INTERNATIONAL JOURNAL OF
PHYSICAL THERAPY RESEARCH & PRACTICE
AN OFFICIAL JOURNAL OF SAUDI PHYSICAL THERAPY ASSOCIATION

Original Article

Association Between Cigarette Smoking and Selected Health-Related Physical Fitness Indicators in Young Bahraini Men: A Pilot Cross-Sectional Study

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Abstract

Background: Cigarette smoking is a major global health issue, but its effects on health-related physical fitness among young adults in the Middle East—particularly in Bahrain—are not well studied. Most existing research focuses on older or Western populations. This study fills that gap by investigating the association between smoking status and BMI, pulmonary function (FVC), and functional capacity (6MWT) among male university students in Bahrain, a population for which localized evidence is currently lacking. **Methods:** Forty-one men aged 18–26 years were classified as smokers (n=20) or non-smokers (n=21). Standardized protocols were used for anthropometry, spirometry, and 6MWT. Exercise habits were assessed via a questionnaire. Between-group differences were estimated using unpaired t-test, with effect sizes and 95% confidence intervals reported. **Results:** The results showed that there were no significant differences between smokers and non-smokers in all measured parameters. The P values were 0.545, 0.885, and 0.278 for BMI, FVC, and 6MWT respectively. For the physical activity and exercising status, among the smoker's group, 50% never exercised, 15% had occasional exercise, and 35% had regular planned exercising. Among the non-smokers group, 19% never exercised, 24% had occasional exercise, and 57% had regular planned exercise. **Conclusion:** This study offers the first evidence from Bahrain on smoking and physical fitness in young men, indicating that lifestyle behaviors may differ despite unaffected short-term physiological measures and underscoring the need for early preventive strategies and longitudinal research to assess long-term effects.

Keywords: Cigarette smoking, Physical fitness, Young adults, Bahrain; Pulmonary function, Exercise behavior.

Article info : Received: **Jan. 10, 2026,** Accepted: **Jan. 24, 2026 ,** Published: **Jan. 31, 2026**

To Cite: Alrayes M. M. and Dalia Mohamed Kamel. Association Between Cigarette Smoking and Selected Health-Related Physical Fitness Indicators in Young Bahraini Men: A Pilot Cross-Sectional Study. (2026). International Journal of Physical Therapy Research & Practice, 5(1), 117-125. https://doi.org/10.62464/vwefnp74

Introduction

The terms of physical fitness, physical activity, and exercise represent related but distinct concepts and are often used interchangeably. Physical activity refers to any bodily movement produced by skeletal muscles that results in energy expenditure, whereas exercise is a planned, structured, and repetitive form of physical activity undertaken with the goal of improving or maintaining one or more components of physical fitness (Jeon & Kim, 2020). Physical fitness encompasses a state of health and well-being characterized by a reduced risk of premature health problems and the capacity to meet daily physical demands with vigor (Lyu et al., 2023).

Physical fitness is widely recognized as a multidimensional construct encompassing both health-related and skill-related attributes. According to the American College of Sports Medicine (ACSM), physical fitness refers to a set of characteristics that individuals possess or develop, which enable them to perform physical activities efficiently. These attributes include cardiovascular endurance, muscular strength and endurance, flexibility, body composition, and increasingly, psychological and social adaptability (Balague et al., 2025; ACSM, 2024).

Recent literature emphasizes that regular physical activity and optimal physical fitness are associated with reduced risks of premature mortality and chronic diseases such as colorectal cancer, type 2 diabetes, osteoporosis, and hypertension. Moreover, physical activity contributes significantly to improved mental health, cognitive function, and overall quality of life (CDC, 2024; Hallal et al., 2024; Kempermann, 2025).

Cigarette smoking remains one of the most significant global public health challenges. It is a leading cause of preventable death and contributes to a wide range of health disparities. Smoking is associated with increased risks of cardiovascular disease, chronic obstructive pulmonary disease (COPD), renal dysfunction, stroke, and neurodegenerative conditions (WHO, 2023; Tanaka et al., 2025; CDC, 2024). The cumulative exposure to tobacco, often measured in pack-years, correlates with the severity of these health outcomes (Zhang et al., 2023).

