



Volume 29, 2026

## FACTORS ASSOCIATED WITH WEARABLE HEALTH DEVICE USE AMONG FEMALE UNIVERSITY STUDENTS IN KUWAIT: BEHAVIORAL AND PSYCHOLOGICAL PERSPECTIVE

Sumayya Banna

Arab Open University - Kuwait Branch, [sumayya@aou.edu.kw](mailto:sumayya@aou.edu.kw)  
Ardiya, Al Farwaniyah, Kuwait

### ABSTRACT

Aim/Purpose	This study explored the associations among stress, eating attitudes, self-esteem, physical activity, and wearable device engagement (use experience and usage period), alongside related health app use and health-tracking practices, among female university students in Kuwait.
Background	The proliferation of wearable health-monitoring technologies has reshaped personal healthcare and self-management among young adults. However, adoption and sustained use among female university students may be influenced by intersecting psychological and behavioural factors, including stress, self-esteem, physical activity, and eating attitudes, particularly in academic settings where stress and irregular health habits are common.
Methodology	The study utilised validated instruments: the Perceived Stress Scale, Eating Attitudes Test (EAT-26), Rosenberg Self-Esteem Scale, and the International Physical Activity Questionnaire. To achieve the study's objectives, 325 female students were surveyed quantitatively. Descriptive statistics, correlation analysis, and linear regression were performed using SPSS.
Contribution	The study contributes to the extant literature on health informatics and behavioural psychology by providing a comprehensive understanding of how monitoring devices supporting self-care and health behavior management, and their sustained use among female university students, remain uneven and are shaped by the matter of health wearable devices in Kuwait. The study supports a shift toward holistic approaches to student well-being in higher education and public health.

Accepting Editor Akhil Prakash | Received: January 24, 2026 | Revised: March 30, 2026 |

Accepted: May 4, 2026.

Cite as: Banna, S. (2026). Factors associated with wearable health device use among female university students in Kuwait: Behavioral and psychological perspective. *Informing Science: The International Journal of an Emerging Transdiscipline*, 29, Article 8. <https://doi.org/10.28945/5781>

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Findings	The results revealed a positive self-rated health and moderate physical activity, alongside prominent academic-related stress and notable weight- and shape-related concerns. Stress and eating attitudes were strongly and reciprocally associated, while self-esteem showed a protective association with eating attitudes. Physical activity duration, but not intensity, was positively associated with self-esteem. Wearable device use experience was associated with higher physical activity intensity, whereas longer usage period was positively associated with self-esteem and eating attitudes, suggesting mixed effects of sustained self-tracking. Non-use was primarily attributed to lack of perceived need and cost, while many non-users expressed openness to future adoption.
Future Research	Future research should explore longitudinal or prospective designs to clarify temporal ordering and potential reciprocal effects, particularly between stress and eating attitudes. To better identify leverage points for targeted interventions, future work should test more comprehensive explanatory models that incorporate contextual and psychosocial variables (e.g., academic stress exposure, coping style, body image, and social support). To enhance the generalizability of the findings, a larger-scale survey across a broader geographical range would be beneficial.
Keywords	wearable health devices, female university students, stress, self-esteem, eating attitudes, physical activity, digital health, Kuwait

## INTRODUCTION

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The growing concern surrounding health behaviours among university students has attracted increasing academic and public health attention, as this transitional period plays a critical role in shaping long-term lifestyle patterns. During the transition to university life, students often adopt behaviours that can either support or undermine their physical and psychological well-being, particularly in relation to diet, physical activity, and stress management (Aceijias et al., 2017; Åsberg et al., 2022; X. Li et al., 2024; Oftedal et al., 2024). These behaviours are influenced by increasing independence, academic pressures, and new social and environmental exposures, which may encourage unhealthy patterns and elevate the risk of chronic health conditions later in life (Aceijias et al., 2017; Lonati et al., 2024; Sogari et al., 2018).

Promoting healthy behaviours during the university years, therefore, has significant public health implications (Lonati et al., 2024; Sok et al., 2020). This is particularly relevant for female students, who often report higher levels of health awareness while simultaneously experiencing greater academic stress, sleep disturbances, and body image concerns (Doak et al., 2023; Jäckel & Garai-Fodor, 2024; Marendić et al., 2024). Such stressors may negatively affect eating attitudes, self-esteem, and physical activity, with consequences for both well-being and academic performance (Rogowska et al., 2020; Shang et al., 2021; Vainshelboim et al., 2019). Accordingly, targeted approaches that address these gender-specific challenges are essential.

