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TRACKING PHYSICAL ACTIVITY IN HEALTH STUDENTS: THE ROLE OF WEARABLE DEVICES: A CROSS-SECTIONAL STUDY

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Abstract

Background: Regular physical activity is essential for maintaining health; however, many university students encounter barriers that limit their participation. Understanding these factors is crucial for developing targeted interventions. **Aim:** The study aims to track physical activity in health students and evaluate the role of wearable devices in enhancing their activity levels. **Methods:** A cross-sectional study was conducted among 400 students. Data on socio-demographics, BMI, chronic illness, physical activity participation, barriers, and smartwatch usage were collected using structured questionnaires. Statistical analyses, including chi-square tests and logistic regression, were performed to examine associations and predictors of physical activity**. Results:** The mean age of participant was 21.7 ± 9.109 years, with 82% being male. Normal BMI was found in 60.5% of students, while 10% reported chronic illnesses. Only 42.5% engaged in regular physical activity, with poor time management (35.5%) and lack of motivation (15.6%) being the main barriers. More than half (58.5%) used smartwatches for activity tracking. Significant associations were found between physical activity and age ($p < 0.001$), gender ($p < 0.001$), income ($p < 0.001$), BMI ($p < 0.001$), and chronic illness ($p < 0.001$). Males, students with normal BMI, and those with sufficient income were more likely to participate in physical activity. Logistic regression identified BMI and gender as significant predictors of physical activity, while income and BMI predicted smartwatch usage. **Conclusion:** A significant proportion of students do not engage in regular physical activity, with time constraints and motivation being key barriers. Smartwatch usage is relatively high, indicating its potential as a tool to promote activity. Targeted interventions, including time management strategies, motivational programs, and increased access to exercise facilities, are recommended to improve physical activity levels among university students.

Keywords: Physical Activity, Healthy Students, Wearable Devices.

INTRODUCTION

A lack of physical activity (PA) increases the risk of negative health outcomes and reduces life expectancy, making PA a crucial component of healthy living **(Alasqah, Mahmud, East, Alqarawi, & Usher, 2021).** According to the World Health Organization (WHO), children and adolescents (aged 5–17) should engage in 60 minutes of moderate-to-vigorous physical activity daily. They should also participate in activities that strengthen their bones and muscles at least

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three times a week. Inadequate physical exercise is the fourth leading cause of non-communicable diseases (NCDs) **(World Health Organization, 2020).**

Over the last several decades, the Kingdom of Saudi Arabia has undergone significant changes in its economy, lifestyle, population, and level of urbanization. These changes have negatively impacted the population's behavior, contributing to increased sedentary habits and physical inactivity. Consequently, the prevalence of NCDs linked to unhealthy lifestyle choices, such as obesity, diabetes, heart disease, and high blood pressure, has risen dramatically. This shift in lifestyle is a major contributor to this trend **(Munawir Alhejely, 2023).**

Despite a strong body of research supporting the role of PA in reducing chronic NCDs, a significant portion of the Saudi population remains inactive. Research indicates that around 78% of Saudi adult women and 78.1% of teenage girls are inactive. This high level of physical inactivity presents a serious public health challenge in Saudi Arabia. The population attributable fraction (PAF) for all-cause mortality related to physical inactivity is estimated to be 18.4%. This proportion could be significantly reduced if all sedentary individuals engaged in recommended levels of physical exercise. Furthermore, the PAF is much higher than the median for the Eastern Mediterranean Region (12.5%) and the median for all WHO regions (9.4%) **(Hazazi & Wilson, 2022).**

Approximately 1.71% of Saudi Arabia's total healthcare expenditures are attributable to a lack of physical exercise **(Samarkandi, 2022).** It is essential to eliminate obstacles to physical activity to encourage active lifestyles, combat inactivity, and reduce healthcare costs. According to a WHO report 2020, various barriers related to social, cultural, and architectural contexts contribute to global inactivity. These include safety concerns due to high traffic, poor air quality, and a lack of proper amenities like parks and exercise spaces. Other factors, such as age, financial constraints, time limitations, lack of motivation, and health issues, also contribute to lower levels of physical activity among adults. Furthermore, individuals from families with lower incomes are less likely to meet physical activity standards, indicating that family income is a significant factor in the prevalence of physical inactivity **(Albujulaya, Stevinson, & Piggin, 2023).**

