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LEVEL OF PHYSICAL FITNESS AMONG SCHOOL ADOLESCENT AT SMK TELUK BAHANG, PENANG, MALAYSIA

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Abstract:

Background: Establishing a solid foundation of health during adolescent is vital for promoting long-term overall well-being. However, technological advancements have revolutionized human behavior and social dynamics across all age groups, but particularly in adolescent, where prolonged exposure to digital platforms has led to sedentary behavior. This shift has been associated with rising rates of obesity and non-communicable diseases (NCDs) like diabetes and hypertension. Recognizing the importance of physical fitness is necessary for screening health risks among adolescents, therefore, this study aimed to assess the physical fitness levels of school adolescent at Sekolah Menengah Kebangsaan (SMK) Teluk Bahang, Penang, Malaysia. **Method**: Each participant performed three physical fitness tests; (1) push-up test, (2) beep test, and (3) sit-and-reach test. The push-up test was used to measure upper body strength and endurance, the beep test was used to estimate aerobic fitness, and sit and reach test was used to measure flexibility of hamstring muscles. The results were then analyzed based on normative values of each test

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using IBM SPSS Statistic version 29.0. **Results:** 61 school adolescents completed the entire tests. When compared to normative values for push-up test (20.25 ± 13.2 rep in male and 10.49 ± 7.3 rep in female), beep test (27.75 ± 5.5 ml.kg^{-1}.min^{-1} in males and 23.0 ± 3.6 ml.kg^{-1}.min^{-1} in females), and the sit-and-reach test (21.28 ± 9.2 cm in males and 20.4 ± 7.5 cm in females), all of them were under average. **Conclusion:** The level of physical fitness among school adolescents at Sekolah Menengah Kebangsaan (SMK) Teluk Bahang, Penang, Malaysia is somewhat below average.

Keywords:

Adolescents; Aerobic Fitness; Endurance; Flexibility; Fitness Level

Introduction

Technological advances have significantly influenced human behaviors, social relationships, and life understanding from infancy to late adulthood. With the emergence of artificial intelligence (AI), accessibility to the information, communications, and work efficiency has become more efficient, streamline, and often-easier (Moreno-Llamas, García-Mayor, & De la Cruz-Sánchez, 2020). Despite technological advances contributing to numerous benefits for society such as increased life expectancy, the physical function and quality of life have been reduce due to the growing prevalence of sedentary behavior (Woessner et al., 2021) starting as early as adolescence (Kracht et al., 2021; Park et al., 2020).

World Health Organization (WHO) defined an adolescent as any individual ages 10 to 19, the phase of life between childhood and adulthood and a crucial period for establishing a solid foundation of health. Establishing positive habits and practices in daily life, including physical activity, mindful food intake and ensuring adequate sleep, is crucial for promoting long-term overall well-being. However, the extended time of adolescent spending on smartphones, social media and other digital platforms, contributing to sedentary behavior, has been linked to the rise of obesity (Woessner et al., 2021) and non-communicable diseases (NCDs) such as diabetes, mental health condition, and hypertension (Park et al., 2020; van Sluijs et al., 2021).

Physical inactivity is highly correlated with NCDs, imposing a significant burden on both global health system and public, with treatment costs reaching at least $54 billion and $31 billion, respectively. Approximately 5.3 million deaths are attributed to NCDs annually (van Sluijs et al., 2021). In Malaysia, an estimated 113,400 out of 154,000 deaths are NCD-related. Moreover, 3.5 million adult Malaysians are living with diabetes, 6.1 million with hypertension, 9.6 million with hypercholesterolemia, 3.3 million with obesity and the prevalence of NCDs continues to rise (Ministry of Health Malaysia, 2020). While NCDs are globally recognized, much of the evidence is derived from studies among adults. Nevertheless, there is growing trend of NCDs among adolescents that should not be neglected (van Sluijs et al., 2021).