Smoking status can be classified in several ways. A non-smoker is generally defined as an individual who has never smoked, not even a single puff (Jeon & Kim, 2020). Smokers may be categorized according to frequency, lifetime exposure, or stage of smoking behavior development, particularly among young adults (Kim et al., 2021; Müller et al., 2024).

In Bahrain, the prevalence of smoking among adults aged 15 years and older was estimated at 18.1% in 2022, with a marked gender disparity: 25.7% among males and 4.9% among females (GSTHR, 2025). Despite this high prevalence, there is a notable lack of localized research investigating the impact of smoking on physical fitness within the Bahraini population.

The relationship between smoking and physical fitness remains controversial. While several studies have demonstrated a negative association between smoking and physical performance, others have reported inconclusive or contradictory findings. For example, systematic reviews indicate that many studies find smoking and physical activity to be largely incongruent behaviors, with a majority showing negative associations but with results varying by subgroup and exercise type (Taylor, Ussher, & Faulkner, 2007). Individual research has also shown smokers to have lower agility, speed, and some fitness measures than non-smokers, though certain differences, such as muscle endurance and flexibility, are not always statistically significant (Jeon & Kim, 2021). Additionally, large observational studies report inconsistent associations between smoking status and multiple fitness outcomes, suggesting that the relationship is not uniformly established across all fitness domains and populations (Yang, Hsu, Chiang, & Chuang, 2022). This inconsistency highlights a gap in literature, particularly in the context of young adults in the Middle East.

Although extensive research has established the detrimental effects of smoking and the benefits of physical fitness independently, the direct association between smoking habits and physical fitness performance remains underexplored in Bahrain. This study aims to address this gap by examining the relationship among male university students and testing the hypothesis that the Cigarette smoking affected the physical fitness.

Methodology

Study design and setting

This cross-sectional observational pilot study was conducted at Ahlia University, Kingdom of Bahrain, and was reported in accordance with the STROBE guidelines. Male university students aged 18–26 years were recruited through campus announcements and word-of-mouth. The study sample consisted exclusively of male participants, which limits the generalizability of the findings, as physiological, behavioral, and lifestyle differences between men and women may influence health-related fitness outcomes; therefore, the results cannot be confidently extrapolated to female populations. Eligible participants included current smokers, defined as individuals with regular cigarette use based on established frequency and duration criteria, and non-smokers who had never smoked, while individuals with known cardiopulmonary disease, recent musculoskeletal injury, or acute illness were excluded to minimize potential confounding and ensure participant safety. No formal power calculation was performed, as this was a pilot study; instead, a pragmatic sample size of 41 participants (20 smokers and 21 non-smokers) was selected to assess feasibility and generate preliminary effect size estimates for future research. Convenience sampling was used due to logistical constraints and reliance on voluntary participation.

Variables and Measurements

Anthropometric measurements included height and weight assessed using calibrated instruments, with body mass index (BMI) calculated as weight (kg) divided by height squared (m^2) in accordance with NHLBI guidelines. Pulmonary function was evaluated using forced vital capacity (FVC), measured with a calibrated spirometer following ATS/ERS standards; three acceptable trials were performed, and the highest value was recorded for analysis. Functional capacity was assessed using the Six-Minute Walk Test (6MWT), administered according to ATS protocol, during which participants walked at a brisk, self-paced speed for six minutes and the total distance covered was recorded. Exercise status was obtained through a structured self-reported questionnaire and categorized as regular, occasional, or never exercising. Participants were classified as never exercising if they had not engaged in any exercise or physical activity in the six months prior to the study, as occasional exercisers if they exercised on some days per month without a structured plan, and as regular exercisers if they followed an organized exercise plan, engaging in moderate- to vigorous-intensity exercise at least twice per week or low-intensity exercise on most weekdays at the time of the study.

Bias Control

The use of convenience sampling may limit representativeness and introduce selection bias, potentially affecting external validity. However, measurement bias was minimized through standardized protocols and calibrated equipment; moreover, assessors were blinded to smoking status to reduce measurement bias. Residual confounding by smoking intensity and physical activity cannot be excluded.