A comprehensive meta-analysis of 23 trials found that cardiovascular disease risk decreases with increasing levels of physical activity. Inadequate physical activity is linked to about 6% of the world's coronary heart disease, 7% of type 2 diabetes, and 10% of breast and colon cancer burdens. In 2008, inadequate physical activity was responsible for approximately 5.3 million deaths worldwide, accounting for 9% of early mortality. A further finding from 2018 by the WHO indicated that over 80% of 11–17-year-olds were not physically active enough **(Anderson & Durstine, 2019).**

Health-enhancing physical activity refers to any activity that improves health and functional capabilities without causing injury or danger. This term encompasses all forms of human activity, including cycling, vigorous hobbies, competitive sports, and everyday physical tasks **(National Institute on Aging, 2025)**. Regular exercise offers numerous health benefits, such as lowering the risk of obesity, improving mental health by reducing anxiety and depression,

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and strengthening bones and muscles **(Anderson & Durstine, 2019; Mostafa, Harfoush, et al., 2025).**

A person's level of regular physical exercise in adulthood is significantly influenced by their behaviors in childhood and adolescence. Physical environments impact accessibility and availability, but social, economic, and cultural factors also play crucial roles in determining opportunities for PA **(Shao & Zhou, 2023).**

Health education initiatives in Saudi Arabia have raised public awareness of the benefits of physical activity, leading to a recent uptick in its popularity. However, challenges remain, such as reliance on cars over public transport, busy lifestyles, cultural values, and the availability of vehicles. Despite extensive literature on PA in other countries, there is limited knowledge regarding its prevalence in Saudi Arabia. This research focuses on the physical activity levels of medical students at Qassim University, particularly in light of their hectic schedules **(Zain et al., 2023).**

To encourage active living and decrease inactivity in the population, it is essential to identify and remove obstacles to PA. Environmental issues, including a lack of proper exercise areas, sports facilities, walkways, and parks, as well as fears related to violence, high-density traffic, and poor air quality, contribute to the global inactivity crisis attributed to urbanization. Additionally, family income impacts physical inactivity; those with lower incomes are less likely to meet PA recommendations. In developed countries, barriers include aging and insufficient time **(Boakye et al., 2023).**

This comprehensive research examines the levels of PA and inactivity among the Saudi population within the context of rapid economic development. Studies indicate that most Saudi children, teenagers, and adults do not engage in the recommended amount of PA, with girls being less active than boys from elementary school onward. Factors such as increasing urbanization, heavy traffic, harsh weather, cultural barriers, social isolation, lack of female school PA programs, inadequate time and resources, and general lack of motivation contribute to Saudi Arabia's high rate of inactivity. Promoting PA and discouraging sedentary behaviors is essential to reducing the prevalence of NCDs in the country **(Al-Hazzaa, 2018).**

Although the benefits of PA are well-documented, encouraging those who do not exercise to start and maintain a program can be challenging. Therefore, it is crucial for Saudis to make PA opportunities more accessible in their communities, workplaces, and schools. Records of previous PA programs promoting healthy living in the country are surprisingly scarce. This review aims to address this knowledge gap and provide a foundation for future Saudi public health policies and programs aimed at combating physical inactivity and promoting active living. The current research also seeks to assess medical students' understanding of the benefits of physical exercise and their self-reported patterns of physical activity in the Qassim area of Saudi Arabia.

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RESEARCH METHODOLOGY

Aim: The study aims to track physical activity in health students and evaluate the role of wearable devices in enhancing their activity levels.

Research Question

- What is the impact of wearable devices on the physical activity levels of health students?
- How do these devices influence their engagement in regular exercise?

MATERIAL AND METHODS

Study Design: A cross-sectional research design was conducted.

Setting: The study focused on university students in the Qassim region of Saudi Arabia.

Study Population and Sampling: The study targeted both male and female university students enrolled in various academic disciplines. A total of 400 students were recruited using convenience sampling. Inclusion criteria included current enrollment at a university in the Qassim region and the provision of informed consent to participate. Students with severe disabilities or cognitive impairments that could hinder their ability to respond to the questionnaire were excluded from the study.

Data Collection Tool: A structured, self-administered questionnaire was developed and validated to collect data on several domains, including sociodemographic characteristics (age, gender, income), health-related factors (body mass index [BMI], presence of chronic illnesses), physical activity participation (frequency, duration, and regularity), perceived barriers to physical activity (e.g., time constraints, motivation), and the use of wearable devices (smartwatches) for tracking physical activity. To ensure clarity and reliability, the questionnaire was piloted on a small sample of students (n=30) prior to full administration.