National data from the National Health Morbidity Survey (NHMS) 2017 indicated that only one out of five Malaysian adolescent were physically active (Shahril et al., 2023). This representative data continued to remain the same during and after COVID-19 period. According to the 2022 Report Card produced by Active Health Kids Malaysia Research Committee, there are several factors contributing to the sedentary lifestyle of adolescents in Malaysia. For example, emotional boredom and online learning led to an increase in the use of electronic devices during COVID-19, which has become a habit after the lockdown period

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(Shahril et al., 2023). In fact, a larger variety of games and activities are available online for all age groups, leading many adolescents to opt for playing with technological devices rather than engaging in traditional form of play. Additionally, their social interaction on electronic devices are broader compared to physical interaction, as many choose to interact online (Slutsky, Slutsky, & deShelter, 2014). This trend leads to less physical activity and contributes to a sedentary lifestyle among adolescents.

Physical fitness is a multicomponent construct used to measure the capacity of an individual's capacity to perform physical activities and/or physical exercises, integrating the majority of bodily function (Martínez-Vizcaíno & Sánchez-López, 2008; Masanovic et al., 2020). It is crucial health marker because high levels of fitness during adolescence can positively impact positively both adolescent and adult health in the future, thereby helping to reduce health problems (Masanovic et al., 2020). There are four health-related physical fitness tests, which are (1) cardio-respiratory capacity, (2) muscle strength and endurance, (3) muscle flexibility, and (4) body composition (Martínez-Vizcaíno & Sánchez-López, 2008; Mirza, Noor, Noor, & Latir, 2022). Sedentary lifestyles are often associated with reduced cardio-respiratory capacity, muscle strength and endurance, therefore, the objective of this study was to investigate the level of physical fitness among high school students aged 13 to 16 years old at Sekolah Menengah Kebangsaan (SMK) Teluk Bahang, Penang, Malaysia.

Materials and Methods

A cross-sectional study involving adolescents aged 13 to 16 years old from Sekolah Menengah Kebangsaan (SMK) Teluk Bahang, Penang, Malaysia, was conducted on January 9, 2024. The data collection process occurred during school hours from 8.00 a.m. until 1.00 p.m. Before the testing day, the participants were informed to wear suitable clothing and footwear, and avoid heavy meals. All participants attended a single testing session that lasted for approximately 40 minutes in the school hall and field.

The Physical Activity Readiness Questionnaire for Everyone (PAR-Q+) from the PAR-Q+ Collaboration (Warburton, Jamnik, Bredin, & Gledhill, 2011) was administered prior to enrollment in the testing session to assess their ability to safely participate in exercise and exercise testing. Participants were excluded from the study if they met any of the criteria based on the PAR-Q+ results: (1) having any contraindication for exercise and exercise testing, (2) medical issues such as any cardiopulmonary diseases, and (3) musculoskeletal pain/injury that could affect their performance during the assessment.

The participants were required to warm up their bodies before undergoing the physical fitness test. Weight and height measurements were recorded along with demographic data. Each participant performed push-up test, beep test, and sit-and-reach test. A minimum of 10 minutes rest were given between tests. Informed consent was obtained from all participants before the data collection.

Measurement

Push-up test: The push-up test is a reliable tool for assessing upper body strength and endurance, targeting the pectoralis major, minor and triceps brachii muscles (Adams, Hatch, Winsor, & Parmelee, 2022), with a high degree of interrater reliability (α: .987) (Diehl et al., 2019). Male participants utilized standard push-up positions (Figure 1), while female

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participants used bent-knees push-up (Figure 2). Participants should maintain a straight and taut body, lowering themselves until their chest touches the floor. The test was conducted for 1 minute or until the participant can no longer maintain perfect form (Subrata, Ni Wayan Rusni, & I Nyoman Arie Purwana, 2022). The investigator then recorded the total number of push- up completed in the test.

Figure 1: Standard Push-Up Test

Figure 2: Bent-Knees Push-Up Test

Beep test: The beep test, also known as multistage fitness test (MSFT) has been widely used to predict VO_2 max for fitness test in healthy population. It has been widely used due to low-cost equipment, simplicity in administering, adaptable for the participants, and convenience for a larger testing group of adolescents (Dimarucot & Macapagal, 2021). In this test, participants ran back and forth synch with the corresponding beep between two points that are 20 m apart. In this test, participants could miss only one shuttle if they manage to catch up for the next shuttle. However, they eliminated from the test if they miss two consecutive shuttles (Macmahon, Hawkins, & Schücker, 2019). The investigator then recorded the total distance covered by the participants.