Ethical Considerations

Ethical approval was obtained from Ahlia University. Written informed consent was obtained from all participants prior to data collection. Participation was confidential, and all personal data were securely stored and accessible only to the research team. A summary of Assessment Procedures is shown in Table 1.

Table 1: Summary of the current study procedures.

<table>
<tr><td>Phase (1): Before tests</td><td colspan="5">Phase (2): Tests and measures to apply</td><td>Phase (3): After tests</td></tr>
<tr><td rowspan="2">Step (1)
Informing the participants about study and assessment procedures.</td><td>(1)
Total body fat
$\text{BMI} = \frac{\text{Wight (kg)}}{\text{Hight}^2\ (\text{m}^2)}$</td><td rowspan="3">Rest</td><td>(2)
Forced vital capacity (FVC)</td><td rowspan="3">Rest</td><td>(3)
Functional & cardio- pulmonary capacity</td><td rowspan="2">Step (1)
Confirming the participant’s data, test results, and measurements</td></tr>
<tr><td>Weight and height scale</td><td>Spirometer</td><td>6MWT</td></tr>
<tr><td>Step (2)
Consent form signed by the participants.</td><td>One-time measurement of weight and height.</td><td>3 reps. Maximum value recorded.</td><td>Walking as fast as possible within 6 min</td><td>Step (2)
Informing the participants about his results.</td></tr>
<tr><td>Step (3)
Confirming the inclusion and exclusion criteria.</td><td colspan="5">Assessment of general physical activity and exercising status</td><td>Step (3)
Thanking the participants.</td></tr>
</table>

Statistical Analysis

All collected data were entered into SPSS (Version 23) for processing and statistical analysis. Descriptive statistics—including means, standard deviations, and percentages—were computed to summarize participant demographics and key outcome variables. Differences between smokers and non-smokers were assessed using an independent samples t-test, with 95% confidence intervals reported. For variables related to exercise status, risk difference (RD) and risk ratio (RR) with corresponding 95% confidence intervals were calculated. A two-tailed p-value < 0.05 was considered indicative of statistical significance.

Results

This study examined the association between cigarette smoking and selected indicators of physical fitness among male students at Ahlia University, Kingdom of Bahrain. Forty-one participants aged 18–26 years (mean age = 20.44 ± 2.26 years) were enrolled. Participants were divided into two groups based on smoking status. The smoker group (n = 20) met the inclusion criteria for regular smoking as defined by frequency and duration (Bothmer et al., 2002; White & Hayman, 2004) and had an average smoking history of 5 ± 1.9 years. The non-smoker group (n = 21) comprised individuals who had never smoked (White & Szabo, 2002).

Body Mass Index (BMI)

The average BMI values for smokers' group and non-smokers group were 24.520 & 25.566 (kg/m^2) respectively. There was no significant difference (P > 0.05) between smokers and non-smokers, as presented in Table (2) and Figure (1).

Table 2: Results of BMI in both groups.

BMI	Mean (kg/m^2)	SD	P value
Smokers (n = 20)	24.5	5.6	0.545
Non-smokers (n = 21)	25.6	5.1	

Significant value if p<0.05.

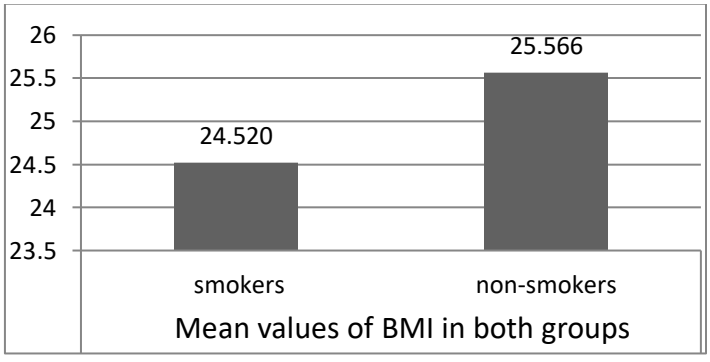

Figure 1. BMI scores in smokers and non-smokers.

