

Use of wearable technologies in health promotion in Human Medicine students

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Abstract

INTRODUCTION: In the current era marked by rapid technological advances, the integration of wearable devices into everyday life has been a remarkable phenomenon. These devices, ranging from smart watches to physical activity monitors, have gained popularity and have become ubiquitous tools that track various aspects of health and wellness.

OBJECTIVE: To characterize the use of wearable technologies in health promotion in Human Medicine students.

METHODS: The research is characterized by its cross-sectional and quantitative nature, with a basic and descriptive non-experimental design. The study population consisted of 128 students of Human Medicine at a private university located in Arequipa, Peru. Data collection was carried out through the use of surveys and questionnaires.

RESULTS: Regarding the adoption and use of wearable technologies, 35.94% (46) reported a moderate level, 32.81% (42) indicated a high level, while 31.25% (40) indicated a low level. This finding suggests a balanced and non-extreme adoption of wearable technologies among the students examined in the context of health promotion.

CONCLUSIONS: We were able to determine a moderate level of adoption and use of wearable technologies among Human Medicine students to promote health and wellness. This result points to the relevance of these technologies in health-related activities, highlighting a particular emphasis on a moderate level of use.

Keywords: Wearable technologies, Wearables, Health promotion, Physical activity, Healthy habits.

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1. Introduction

Medicine has undergone an unprecedented transformation in recent decades, driven by technological advances that have permeated every corner of medical care (1) (2) (3). Among these advances, wearable technologies have emerged as powerful tools with the potential to revolutionize health promotion (4) (5). In the educational context, the role of wearable technologies in health promotion among students has emerged as an area of significant interest and study (6) (7).

Student youth, as a key demographic group, are immersed in an environment that demands high levels of academic achievement and overall well-being (8) (9) (10) (11) (12). The adoption of wearable technologies among students opens up new possibilities for understanding and improving health in this environment (13) (14) (15). This study seeks to explore students' perceptions of the impact of wearable technologies on health promotion, assessing the effectiveness of these devices as tools to promote healthy lifestyles (16).

In a world where the mental and physical health of students is essential to academic and personal success, incorporating wearable technologies into the educational wellness equation presents itself as an innovative and promising strategy (17) (18) (19) (20) (21). The increasing availability and accessibility of these devices raise critical questions about how students perceive their usefulness and how these tools can effectively contribute to health improvement in the educational context (22) (23) (24) (25) (26). This study focuses not only on the technology itself, but also on how students' interaction with these tools can influence their healthy behaviors and habits (27) (28).

Wearable technologies, also known as wearables, refer to electronic devices that are worn or worn as accessories (29). These devices are designed to be worn directly on the body and typically have functionalities related to health monitoring, physical activity, connectivity and various other applications (30) (31). Common examples of wearable technologies include smart watches, fitness wristbands, smart glasses, wearables with integrated sensors, and biometric monitoring devices (32) (33).

The information collected can be analyzed through mobile applications or online platforms, giving users the ability to track their physical activity, sleep patterns, heart rate, among other aspects relevant to their health. (34). These wearable technologies have gained popularity in recent years due to their ability to provide users with detailed information about their health status and daily habits. In addition to their application in the field of health, they are also used in sports, entertainment and various areas of daily life, thus contributing to the interconnection and digitization of human activities.

Health promotion is a comprehensive approach that seeks to improve people's general health and well-being, as well as to prevent diseases and disorders. (35). It focuses on promoting healthy lifestyles, addressing the social

determinants of health (36) (37) (38), and creating environments that facilitate healthy choices (39) (40) (41). Health promotion goes beyond the treatment of disease and is oriented toward improving quality of life, promoting positive habits and empowering people to make informed decisions about their health (42) (43) (44).

In the context of university education, the importance of health promotion is significant due to several factors: student wellbeing, comprehensive training, prevention of health problems, academic performance, development of long-term healthy habits, and culture of care (45) (46).

The intersection between technology and health in the educational environment is a dynamic and evolving field of research. (47) As the adoption of wearable technologies continues to grow, the need to better understand their actual impact on health promotion among students arises (48). In addition, exploring potential challenges and benefits associated with the use of these devices is essential to inform educational and public health strategies (49) (50) (51). This study adds to the growing literature on the topic, bringing new perspectives and approaches that will contribute to a comprehensive understanding of the relationship between wearable technologies and health in the educational setting.