Sit-and-reach test: The sit-and-reach test is a reliable tool to measure trunk and lower limb flexibility. The test is commonly available due to low cost equipment and convenience in testing (Jankowicz-Szymańska et al., 2022). The participants placed their heels on the device in a long sitting position, flexed their trunk and reached forward by pushing the measuring device using their fingertips as far as they could without bending their knees (Akinoğlu, Paköz, Hasanoğlu, & Kocahan, 2021). The investigator then recorded the average of three measurements.

Sample Size

The sample size was determined using Raosoft calculator with a margin error was set at 10% and confidence interval was set at 90%. Total number of students at SMK Teluk Bahang was 380 students, hence, from the calculation; the recommended sample size for this study was 58. The number escalated to 5% to account for any dropouts from those unable to complete the test or refuse to do the test. During the test day, 145 participants showed up, however only 61 were completed all the fitness tests for this study.

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Statistical Analysis

The collected data were analyzed using IBM SPSS Statistic version 29.0 (SPSS V.29). Descriptive statistical analysis used to report the mean and standard deviation (Mean ± SD) for all data in this study.

Results

Demographic Information of the Participants

A total of 37 female students and 24 male students were included in this study, which is in congruence with the recommended number of 58 for reliability studies. The demographic data shown in Table 1 and Table 2.

Table 1. Demographic Information of Respondent.

Demographic Data	n (%)	Mean ± SD
Age		
Male	-	13.67 ± 0.963 year
Female	-	14.54 ± 1.282 year
Gender		
Male	24 (39.34)	-
Female	37 (60.66)	-
BMI		
Male	-	18.39 ± 3.535 kg.m.$^{-2}$
Female	-	20.54 ± 4.184 kg.m.$^{-2}$

Table 2. Category of BMI

Gender	Category of BMI [n (%)]			
	Underweight	Healthy weight	Overweight	Obesity
Male	17 (27.87)	5 (8.20)	2 (3.27)	0
Female	12 (19.67)	19 (31.15)	5 (8.20)	1 (1.64)
Total	29 (47.54)	24 (39.35)	7 (11.47)	1 (1.64)

Table 1 shows that 60.66 % of participants were female (age 14.54 ± 1.282 year, BMI 20.54 ± 4.184 kg.m.$^{-2}$), while 39.34 % of participants were male (age 13.67 ± 0.963 year, BMI 18.39 ± 3.535 kg.m.$^{-2}$). Table 2 shows that the majority of participants are underweight (46.54 %).

Level of Physical Fitness

Table 3 reports the findings for push- up test, beep test, and sit-and-reach test. The push-up test is used to measure upper limb strength, the beep test is used to measure cardiovascular fitness and the sit-and-reach test is used to measure trunk and lower limb flexibility.

Table 3. Fitness test

Variables	Male (Mean ± SD)	Female (Mean ± SD)
Push- up test	20.25 ± 13.2 rep	10.49 ± 7.3 rep
Beep test	27.75 ± 5.5 ml/kg/min	23.0 ± 3.6 ml/kg/min
Sit and reach test	21.28 ± 9.2 cm	20.4 ± 7.5 cm

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There were significant differences in push- up repetitions between male and female students; however, both of them were under normative values. The beep test, and the sit-and-reach test showed slight differences between males and females, and all scores were also below average value.

Figure 3 and 4 depict histograms illustrating the distribution of push-up test score among male and female participants, respectively. In Figure 3, the spread of scores ranges from 0 to 50 for male, with the highest push-up of repetitions occurring at 30. Conversely, Figure 4 representing female participants shows a narrower spread of scores ranging from 0 to 30, with the highest push-up repetitions occurring at 7. The data indices that males generally exhibit higher upper body strength endurance of males compared to females. However, both males and females scored below the average norm.