Forced Vital Capacity (FVC)

The average FVC values for smokers' group and non-smokers group were 4717.5& 4754.76 mL respectively. There was no significant difference (P > 0.05) between smokers and non-smokers, as presented in Table (3) and Figure (2).

Table 3: Results of FVC in both groups.

FVC	Mean (ml)	SD	P value
Smokers (n = 20)	4717.5	105.1	0.885
Non-smokers (n = 21)	4754.8	75.2	

Significant value if p<0.05

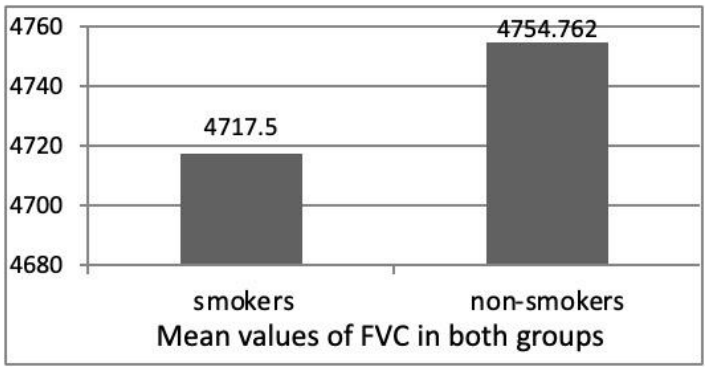

Figure 2. FVC mean scores in smoker and non-smoker.

Six-Minute Walk Test (6MWT)

The average 6MWT values for smokers' group and non-smokers group were 572.205 & 604.257 meters respectively. There was no significant difference (P > 0.05) between smokers and non-smokers, as presented in Table (4) and Figure (3).

Table 4: Results of 6MWT in both groups

6MWT	Mean	SD	P value
Smokers (n = 20)	572.2	105.1	0.278
Non-smokers (n = 21)	604.3	75.2	

Significant value if p<0.05.

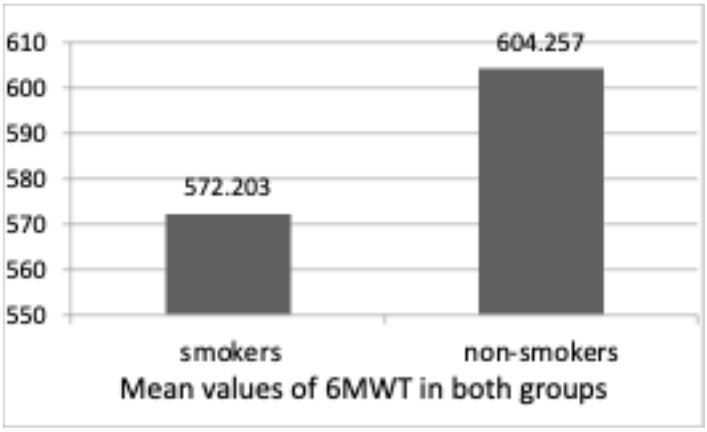

Figure 3. 6MWT mean scores in smoker and non-smoker.

General Physical Activity and Exercise Status

Smokers group: Out of 20 participants in this group, 10 (50%) had never exercised, 3 (15%) had occasional exercise, and 7 (35%) had regular planned exercising, as presented in Figure (4).

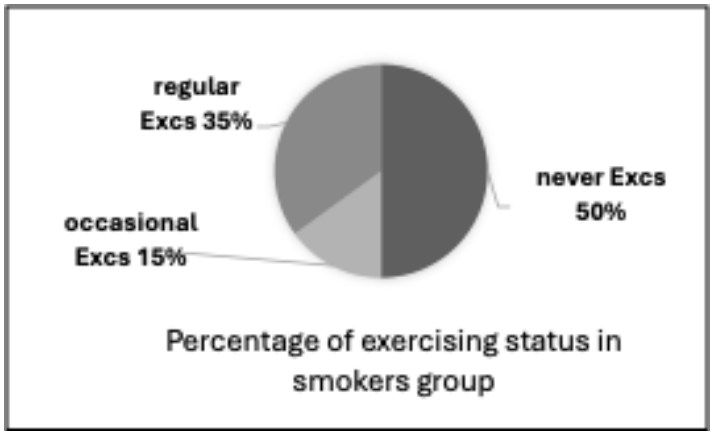

Figure 4. Percentage of exercising status in smoker.