Data Collection Procedure: Data were collected over a two-month period. Participants were approached in various college settings (e.g., classrooms, cafeterias, recreational areas) and invited to complete the questionnaire. Height and weight were self-reported to calculate BMI. All data were anonymized, and confidentiality was ensured throughout the research process.

Ethical Considerations: Ethical approval was obtained from the relevant Institutional Review Board (IRB) before initiating the study. Participants were informed about the study's purpose, and informed consent was obtained from all respondents. Participation was voluntary, and respondents could withdraw at any time.

Data Analysis: Data were coded and entered into the Statistical Package for the Social Sciences (SPSS), version 25. Descriptive statistics (means, standard deviations, frequencies, and percentages) were used to summarize participant characteristics and responses. Chi-square tests were employed to examine associations between physical activity participation and independent variables (e.g., age, gender, BMI, income, chronic illness). Binary logistic regression analysis was conducted to identify significant predictors of physical activity and smartwatch usage. A p-value of less than 0.05 was considered statistically significant.

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RESULTS

Table 1: Distribution of students according to socio-demographic characteristics.

Socio demographic data	Total (No =400)	Percent (%)
Age classes		
• 18-20 years	242	60.5
• 20-22 years	68	17.0
• 22-25 years	90	22.5
Mean ± SD = 21.7± 9.109 years		
Gender distribution		
• Females	72	18.0
• Males	328	82.0
Income		
• Sufficient	240	60.0
• Insufficient	40	10.0
• Sufficient and save	120	30.0

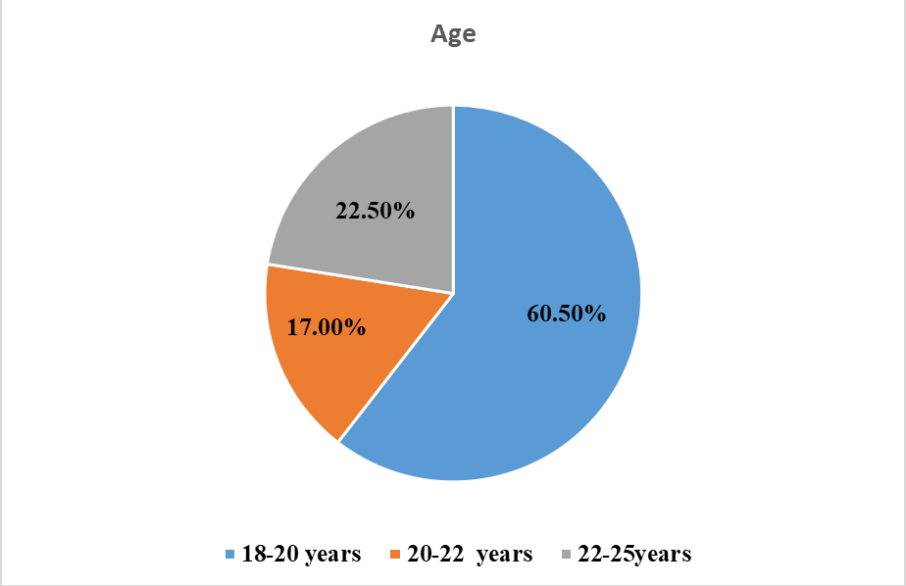

Figure 1: Distribution of students according to age

Table 1 ang figure 1 Illustrates socio-demographic characteristics of the 400 students interviewed in Qassim region. The table shows that age, ranged from 18 to 25 years with (Mean ±SD 21.7± 9.109 years). The table indicates that less than two thirds (60.5%) students were 18-20 years, less than one fifth (17.0%) of them were 20-22 years and less than one quarter (22.5%) of them were 22-25 years.

The table shows that more than three quarters (82.0 %) of students were male and less than one fifth (18.0%) were males. Less than two thirds (60.0%) of students felt that their income is sufficient to meet their needs, more than one quarters (30.0%) of them felt that their income is Sufficient and save, and only 10.0% of students felt that their income is Insufficient

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Table 2: Distribution of the studied sample (n=400) according to their health-related data

Health Related Data	Total (No =400)	%
Body Mass Index (BMI)		
• Normal weight (18.5–24.9 kg/m²)	242	60.5
• Overweight (25.0–29.9 kg/m²)	130	32.5
• Obese (34.9- 30 kg/m²)	20	5.0
• Obese grade 1 (≥35)	8	2.0
Mean ±SD	**27.2±6.918**	
Chronic illness		
• Yes	40	10.0
• No	360	90.0