According to Khosravi et al. (13) portable devices intended to enhance the learning process have been mostly used in areas such as the head (e.g., eyeglasses), the wrist (e.g., watches) and the chest (e.g., electrocardiogram patch). Specifically, among these locations, it is observed that devices used on the head favor greater student interaction with learning materials, improved student attention, as well as greater spatial and visual awareness (52).

According to Sousa et al. (6) the findings of their study indicated that there is little research on the impact of these technologies on school physical activity. In agreement with previous research, they concluded that portable devices can be used as a motivational resource to enhance behaviors related to physical activity and to evaluate the effectiveness of interventions in this area (53) (54).

From the study by Bustos et al. (55) study, it can be seen that the conventional physiological signals used to evaluate student participation include aspects such as heart rate, skin temperature, respiratory rate, oxygen saturation, blood pressure and electrocardiogram information.

For Bardus et al. (56) the most prominent devices in their study were Fitbit, Apple Watch and Garmin. Similarly, 82 students (40%) used apps, mainly MyFitnessPal, Apple Health and Samsung Health. However, many participants abandoned their use due to loss of interest or technical drawbacks (breakage, usability issues, obsolescence, or lack of engagement) (57). Wearable devices were perceived to outperform cell phones alone as physical activity monitors. However, establishing regular habits made personal monitoring through technology less relevant.

In the study by Diaz et al. (58) study, the results of the analysis indicated an inclination toward an increase in students' physical activity and number of steps during

weekends. Also, participants achieved higher levels of physical activity and steps.

According to Patil et al. (59) in their study, which sampled 495 people, overall, 50.3% of the participants were between 25 and 50 years of age, and 51.3% belonged to the lower income group. While 62.2% of the respondents reported using portable devices to manage their health, 29.3% used them on a daily basis.

In this context, the objective of this study is to characterize the use of wearable technologies to promote health among students of Human Medicine. To this end, several aspects will be explored in the student population under analysis, including: the adoption and use of these technologies, the level of knowledge and perception, the impact on physical activity, monitoring of health and well-being, individual experiences, the most predominant wearable technologies, their influence on the adoption of healthy habits, the associated challenges and their contribution to health promotion in the educational and organizational settings (60) (61) (62) (63) (64).

2. Methods

The research follows a cross-sectional design with a quantitative approach, adopting a non-experimental design of basic nature and descriptive level (65) (66) (67) (68). In this context, statistical data were collected from all participants at a given moment in time, without intervention in any variable (69) (70). Through this methodology, it was possible to obtain significant information on the use of wearable technologies in health promotion among university students.

The research population comprised 128 students of Human Medicine at a private university in Arequipa, Peru, who were enrolled in the Research I course. In this study, a census sample was used (71) (72). The 128 students who constituted the totality of the population under study were included in this study.

In this study, a survey was chosen as the main method for obtaining information. The instrument selected for this purpose was a questionnaire, which was designed in a structured manner and comprised a total of 25 questions. These questions addressed several specific areas, including: demographics, adoption and use of these technologies, level of knowledge and perception (73) (74), impact on physical activity (75) (76), monitoring of health and well-being (77), individual experiences, most prevalent wearable technologies, their influence on the adoption of healthy habits, associated challenges and their contribution to health promotion in the educational setting (78) (79) (80) (81).

The validity of the instrument was ratified by the evaluation of experts, who ensured that the questions were directly related to the previously established measurement objective (82). Consequently, it was evidenced that the questionnaire was appropriate for administration to the study participants. Regarding reliability, it was evaluated using Cronbach's Alpha coefficient during a pilot test

conducted on individuals with characteristics similar to those of the main study subjects (83) (84) (85). The result obtained, a value of 0.874, indicated a very high level of reliability.

In relation to the procedures carried out for the execution of the research, in the first instance, the corresponding authorization was obtained from the institution to access the sample of participants and use the study instruments (86). Subsequently, the data collected through the application of the questionnaires were organized and structured in a database, aligning them with the aspects related to the object of research. The data were then processed and analyzed by means of descriptive statistical techniques using SPSS software (87) (88). General valuation of this protocol suggested that systematic reviews and bibliometric studies are critically needed in order to reach a better understanding of the results (89) (90) (91) (92).