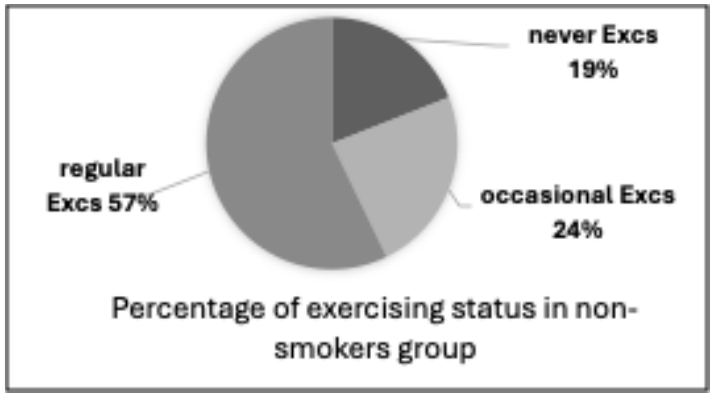

Figure 5. Percentage of exercising status in non-smoker.

Non-smokers group: Out of 21 participants in this

group, 4 (19%) had never exercised, 5 (24%) had occasional exercise, and 12 (57%) had regular planned exercising, as presented in Figure (5).

According to previous statistics that described the physical activity and exercising status, non-smokers were more likely to be physically active compared to smokers.

Discussion

The present study examined the association between cigarette smoking and selected components of health-related physical fitness—body mass index (BMI), forced vital capacity (FVC), and six-minute walk test (6MWT)—among 41 male students aged 18–26 years at Ahlia University. Participants were divided into smokers (n = 20) and non-smokers (n = 21). No statistically significant differences were observed between smokers and non-smokers for BMI, FVC, or 6MWT performance ($p = 0.545$, 0.885, and 0.278, respectively).

Several factors may contribute to the absence of significant differences in the measured outcomes. The sample size was relatively small as it was pilot study. In addition, occasional and daily smokers were combined into a single category, potentially diluting group differences. Furthermore, the age range (18–26 years) as confined to the university students may mean that participants had not yet experienced the longer-term health impacts of smoking.

The broader literature presents mixed findings regarding the impact of smoking on physical fitness. Recent studies indicate that smokers generally have lower fitness levels compared to non-smokers. Kim et al. (2021) found that smoking was associated with reduced physical fitness among adults, while Lyu et al. (2023) reported that higher recreational physical activity levels are inversely associated with smoking behavior. Similarly, Müller et al. (2024) observed that physically active individuals are less likely to be current smokers.

However, young adults with limited smoking history may not yet show measurable declines in pulmonary function or functional capacity. The CARDIA study (Lee et al., 2017) demonstrated that cardiorespiratory fitness in young adulthood helps preserve lung health over time, even in individuals exposed to smoking, suggesting that early smoking may not immediately manifest as measurable decrements in FVC or endurance tests such as the 6MWT.

In the present study, descriptive data on physical activity and exercise habits indicate that non-smokers were more likely to engage in regular planned exercise compared to smokers, consistent with prior findings that smoking is generally associated with lower levels of physical activity (Jeon & Kim, 2020; Lyu et al., 2023; Müller et al., 2024).

Taken together, these results suggest that, among young adults with relatively short smoking histories, measurable differences in BMI, pulmonary function, or functional endurance may not yet be apparent. Nevertheless, lifestyle behaviors such as exercise participation already differ between smokers and non-smokers, highlighting the potential long-term consequences of smoking on overall physical fitness. Future research with larger, more diverse populations, longer smoking histories, and more sensitive measures of cardiopulmonary and functional fitness is warranted to clarify the relationship between smoking and physical fitness across the lifespan.

Comparison with Recent Evidence and Mechanistic Insights

Recent studies confirm that smoking negatively influences aerobic capacity, muscular strength, and respiratory function, with effects intensifying over time and reversing after cessation (Su et al., 2020; Bernaards et al., 2003). Mechanisms include endothelial dysfunction, impaired oxygen exchange, and mitochondrial inhibition, explaining consistent deficits across fitness domains.