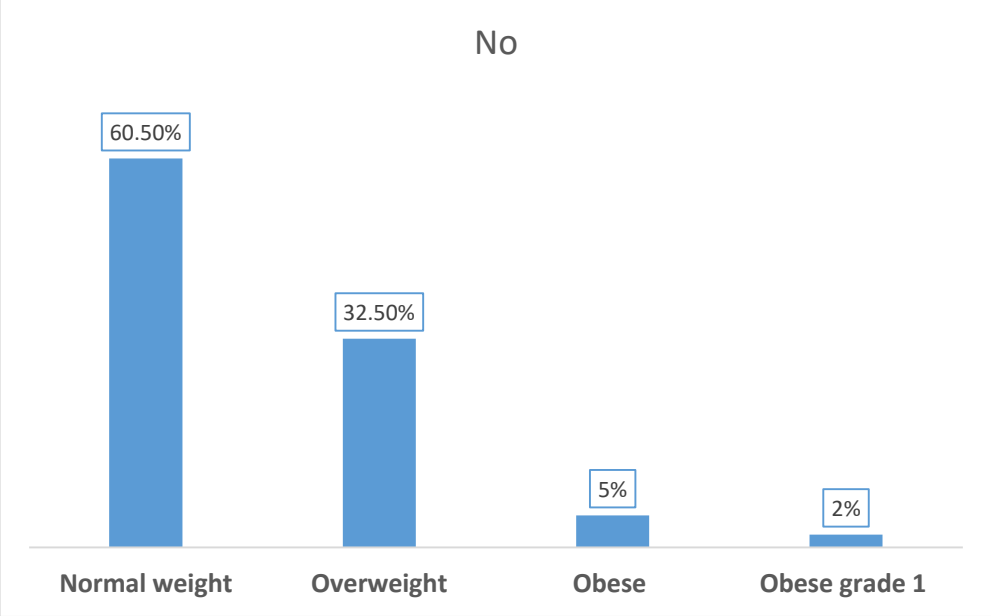

Figure 2: Distribution of the studied sample (n=400) according to Body Mass Index (BMI)

Table 2 figure 2 indicates that the Mean and SD body mass index (BMI) was 27.2±6.918 of the total patients interviewed 60.5% had normal weight for height and 32.5% overweight, 5.0% were obese and Only 2.0% were obese grade 1.

Table 2: illustrate that one tenth (10.0%) of students admitted that they suffer from other chronic diseases.

Table 3: Distribution of the studied sample (n=400) according to their Prevalence of participation in regular physical activity

Prevalence of participation in regular physical activity	Frequency No. = 400	Percentage (%)
• Participation in regular physical activity	170	42.5
• Lack of regular physical activity	230	57.5

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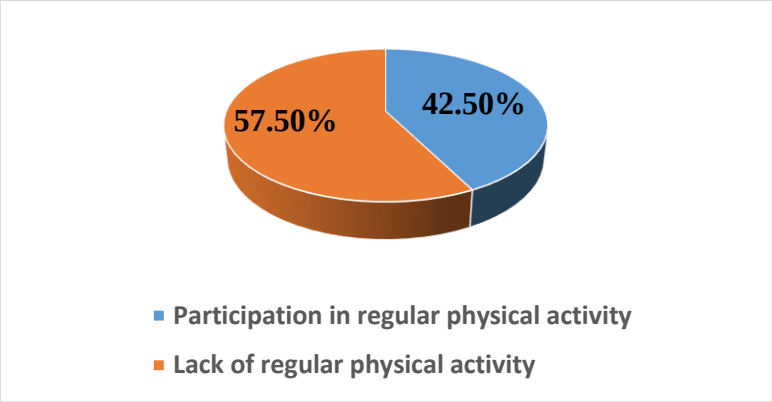

Figure 3: Distribution of the studied sample (n=400) according to their Prevalence of participation in regular physical activity

Table 3 and figure 3 shows the responses of students as regards the prevalence and barriers of participation in regular physical activity. Less than half (42.5%) students had a participation in regular physical activity among participants. While more than half (57.5%) of them had lack of participation in regular physical activity.