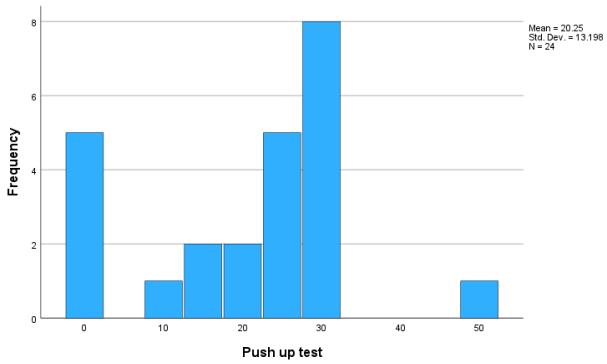

Figure 3: Histogram Push-Up Test For Male

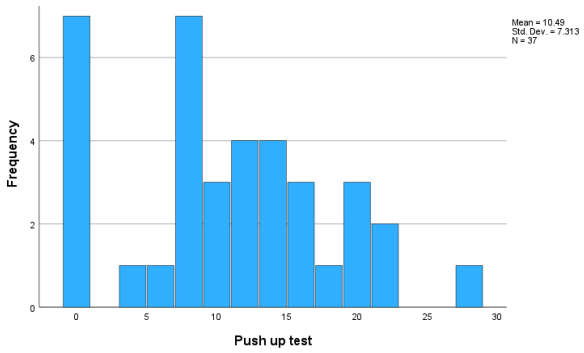

Figure 4: Histogram Push-Up Test For Female

Figure 5 and 6 below describe the distribution of VO_2 max data from the beep test results among male and female participants, respectively. In Figure 5, the data exhibit a right-skewed distribution, with the majority accumulating on the left side. The mean value for male participants is 27.75 ml/kg/min. Conversely, Figure 6 shows a normal distributed pattern for female participants, with a mean score of 23.0 ml/kg/min. The data indicates that males generally exhibit higher VO_2 max compared to females. However, both males and females scored within 'very poor' range.

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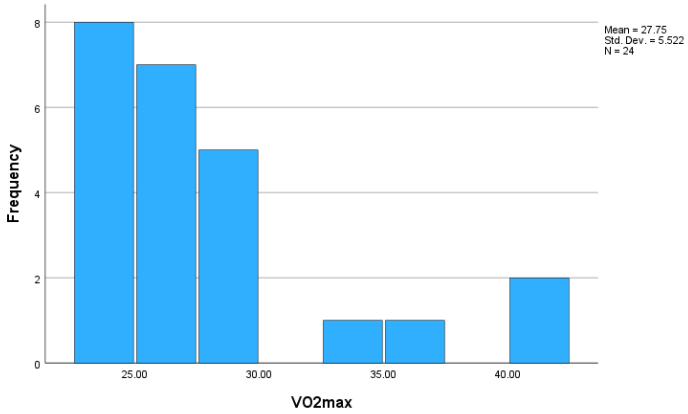

Figure 5: Histogram VO_2 Max For Male

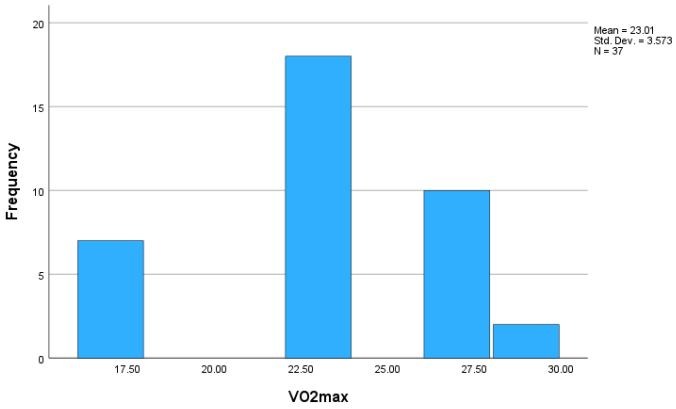

Figure 6: Histogram VO_2 Max For Female

Figure 7 and 8 show the data for muscle flexibility in males and females respectively. Figure 7 show a normally distributed data with mean score of 21.28 cm, while Figure 8 show a right-skewed distribution with mean score of 20.4 cm. The data indicates that muscle flexibility of trunk and lower extremity is slightly higher in males than females. However, both males and females scored below the average value.