Strengths and Limitations

The study focused on a well-defined, homogeneous population of young male university students, minimizing confounding variables related to age, sex, or occupational differences. Multiple measures of health-related physical fitness (BMI, FVC, 6MWT) were included, providing a multidimensional assessment. Updated and standardized procedures were followed for anthropometry, spirometry, and functional testing, ensuring data reliability.

This study was limited to a small sample size (n = 41) limited statistical power and may have contributed to non-significant findings. Combining occasional and daily smokers into a single group may have diluted potential differences in outcomes. Cross-sectional design limits causal inference between smoking and physical fitness outcomes. The sample included only male participants, which limits the generalizability of the findings to broader populations.

Implications for Future Research

Larger, longitudinal studies are needed to assess the long-term impact of smoking on physical fitness across different age groups. Stratifying participants by smoking intensity, duration, and type (occasional vs. daily) could provide more precise insight into dose-response relationships. Incorporating additional measures of cardiopulmonary and muscular fitness (e.g., VO_2-max, strength tests) may improve sensitivity to early foundation for more comprehensive future research.

Future recommendations

There is a deficiency in the studies that investigate the effects of smoking on physical fitness, and there are no studies done in Bahrain, the few available literatures are controversial, so it is recommended to do more studies supporting this topic. Further studies are recommended to recruit larger samples from both genders and from different places aside from university students to obtain more accurate results that can be generalized. Further studies are recommended to assess the effects of smoking on health via measuring other parameters such as muscular strength & endurance, flexibility, agility, balance, coordination, speed, and reaction time. Further studies are warranted to use another method to assess the physical activity level of the smokers compared to non-smokers by using an international, valid and reliable questionnaire such as International Physical Activity Questionnaire (IPAQ) or Global Physical Activity Questionnaire (GPAQ) or any other method. Studying the effects of exercise and physical activity on smoking cessation is strongly recommended by the current study as some literatures found positive effects in this topic.

physiological effects of smoking. Examining behavioral interventions that promote physical activity among young smokers may help mitigate long-term adverse effects.

Conclusion

The present study examined the relationship between cigarette smoking and selected health-related physical fitness components among young adult male students. No statistically significant differences were observed between smokers and non-smokers in BMI, forced vital capacity (FVC), or six-minute walk test (6MWT) performance. However, non-smokers were more likely to engage in regular physical activity, suggesting that lifestyle behaviors may diverge even when short-term physiological measures are unaffected. These findings indicate that, in young adults with limited smoking history, measurable declines in cardiopulmonary function or endurance may not yet manifest, but early differences in exercise habits could influence long-term health trajectories. Future studies with larger sample sizes, longer follow-up periods, and more sensitive functional assessments are recommended to further elucidate the impact of smoking on physical fitness across the lifespan (Kim et al., 2021; Lyu et al., 2023; Lee et al., 2017; Müller et al., 2024). As this investigation represents a preliminary pilot study, the results should be interpreted cautiously and viewed as a

Author Contributions

All authors significantly contributed to the work reported, including conception, study design, execution, data acquisition, analysis, and interpretation. They actively participated in drafting, revising, or critically reviewing the manuscript, provided final approval of the version to be published, agreed on the journal submission, and accepted accountabilities for all aspects of the work.

Ethical Approval and Patient Consent

Approval for this research was provided by the institutional ethics committee prior to data collection. All participants consented voluntarily after being informed of the study procedures. Measures were implemented to ensure confidentiality, with data securely maintained and accessible exclusively to the research team.

Data Availability Statement

The authors will transparently provide the primary data underpinning the findings or conclusions of this article, without any unjustified reluctance. If need from editorial team.

Funding

The author/s have not received any funding for. This study.

Conflicts of Interest

The authors declare no potential conflicts of interest in this study.

Declaration of generative AI and AI-assisted technologies

The author utilized AI tools to enhance the language quality and address any grammatical issues while preparing the manuscript. Following the use of this tool, the author carefully reviewed and edited the content as necessary and assumes full responsibility for the accuracy and integrity of the published work.

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