Table 4: Distribution of the studied sample according to their knowledge and Barriers about benefits of regular physical activity

Knowledge about benefits of regular physical activity #	**No. = 466**	
• Improve physical fitness	200	42.9
• Improve heart muscle strength	92	19.7
• Improve physical and mental health	74	15.9
• Improve blood circulation	40	8.6
• Resist diseases	60	12.9
Barriers of participation in regular physical activity #	**No. = 230**	
• Poor time management	210	35.5
• Lack of motivation and desire	92	15.6
• Conflict with study	67	11.3
• Lack of allowed places	110	18.7
• Conflict with family duties	42	7.1
• Obesity/pain/weather	70	11.8

Table 4 illustrate that the distribution of students who had Knowledge about benefits of regular physical activity (n=170) according to the whole student participated in the study.

Student response about knowledge about benefits of regular physical activity showed that less than half of students (42.9%) believed that regular physical activity improves physical fitness, less than one fifth (19.7%) reported improve heart muscle strength, more than one tenth (15.7%, 12.9%) believed that regular physical activity improves improve physical and mental health, and Resist diseases while, less than one tenth (8.6%) that improve blood circulation

Student response about the barriers for participation in regular physical activity showed that more than one third (35.5%) indicated the Poor time management as main barrier, (15.6%)

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showed lack of motivation and desire barrier, smaller percentage of participant (11.3%) considered conflict with study as barrier. (18.7%) participants indicated lack of allowed places as a barrier of regular physical activity, (7.1%) mentioned conflict with family duties as a barrier and (11.8%) indicated Obesity/pain/weather as other barriers

Table 5: Distribution of students according to uses a smart watch to help you increase your physical activity and monitor vital signs

Smart watch Use to increase physical activity and monitor vital signs	Frequency	%
• Smart watch use	234	58.5
• None use Smart watch	166	41.5

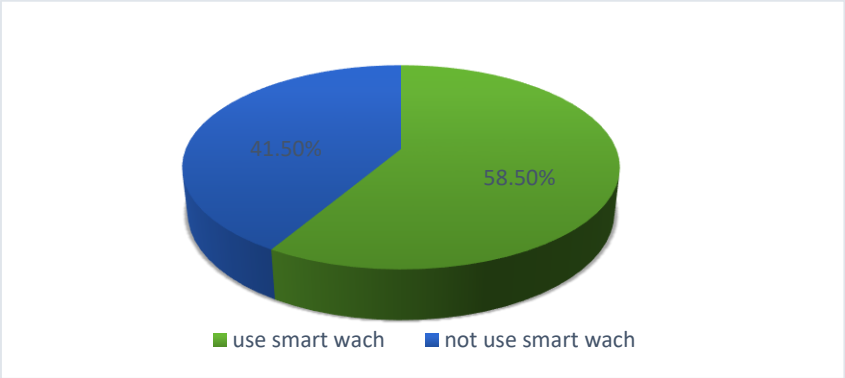

Table 5 and figure 4 illustrate that More than half (58.5%) of student use smart watches to help to increase physical activity and monitor vital signs

Table 6: Association between participation in regular physical activity and subject characteristics

	Participation in regular physical activity			χ^2	p -value
	Yes No. = 170	No No. = 230	Total 400		
Age					
• 18-20 years	74 (43.5%)	168(73.0%)	242(60.5%)	36.792	0.000*
• 20-22 years	38(22.4%)	30(13.1%)	68(17.0%)		
• 22-25 years	58 (34.1%)	32(13.9%)	90(22.5%)		
Gender					
• Female	56 (32.9%)	16(7.0%)	72(18.0%)	44.716	0.000*
• Male	114 (67.1%)	214(93.0%)	328(82.0%)		
Income					
• Sufficient	130 (76.5%)	110(47.8%)	240(60.0%)	36.828	0.000*
• Insufficient	15(8.8%)	25(10.9%)	40(10.0%)		
• Sufficient and save	25(14.7%)	95(41.3%)	120(30.0%)		
BMI					
• Normal weight	114 (67.1%)	128(55.7%)	242 (60.5%)	29.976	0.000*
• Overweight	35 (20.6%)	95 (41.3%)	130 (32.5%)		
• Obese	17 (10.0%)	3(1.3%)	20(5.0%)		
• Obese grade 1	4 (2.3%)	4(1.7%)	8 (2.0%)		

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Table 6 indicate that the statistically significant differences are observed between regular physical activity and their age (X^2 = 36.792, P = 0.000). Less than half (43.5%) of students who were 18–20 years old were regular physical activity, compared to 22.4% of those who were 20–22 years old and 34.1% of students who were 22–25 years old. On the other hand, around two-thirds (73.0%) of students who were 18–20 years old had no participated in regular physical activity, compared to 13.9% of those who were 22–25 years old, and only 13.1% of students were 20–22 years old.