Beyond individual outcomes, improving the health behaviours of female university students has broader societal implications. Women often play central roles in family health and caregiving, meaning their lifestyle choices can influence household and intergenerational health practices (Herbert, 2022; Rehman et al., 2018). Moreover, female students show greater engagement with health promotion initiatives, particularly those focused on stress management and disease prevention (Jürgensen et al., 2024). Empowering female students with appropriate knowledge and tools can therefore generate benefits that extend beyond the individual to the wider community (Banna & Alzougool, 2024; Banna & Ottesen, 2018; Hardy et al., 2018; Ndaita & Chebet, 2024).

In this context, mobile health (mHealth) applications and wearable health-monitoring devices have become increasingly prominent in supporting self-care and health behaviour management among young adults (Shin et al., 2023). These technologies enable real-time monitoring of physical activity and lifestyle behaviours, thereby redefining personal healthcare practices. However, both adoption and sustained use remain uneven among female university students and are shaped by psychological factors such as stress, self-esteem, eating attitudes, and body image concerns (Gao et al., 2020; Grasdalsmoen et al., 2020; Shin et al., 2023). Female students are particularly vulnerable to stress and disordered eating during university years, which may influence how digital health tools are perceived, interpreted, and utilised (Shin et al., 2023).

Despite the growing interest in digital health, empirical research on wearable health technology adoption within Gulf Cooperation Council (GCC) countries remains limited (Almutairi et al., 2018). In Kuwait, in particular, there is a lack of evidence on the behavioural and psychological correlates of wearable device use among female university students. This gap is especially notable given the rapid digitalisation of healthcare and the expanding role of health information technologies in the region. More critically, limited research has examined how wearable technologies function as information systems in this context, specifically how health-related information is generated, interpreted, communicated, and translated into behavioural action by users.

Consequently, this study investigates the behavioural and psychological factors associated with wearable health device use among female university students in Kuwait, while also examining how these technologies function as informing systems that support health-related decision-making and behaviour change. By addressing this gap, the study contributes to both digital health research and the informing science literature by offering insights into how information-driven technologies can enhance well-being within a culturally specific context.

From an Informing Science perspective, wearable devices are important because they do not merely collect data; they inform users by transforming personal health signals into actionable information that can shape awareness, self-regulation, and well-being-related decisions.

The remainder of the paper is structured as follows. The next section presents the literature review, followed by research questions, method, findings, and discussion. The final sections outline limitations and directions for future research, conclusions, implications, and recommendations.

## LITERATURE REVIEW

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### *AN OVERVIEW*

#### **Self-rated health and physical activity**

Self-rated health is a widely used subjective indicator of overall health status and a robust predictor of future morbidity and mortality (Hetlevik et al., 2020; Jylhä, 2009; Vie et al., 2019). It reflects individuals' integrated perceptions of their physical, psychological, and social well-being and encompasses medical, cultural, social, religious, ethnic, and gender-related dimensions (Martin et al., 2022; Mutz & Lewis, 2022). The relative importance of these dimensions varies across individuals and populations, contributing to observed differences in the association between self-rated health and health outcomes across cultures, age groups, and genders (Wuorela et al., 2020).

A substantial body of research demonstrates a consistent association between self-rated health and physical activity among university students, with healthier self-perceptions linked to more active lifestyles and favourable psychosocial profiles (de Souza Soares et al., 2025; Jones & Schreier, 2023; Oftedal, Kolt, Holliday, et al., 2019; Pengpid & Peltzer, 2019; Porru et al., 2022). Among female students, lower physical activity levels, unhealthy lifestyle habits, and sleep problems have been associated with impaired self-rated health (Ohtsuki et al., 2021). As such, self-rated health is increasingly recognised as a valuable screening tool for identifying students at risk of future health problems (El Ansari et al., 2023; Murphy, MacDonncha, Murphy, Murphy, Nevill, & Woods, 2019). Evidence also

links poor self-rated health to elevated stress levels and inadequate mental health support, highlighting the need for integrated health promotion strategies within university settings (Murphy, MacDonncha, Murphy, Murphy, Timperio, et al., 2019; Oftedal, Vandelanotte, & Duncan, 2019).

Recent literature suggests that wearable technologies and digital health tools may enhance university-based health promotion by enabling real-time monitoring of physical activity, stress, and lifestyle behaviours, and by supporting personalised interventions (Bao & Lee, 2024; Lee et al., 2024). When thoughtfully implemented, such tools may help mitigate health risks and support student well-being (Coelho et al., 2025; Mehnaz et al., 2025; Vu & Tagliabue, 2025).

### **Physical activity levels, types, and barriers**

Regular engagement in moderate-to-vigorous physical activity is essential for maintaining physical and mental health and preventing long-term disease (Bourque et al., 2025; Finne et al., 2019). However, evidence consistently shows gender differences in activity patterns among university students, with females reporting lower activity levels and self-efficacy than males (Elliott et al., 2024; Han et al., 2022; Y. Liu et al., 2023; Sheng et al., 2025; K. Wang et al., 2020). Psychological factors such as motivation, self-perception, and goal setting play a critical role in sustaining physical activity, underscoring the relevance of self-esteem and mental resilience (X. Li et al., 2024; Murphy, MacDonncha, Murphy, Murphy, Timperio, et al., 2019; Z. Yang et al., 2024).