3. Results

According to the results obtained through the application of the questionnaire and when examining the first item related to sociodemographic characteristics, a total of 128 students were surveyed. Table 1 shows that, of this group, 57.03% (73) correspond to male students, while 42.97% (55) are female students. This suggests that the majority of the participants in the study are male.

As for the age of the participants, 65.63% (84) are in the age range of 21 to 23 years, 19.53% (25) are located in the age group of 24 to 26 years, while 14.84% (19) are aged between 18 and 20 years. Therefore, the majority of the students are between 21 and 23 years of age.

In relation to the distribution by study cycle of the 128 participants, 49.22% (63) are in the seventh cycle, 35.16% (45) are in the sixth cycle, and 15.63% (20) are in the eighth cycle. Therefore, most of the students are in the seventh cycle.

Table 1. Sociodemographic characteristics of the sample

Sociodemographic variables		N	%
Genre	Male	73	57.03%
	Female	55	42.97%
Age	18-20 years	19	14.84%
	21-23 years	84	65.63%
	24-26 years	25	19.53%
Cycle	Sixth	45	35.16%
	Seventh	63	49.22%
	Eighth	20	15.63%

In relation to the results linked to the other elements investigated, presented in Table 2, it stands out that, regarding the adoption and use of wearable technologies or

wearables, 35.94% (46) reported a moderate level, 32.81% (42) indicated a high level, while 31.25% (40) indicated a low level. Consequently, it can be inferred that a moderate level of use and adoption of wearable technologies prevailed among the evaluated students. This finding suggests a balanced rather than extreme adoption of wearable technologies among the examined students in the context of health promotion (93) (94) (95) (96) (97).

Regarding students' knowledge and perception of wearable technologies, 41.41% demonstrated a moderate level, 35.16% (45) indicated a high level, while 23.44% (30) expressed a low level. Consequently, it is observed that the majority of students are at the moderate level in terms of their knowledge about these technologies, demonstrating a balanced and substantial understanding (98). This finding indicates that, in general, students possess a solid knowledge and balanced perception about wearable technologies, which may be useful for understanding how these tools are perceived and used in the context of health promotion among this specific group (99).

Regarding the impact that this technology has had on the physical activity of the students analyzed, 42.97% (55) obtained a moderate level, 29.69% (38) indicated a high level, while 27.34% (35) indicated a low level, to this effect most of the students specified the moderate level in the impact of this technology on physical activity. This means that, in general terms, these technologies have had a balanced and significant effect on students' physical activity.

In relation to health and wellness monitoring through wearable technologies among the examined students, it is observed that 25.00% (32) use them to monitor their cardiovascular activity, 21.88% (28) employ them to track their overall physical activity, 19.53% (25) use them to monitor their overall wellness, 17.97% (23) employ them to track their nutrition, while 15.63% (20) use them to assess their sleep quality. Thus, it stands out that most of the surveyed students employ these technologies to monitor their cardiovascular activity (100). The preference for monitoring cardiovascular activity can also be interpreted as a response to the growing awareness of the importance of cardiovascular health and the key role it plays in overall well-being.

In reference to the experiences of the respondents, 37.50% (48) have experienced increased awareness of physical activity, 35.16% (45) have felt increased motivation for exercise, while 27.34% (35) have improved stress management. In this sense, it stands out that the majority of students have experienced increased awareness of their physical activity (101) (102). Which implies that students become more aware, informed or alert about their level of physical activity through the use of wearable technologies (103). This could include aspects such as monitoring steps, the amount of exercise performed, or the intensity of physical activity.

Within the wearable technologies most commonly employed by the respondents, it is observed that 32.81% (42) use smartwatches, 28.13% (36) use fitness trackers,

17.97% (23) use smart headsets, 11.72% (15) use stress monitoring devices, while 9.38% (12) use augmented reality glasses. It highlights, therefore, that the majority of students prefer to use smartwatches as the most commonly employed wearable technology. This finding suggests that students have a significant preference for smartwatches compared to other wearable technologies, such as fitness trackers, smart headsets, stress monitoring devices, or augmented reality glasses. It is likely that smartwatches offer features and functionalities that better align with students' health promotion needs and preferences.