Statistically significant differences are observed between gender and regular physical activity (X^2 = 44.716, P = 0.000). More than two-thirds of subjects who were males (67.1%) and females (32.9%) had participation in regular physical activity. Most subjects (93.0%) who were female, compared to 7.0% of those who were female, hadn't participation in regular physical activity.

Statistically significant differences are observed between income and participation in regular physical activity (X^2 = 36.828, P = 0.000). The majority of subjects who claimed that their income was sufficient (76.5%) or sufficient and save (14.7%) and not enough (8.8%) had participation in regular physical activity. On the other hand, more than half (41.3%) of those who claimed that their income was enough to meet their needs and save or less than one-third (41.3%) were sufficient or more than a tenth (10.9) were insufficient but hadn't participation in regular physical activity

Statistically significant differences are observed between participation in regular physical activity, and their body mass index (X^2 = 29.976, P = 0.003). More than three quarters of students (67.1%) who had normal weight were participation in regular physical activity, compared to 20.6% of those who were overweight, 10.0% of students were obese, and 2.3% were obese grade 1. On the other hand, more than half of students (55.7%) who had normal weight, compared to 41.3% of those who were overweight, 1.3% of students who were obese, and 1.7% of students who were obese in grade 1, had not participation in regular physical activity

Table 7: Association between participation in regular physical activity and chronic illness

Chronic illness	Participation in regular physical activity			Fisher Exact test	p -value
	Yes No= 170	No No = 230	Total NO = 400		
Yes	36 (21.2%)	4 (1.7%)	40 (10.0%)	41.0344	0.0000*
No	134 (78.8%)	226 (98.3%)	360 (90.0%)		

χ^2: Chi- squared value p value: Probability value NS: Non-Significant

Table 8 illustrate that statistically significant differences are observed between participation in regular physical activity and their chronic illness (X^2 = 41.0344, P = 0.000). The majority of students who did not have a chronic disease (78.8%) were participation in regular physical activity, compared to 21.2% of those who had a chronic illness. On the other hand, the majority of students who have a chronic disease (98.3%) were not participation in regular physical activity, compared to 1.7% of those who hadn't a chronic illness.

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Table 8: Association between Smart watch use and subject characteristics

	Smart watch uses			χ^2	p -value
	Yes No. = 234	No No. = 166	Total 400		
Age					
• 18-20 years	134(57.3%)	108(65.1%)	242(60.5%)	15.247	0.004*
• 20-22 years	54(23.1%)	14(8.4%)	68(17.0%)		
• 22-25 years	46(19.6%)	44(26.5%)	90(22.5%)		
Gender					
• Female	64(27.4%)	8(4.8%)	72(18.0%)	33.3998	0.000*
• Male	170(72.6%)	158(95.2%)	328(82.0%)		
Income					
• Sufficient	191(81.6%)	49(29.5%)	240(60.0%)	121.6044	0.000*
• Insufficient	20(8.5%)	20(12.1%)	40(10.0%)		
• Sufficient and save	23(9.9%)	97(58.4%)	120(30.0%)		
BMI					
• Normal weight	144(61.5%)	98(59.0%)	242 (60.5%)	18.3048	0.003*
• Overweight	100(42.8%)	30(18.1%)	130(32.5%)		
• Obese	18(7.7%)	2(1.2%)	20(5.0%)		
• Obese grade 1	7(3.0%)	1(0.6%)	8 (2.0%)		

Statistically significant differences are observed between smartwatch use, and their age (X^2 = 15.247, P = 0.004). More than half of students (57.3%) who were 18–20 years old use smartwatches, compared to 23.1% of those who were 20–22 years old and 19.6% of students who were 22–25 years old. On the other hand, around two-thirds (65.1%) of students who were 18–20 years old had no smartwatch, compared to 26.5% of those who were 22–25 years old, and only 8.4% of students were 20–22 years old.

Statistically significant differences are observed between gender and smartwatch use (X^2 = 33.399, P = 0.000). More than two-thirds of subjects who were males (72.6%) and females (27.4%) had used smartwatches. Most subjects (95.2%) who were female, compared to 4.8% of those who were female, hadn't used smartwatches for monitoring and participation in regular physical activity.