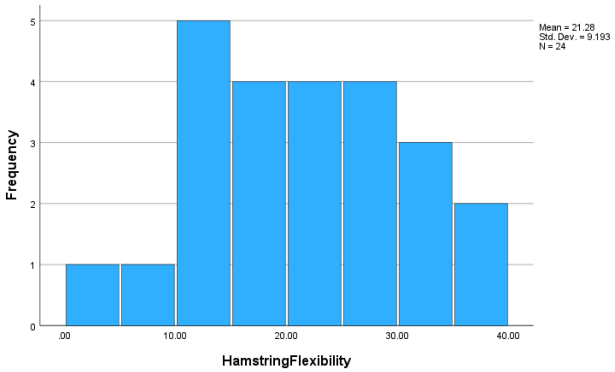

Figure 7: Histogram Muscle Flexibility For Male

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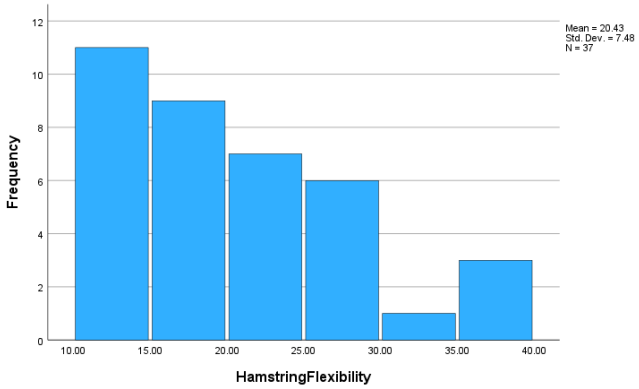

Figure 8: Histogram Muscle Flexibility For Female

Discussion

The present study found that the majority of the participants were below both normal BMI and fitness level. The majority of participants were underweight, exhibited reduced upper body strength and endurance, had lower cardiovascular fitness and demonstrated decreased trunk and lower limb flexibility. This finding is significant as the fitness of adolescents is vital in establishing a solid foundation of health for long-term overall well-being.

An earlier study revealed that screen exposure and reduced physical fitness might lead to obesity among adolescents (Woessner et al., 2021). However, the present study found otherwise, as the majority of participants in SMK Teluk Bahang were underweight. According to Tan et al., (2019), gender was associated with body weight. Underweight was more frequent among male adolescents, and this finding aligns with this study, as a larger proportion of underweight participants were male, while the majority of female participants had a normal weight. Hunger resulting from food shortages at home due to parents with lower incomes was highly correlated among Malaysian adolescents who were underweight (Tan, Yen, Fang, & Chiang, 2019).

Regular practice of physical activity is closely correlated to adequate flexibility. Variable aspects of physical activities, particularly in sports, contribute to achieving a greater range of motion in the joints due to increased strength and elasticity of skeletal muscles, tendons and ligaments (Hobold et al., 2017). Additionally, maintaining an active lifestyle also influences cardiovascular fitness and reduces the chances of having heart disease (Schnermann, Schulz, Herder, Alexy, & Nöthlings, 2021). Considering the above finding, lack of physical activities contributed to reduce muscle flexibility, muscle strength and cardiovascular fitness.

Conclusion

In summary, the aforementioned results indicate that the level of physical fitness among school adolescents at Sekolah Menengah Kebangsaan (SMK) Teluk Bahang, Penang, Malaysia is marginally below the average. This finding aligns with the objective of the study, which aimed to assess the current state of physical fitness in this population. Disseminating the results of the present study for the schools to educate parents and students about the significance of increasing their physical activity levels, as this will positively improve their later adult life. To entice school-aged adolescents, the school and parents must implement new technologies for

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example Instagram and TikTok to make physical activities more enjoyable. It is time to influence posterity to become more active by utilizing the positive aspects of social media. Future research should be tailored towards the establishment of appropriate physical activities to improve the level of physical fitness among school-aged adolescents.

Ethical Clearance

The patient was informed, and written consent was taken from their guardian.

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