relatively small and not statistically significant, both in composite scores and in each test component. These findings indicate that, in the context of the schools studied, variations in fitness performance are more influenced by school environmental factors than by gender alone. Methodologically, the use of Welch's t-test helps reduce the risk of false conclusions when the variance and sample size between groups are not balanced (Delacre et al., 2017).

Although not significant, the slightly higher mean patterns in males for sit-ups and pacer are in line with international literature showing a tendency for boys to excel in cardiorespiratory components in many populations and age ranges (Tomkinson et al., 2017). However, the pacer results in this data are dominated by the "very low" category, which may reflect low daily physical activity, high sedentary behavior, or limited opportunities for structured exercise. Globally, the proportion of adolescents who do not meet physical activity recommendations remains very high and tends to be worse among girls (Guthold et al., 2020; Ricardo et al., 2022), so the interpretation of fitness results needs to consider the context of physical activity behavior.

The strong effect of school on composite scores confirms that the quality of the school ecosystem has the potential to be an important determinant of student fitness. These differences can be influenced by the quality of physical education, a school culture that supports physical activity, the availability of facilities and infrastructure, and extracurricular programs. These findings are consistent with the idea that schools are strategic settings for monitoring and improving fitness through standardized field test batteries (Marques et al., 2021), including the use of broad population norms as comparators (Tomkinson et al., 2018). However, field tests such as the pacer still require careful interpretation; evidence shows that 20 m shuttle run performance cannot always be equated with measures of cardiorespiratory fitness measured directly (e.g., VO_2peak) at the individual level (Welsman & Armstrong, 2019) and needs to be read in the context of implementation and monitoring objectives (Tomkinson et al., 2019).

In terms of public health, low fitness profiles have the potential to correlate with increasing trends of overweight in the Indonesian population, driven by nutritional transitions, urbanization, changes in dietary patterns, and decreased physical activity (Oddo et al., 2019). A review of Indonesian adolescent research also shows that the evidence base for school interventions still needs to be expanded and standardized, both in terms of measurement and evaluation design (Andriyani et al., 2020). On the other hand, social support from parents and peers can strengthen adolescents' participation in physical activity, so strategies to improve fitness need to involve a socio-ecological approach (Keya et al., 2025; Nugroho et al., 2025; Yusuf et al., 2021).

From an intervention perspective, various systematic reviews indicate that school-based high-intensity interval training (HIIT) programs can improve cardiorespiratory fitness and other fitness components in children and adolescents, with relatively efficient duration (Bauer et al., 2022; Duncombe et al., 2022; Eddolls et al., 2017). In addition to HIIT, evidence synthesis also confirms that variations in exercise intensity have different effects on improving health-related fitness (Zhou et al., 2024)and body composition in overweight groups (Huang et al., 2023). Since physical activity guidelines emphasize a combination of aerobic activity and muscle strengthening along with limiting sedentary behavior (Bull et al., 2020), schools can integrate adaptive interventions such as short HIIT modules in physical education, strengthening daily physical activity, and providing sleep and screen time education in line with the 24-hour movement behavior (Zhao et al., 2024). In the future, longitudinal and experimental studies are needed to assess causality and test the effectiveness of school-based programs in the context of Jambi (Kornia et al., 2025; Waluyo, 2023).

Conclusion

Based on the analysis conducted, it was concluded that there was no significant difference in the physical fitness levels of high school students in Jambi Province when viewed from gender differences. This finding indicates that gender is not a major determinant in the variation of Nusantara Student Fitness Test (TKPN) performance in the context of the sample studied. Conversely, substantial variations were observed between schools, indicating that educational environment characteristics have a more significant influence on student fitness achievement. Implicitly, efforts to improve fitness need to consider aspects of school policy, the quality of physical education teaching, and the availability of supporting facilities.

Practically, these findings encourage the need for a school-based approach in planning fitness programs. Educational institutions can use the TKPN results as a basis for evaluation to develop more targeted interventions, such as optimizing the content of physical education and sports learning and developing structured physical activity programs. On the other hand, from an academic perspective, further research is needed to explore more specific contextual factors at the school level, including policy aspects, organizational culture, and daily physical activity behavior, in order to provide a comprehensive explanation of the mechanisms underlying inter-school variations. This exploration is expected to form the basis for the development of more effective and sustainable intervention models.

Limitations: This study used secondary TKPN recapitulation data from only three schools with a relatively small sample, which limits generalizability. The cross-sectional design does not allow causal inference about the influence of gender or school context. Some test component data were incomplete, so the composite score was calculated using a complete-case approach. In addition, the composite score was derived from categorical point conversions rather than raw scores, which may reduce sensitivity. Potential confounders (e.g., biological maturation, habitual physical activity/sedentary behavior, participation in extracurricular sport,

and availability/quality of facilities) were not measured and may explain inter-school differences.

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