Statistically significant differences are observed between income and smartwatch use (X^2 = 121.604, P = 0.000). The majority of subjects who claimed that their income was sufficient (81.6%) or sufficient and save (9.9%) and not enough (8.5%) had used smartwatches. On the other hand, more than half (58.4%) of those who claimed that their income was enough to meet their needs and save or less than one-third (29.5%) were sufficient or more than a tenth (12.1) were insufficient but hadn't used smartwatches for monitoring and participation in regular physical activity.

Statistically significant differences are observed between smartwatch use, and their body mass index (X^2 = 18.3048, P = 0.003). More than half of students (61.5%) who had normal weight were using smartwatches, compared to 42.8% of those who were overweight, 7.7% of students were obese, and 3.0% were obese grade 1. On the other hand, more than half of students (59.0%) who had normal weight, compared to 18.1% of those who were overweight, 1.2% of

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students who were obese, and 0.6% of students who were obese in grade 1, had not used the smartwatch for monitoring and participation in regular physical activity.

Table 9: Association between participation in regular Smart watch use

Chronic illness	Smart watch use			Fisher Exact test	p - value
	Yes No= 234	No No = 166	Total NO. = 400		
Yes	39 (16.7%)	1(0.6%)	40 (10.0%)	27.844	0.000*
No	195 (83.3%)	165 (99.4%)	360 (90.0%)		

χ^2 : Chi- squared value p value: Probability value NS: Non-Significant

Statistically significant differences are observed between smartwatch use and their chronic illness (X^2 = 27.844, P = 0.000). The majority of students who did not have a chronic disease (83.3%) were using smartwatches, compared to 16.7% of those who had a chronic illness. On the other hand, the majority of students who have a chronic disease (90.0%) were not using smartwatches, compared to 10.0% of those who hadn't a chronic illness.

Table 9: Predictors of participation in regular physical activity

	Multivariate analysis			
Variables	***Odds ratio***	***95% CI***	***p-value***	***Sig***
Age			**0.31**	**NS**
• 20-22 years	0.78	0.39-1.49	0.43	
• 22-25 years	0.62	0.32-1.11	0.63	
Gender				
• Female	0.74	0.41.1.69	0.51	
• Male	1.83	1.85-3.20	0.03*	**S**
Weight			**0.000***	**S**
• Overweight	1.96	1.13-3.52	0.04*	S
• Obese	23.19	5.81-107.25	0.008	S
• Grade 1	2.81	1.53-3.76	0.03*	S
Income			**0.211**	**NS**
• Sufficient	1.55	1.14	0.02*	S
• Insufficient	1.75	1.38	0.07	NS
• Sufficient and save	1.77	1.91	0.01*	S
Chronic illness (yes)	2.86	0.84-9.99	**0.07**	**NS**

CI: Confidence interval p value: Probability value S: Significant NS: Non significant

A Binary logistic regression was performed to determine the variables that can predict participation in regular physical activity.

Weight and gender (male) were significant predictors for participation in regular physical activity while age and chronic illness were not a significant predictor for participation in regular physical activity among participants.

Subjects with overweight were 1.96 times more likely to participate in regular physical compared with subjects with normal weight (Odds Ratio = 1.96, 95% CI 1.13-3.52, p = 0.000*).

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\Subjects with income sufficient were 1.55 times more likely to participate in regular physical compared with subjects with sufficient and save (Odds Ratio = 1.96, 95% CI 1.14, p = 0.002*).

Table 10: Predictors of use smart watch during physical activity

Variables	*Multivariate analysis*			
	Odds ratio	*95% CI*	*p-value*	*Sig*
Age				
• 18-20 years	0.81	0.41-1.59	0.53	**NS**
• 20-22 years	0.63	0.34-1.14	0.13	**NS**
• 22-25 years	0.71	035-1.66	0.12	**NS**
Gender				
• Female	0.74	0.41.1.69	0.51	
• Male	1.83	1.05-3.20	0.03*	**S**
Income				
• Sufficient	1.75	1.04	0.01*	**S**
• Insufficient	1.95	1.33	0.12	**NS**
• Sufficient and save	1.87	1.41	0.001*	**S**
BMI				
• Overweight	1.3	1.43-3.72	0.01*	**S**
• Obese	1.96	1.03-2.62	0.02*	**S**
• Obese grade 1	2.81	1.53-3.76	0.03*	**S**
Chronic illness (yes)	2.96	0.87-9.99	0.08	**NS**

CI: Confidence interval p value: Probability value S: Significant NS: Non significant

A Binary logistic regression was performed to determine the variables that can predict participation in using smart watches during physical activity. Gender was a significant predictor for participation in regular physical activity. Male subjects were 1.05 times more likely to use a smartwatch to monitor and participate in regular physical activity compared with female subjects (Odds ratio = 1.83, 95% CI 0.1.05-3.20, p = 0.03).