Regarding the influence of wearable technologies on students' healthy habits, 35.16% (45) have experienced a positive influence on adopting a healthy lifestyle, 33.59% (43) have noticed their impact on weight control, while 31.25% (40) have felt their influence on adopting a balanced diet. In this sense, it stands out that the majority of respondents have experienced a significant influence in adopting a healthy lifestyle (104). This indicates that, according to the perceptions of the participants, the use of wearable technologies has had an important and positive impact in promoting healthy habits and behaviors among students (105) (106).

Regarding the challenges perceived by students in the use of wearable technologies for health promotion, 28.13% (36) highlighted cost as one of the main challenges, 25.78% (33) mentioned interoperability and standards, 24.22% (31) pointed out battery life as a significant challenge, while 21.88% (28) indicated measurement accuracy. Thus, most of the students surveyed identified cost as one of the most relevant challenges associated with these technologies.

Regarding the health promotion of these technologies in the educational context, 35.16% (45) indicated a moderate level, 33.59% (43) indicated a high level, while 31.25% (40) indicated a low level. Therefore, the majority of respondents reported a moderate level of impact of these technologies on health promotion in the educational setting (107) (108). Which, can be interpreted to mean that these technologies are having a significant, but not extraordinary, effect on health promotion in the educational environment according to the perspective of the students examined.

Table 2. Characterization of the use of wearable technologies in the promotion of health and wellness in Human Medicine students.

Appearance		N	%
Adoption and use	Under	40	31.25%
	Moderate	46	35.94%
	High	42	32.81%
Knowledge and perception	Under	30	23.44%
	Moderate	53	41.41%
	High	45	35.16%
Impact on physical activity	Under	35	27.34%
	Moderate	55	42.97%
	High	38	29.69%

Health and wellness monitoring	Monitoring of physical activity	28	21.88%
	Nutrition	23	17.97%
	Cardiovascular activity	32	25.00%
	Sleep quality	20	15.63%
	General wellness	25	19.53%
Experiences	Motivation for exercise		
	Stress management	45	35.16%
	Increased awareness of physical activity	35	27.34%
Most used wearable technologies	Smartwatch	48	37.50%
	Fitness trackers	42	32.81%
	Augmented reality glasses	36	28.13%
	Stress control devices	12	9.38%
	Smart earphones	15	11.72%
Influence on healthy habits	Balanced diet	23	17.97%
	Weight control	40	31.25%
	Healthy lifestyle	43	33.59%
Challenges	Healthy lifestyle	45	35.16%
	Battery life		
	Measurement accuracy	31	24.22%
	Cost	28	21.88%
Health promotion in the educational context	Interoperability and standards	36	28.13%
	Under	33	25.78%
	Moderate	40	31.25%
	High	45	35.16%
		43	33.59%

4. Discussion

This study revealed a moderate level in various aspects, such as utilization and acceptance, knowledge and perception (109), impact on physical activity, as well as health promotion in the educational context, among students of Human Medicine at a private university in Arequipa, Peru, followed by a high level. Similar results were found in the literature regarding several samples (110) (111).

Regarding health and wellness tracking, the majority of students use wearable technologies to monitor cardiovascular activity, followed by physical activity tracking. In terms of respondents' experiences with these technologies, the majority indicated that they have gained increased awareness of their physical activity, followed by an increase in motivation to exercise.

In relation to the most prevalent wearable technologies among the group analyzed, the significant use of smartwatches stands out, followed by fitness trackers, smart headphones, stress management devices and augmented reality glasses. Additionally, it is observed that this technology has impacted students, prompting them to adopt a healthy lifestyle (112), followed by weight regulation and the adoption of a balanced diet. Finally,

when exploring the challenges that students identify with respect to this technology, the most prominent aspects are cost, followed by interoperability and standards, battery life and measurement accuracy.

These results correspond to those reported by Sousa et al. (4), who expressed that wearable technologies can play a motivational role, encouraging behaviors related to physical activity and evaluating the effectiveness of interventions in this area. Several studies have shown similar results (113) (114).

Likewise, the findings of this study are related to the research of Diaz et al. (20), whose results indicated a positive trend towards an increase in the physical activity of students, as well as in the number of steps during the weekends. In addition, significantly higher levels of physical activity and steps were observed among participants from the use of wearable technologies.

Similarly, these findings are similar to those of Patil et al. (21), who reported that 62.2% of participants indicated the use of wearable technologies to manage their health, with 29.3% of them being daily users. Similarly, these results are consistent with those of Bardus et al. (19), who reported an outstanding level of smartwatch and app use by 40% of students.