Income was a significant predictor for participation in regular physical activity, while income was a significant predictor for the use of smartwatches and monitoring, participation in regular physical activity among participants (odds ratio = 1.75, 95% CI 1.04, p = 0.01). Subjects with obesity were times more likely to participate in regular physical activity compared with subjects with normal weight (Odds Ratio = 1.3, 95% CI 2.03-144.53, p = 0.001).

DISCUSSION

The findings of the present study align with and expand upon existing research regarding physical activity (PA) patterns, barriers, and the role of wearable technology among university students. Our results indicate that only 42.5% of students in the Qassim region engage in regular PA, with poor time management (35.5%) and lack of motivation (15.6%) identified as the most significant barriers. These results reflect global trends where university students, despite recognizing the health benefits of PA, often struggle to maintain consistent activity

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levels due to academic and lifestyle constraints **(Ráthonyi et al., 2021; Alkhawaldeh et al., 2024).**

The observation that less than half of students meet recommended PA levels mirrors findings from Hungary **(Alkhawaldeh et al., 2024)**, Portugal **(Clemente et al., 2016)**, and Poland **(Michalčíková et al., 2020)**, where students frequently fail to achieve the target of 10,000 steps per day. Notably, similar to the Hungarian study, we found that body mass index (BMI) significantly influenced PA participation, with overweight and obese students being less active. This highlights the urgent need for targeted interventions that address weight management in conjunction with promoting PA.

Time constraints emerged as a major barrier in our study, corroborating findings from other research **(Ráthonyi et al., 2021; Clemente et al., 2016; Michalčíková et al., 2020),** particularly during exam periods **(Alkhawaldeh et al., 2024)** and weekends **(Clemente et al., 2016; Michalčíková et al., 2020).** For instance, the Hungarian study reported a significant decline in steps during exams, while Portuguese students were notably more sedentary on weekends. This suggests that academic workloads and unstructured weekend time present universal challenges to maintaining an active lifestyle among students.

Additionally, our study identified gender and income as significant predictors of PA, with males and higher-income students demonstrating greater activity levels. This finding contrasts with the Hungarian study, which found no gender differences, but aligns with Portuguese data indicating that males were more active on weekdays **(Clemente et al., 2016, Hafez, et al 2024).** The discrepancy may be attributed to cultural or regional variations in PA norms. Furthermore, the relationship between income and PA in our study likely reflects access to fitness facilities and wearable devices, a factor that warrants further exploration in future research.

A noteworthy finding was that 58.5% of students utilized smartwatches for activity tracking, indicating a strong receptivity to technology-based PA monitoring. This aligns with studies that have employed devices such as Fitbit, Garmin, and MiBand **(Ráthonyi et al., 2021; Alkhawaldeh et al., 2024; Ortiz et al., 2016; Michalčíková et al., 2020),** which have demonstrated that wearables provide objective PA data and enhance self-monitoring. For example, physiotherapy students reported that wearables increased their awareness of PA, although limitations, such as inaccuracies in tracking non-step activities, were noted **(Michalčíková et al., 2020).**

Our study contributes to this body of research by demonstrating that smartwatch usage correlates positively with higher PA participation, underscoring their potential as effective intervention tools. However, while wearables show promise, their long-term efficacy hinges on user engagement. High attrition rates observed in pilot studies **(Köhler et al., 2024)** and the limitations of these devices **(Michalčíková et al., 2020)** indicate that wearables alone are insufficient. To maximize their effectiveness, complementary strategies, such as goal-setting and social support, are essential.

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CONCLUSION AND RECOMMENDATIONS

The study highlights that a substantial proportion of university students in the Qassim region are not meeting recommended levels of physical activity, with poor time management and lack of motivation identified as the most common barriers. Despite this, the relatively high usage of smartwatches suggests a promising opportunity for technology-based interventions. To address these challenges, targeted strategies should be implemented, including time management training, motivational and behavioral change programs, and improved access to exercise facilities. Furthermore, integrating wearable technology into health promotion initiatives may enhance student engagement and support sustained physical activity.

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