Along the same lines, the findings of this study are similar to those of Khosravi et al. (7), who noted a significant use of smartwatches, glasses and electrocardiogram patches used to reinforce the learning process (115). It also supports the idea that the incorporation of wearable technologies among students opens new perspectives for understanding and improving health in this area (116) (117).

Regarding limitations that could have impacted the study, it is important to note that the results may have been influenced by factors specific to the university setting of Human Medicine, which could limit their applicability to other educational or work contexts.

Regarding the practical implications of this study, educational applications using wearable technologies could be developed to provide real-time feedback on health and well-being, effectively integrating into the academic environment. Also, the implementation of wearable technologies could focus on preventive strategies to address potential risks to students' physical and mental health, leveraging early detection and proactive intervention (118) (119).

Within the scope of future perspectives of this research, it opens the possibility of exploring how wearable technologies can be effectively integrated into medical education. This approach seeks to enhance students' understanding of the interrelationship between self-care and practical application in the clinical setting (120) (121). Similarly, to further investigate the impact of wearable technologies on students' mental health, considering the detection and management of factors such as stress and anxiety (122) (123).

5. Conclusions

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A moderate level of adoption and utilization of wearable technologies in the promotion of health and wellness among human medicine students was identified. This finding indicates that wearable technologies play a significant role in the health and wellness related activities of these students, especially highlighting an emphasis on a moderate level of utilization. This observation establishes a solid foundation for deepening the understanding of the involvement of wearables in promoting health and wellness in this group of young college students. Furthermore, it suggests the opportunity to develop effective strategies to encourage healthier and more beneficial use of this technology.

It has been determined that, with regard to students' knowledge and perception of wearable technologies, a moderate level of familiarity with these technologies is found, demonstrating a fair and substantial understanding. This finding indicates that, in general terms, students possess a solid knowledge and balanced perception of wearable technologies, providing valuable information for understanding how these tools are perceived and used in the context of health promotion within this specific group.

In addition, it was determined that in relation to the impact that technology has had on the physical activity of the students examined, a moderate level was identified. This implies that, in general terms, these technologies have had a balanced and significant effect on the physical activity of the students.

It was found that, in terms of health and wellness monitoring using wearable technologies among the students evaluated, the majority of respondents use such technologies to monitor their cardiovascular activity. Within this context, the choice to focus on cardiovascular activity monitoring indicates a particular awareness of the importance of tracking key aspects of health, such as heart rate and other cardiovascular indicators (124).

It was possible to identify, in relation to the experiences of the respondents, that the majority of students have experienced an increase in their awareness of physical activity. This suggests that students develop greater perception, awareness or attention regarding their level of physical activity through the use of wearable technologies. This increased awareness could encompass aspects such as tracking steps, quantifying exercise performed, or assessing the intensity of physical activity.

It could be determined regarding the most used wearable technologies by the respondents, that the majority of students show preference for the use of smartwatches, followed by fitness trackers, smart headphones, stress management devices and augmented reality glasses. This finding indicates a clear inclination of students towards smartwatches compared to other wearable technologies such as fitness trackers, smart headphones, stress management devices or augmented reality glasses. It is likely that smartwatches offer features and functionalities that better fit students' needs and preferences in terms of health promotion.

It has been found that, in terms of the influence of wearable technologies on students' healthy habits, the majority of respondents reported having experienced a significant influence in adopting a healthy lifestyle. This finding suggests that, according to participants' perceptions, the use of wearable technologies has had a significant and positive impact on promoting healthy habits and behaviors among students.

In relation to the challenges perceived by students in the use of wearable technologies for health promotion, it was possible to identify that most of the respondents pointed out cost as one of the most relevant challenges associated with these technologies. In addition, they highlighted other aspects such as interoperability and standards, battery life and measurement accuracy.

It was possible to determine in relation to health promotion through these technologies in the educational context that the majority of respondents indicated a moderate level of impact of these technologies on health promotion in the educational setting. This finding suggests that these technologies are exerting a significant, although not extraordinary, effect on health promotion in the educational setting, according to the perspective of the students evaluated.

Based on the results found in this research, we propose the implementation of training initiatives aimed at students to improve their understanding of the effective use of wearable technologies. In addition, the creation of specific subjects or units focused on the clinical application of these technologies is recommended.

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