Walking and aerobic exercises are the most common activities among university students due to their accessibility and low cost (Burton et al., 2021). Activity patterns shifted during the COVID-19 pandemic, with increased engagement in jogging, cycling, and home-based workouts, and a decline in team sports due to lockdowns and restricted access to facilities (Amornsriwatanakul et al., 2022; Panenggak et al., 2022).

Despite the known benefits, university students face multiple barriers to physical activity. These include psychological barriers (e.g., lack of motivation, fear of injury, time constraints), environmental barriers (e.g., lack of facilities), socioeconomic barriers (e.g., financial limitations), and demographic barriers, particularly gender-related constraints (Farren et al., 2017; Finley, 2019; Griffiths et al., 2022; Hilger-Kolb et al., 2020; Lauderdale et al., 2015; Martinez-Sanchez et al., 2024; Portela-Pino et al., 2020). In GCC countries such as Kuwait, extreme climate conditions, car-dependent urban design, and cultural norms further discourage physical activity, especially among female students (Al-Baho et al., 2016; Al-Hazzaa, 2022; Sharara et al., 2018).

### **Psychological factors: Stress, eating attitudes, and self-esteem**

Psychological factors play a central role in shaping health behaviours and well-being among university students. Stress, eating attitudes, self-esteem, and body image are closely interconnected and collectively influence both mental and physical health outcomes (Karyotaki et al., 2020; Khadija et al., 2023; X. Liu & Liu, 2025; Sharif-Nia et al., 2024; Wilcox et al., 2022). Eating attitudes, defined as individuals' perceptions of food, body image, and emotional regulation, are particularly sensitive to stress and are often linked to maladaptive coping behaviours (Silva et al., 2018).

Healthy self-esteem has been shown to buffer the negative effects of stress and support more adaptive eating behaviours (Yonder Ertem & Karakaş, 2021). Conversely, low self-esteem and negative body image are associated with higher stress levels and disordered eating patterns. Academic and non-academic stressors – including examinations, grades, financial pressures, employment concerns, and interpersonal relationships – are consistently identified as major sources of stress among university students (Karaman et al., 2019; Pitt et al., 2018; Ramon-Arboles et al., 2020; Reddy et al., 2018). Gender differences are particularly pronounced, with female students reporting higher perceived stress, especially during examination periods, due to a combination of biological, social, and role-related factors (Aguilera et al., 2024; Pico-Perez et al., 2025; C. Wang et al., 2022). Social comparison processes, amplified by social media use, further exacerbate stress and body dissatisfaction (Crusius

et al., 2022; Ezeaka et al., 2025). Understanding these psychological dynamics is essential for designing effective interventions that foster resilience, healthy coping strategies, and positive body image (Ang et al., 2022; Kurtović et al., 2018; X. Wang et al., 2023).

### **Wearable health technologies: Adoption, use, and behavioural impact**

Wearable health technologies represent a key component of the Internet of Things (IoT) and the broader digital health ecosystem, enabling continuous self-monitoring and proactive health management (Asthana et al., 2017; Q. Yang et al., 2024). Consumer-grade devices such as smartwatches and fitness trackers are primarily designed for wellness and preventive health, offering accessible and user-friendly monitoring of physical activity, heart rate, sleep, and related metrics (George et al., 2023; Henriksen et al., 2018). Medical-grade wearables, by contrast, support more advanced clinical monitoring and intervention (Barbone et al., 2019; He & Lee, 2021; Shafik, 2025).

Globally, wearable technology adoption has expanded rapidly, driven by perceived usefulness, ease of use, and social influence, as highlighted in technology acceptance models (Adapa et al., 2018; Al-Emran et al., 2023; Kang & Hwang, 2022). Among university students, wearable devices have been associated with increased physical activity, enhanced self-monitoring, and greater awareness of health behaviours (Necaise et al., 2025; Pope et al., 2019; Rathonyi et al., 2019).

However, adoption is not universal. Common barriers include cost, privacy concerns, and limited perceived value, particularly among non-users (Adapa et al., 2018; Al-Emran et al., 2021; White et al., 2023). Motivational factors such as goal setting, self-monitoring, and social sharing play a critical role in sustained engagement (Kim et al., 2018; Munno et al., 2023). Cultural norms and social expectations further shape adoption behaviours, highlighting the importance of context-sensitive and user-centred design (Adapa et al., 2018; Zhang et al., 2022).

Evidence suggests that wearable devices can support behaviour change and self-regulation by providing real-time feedback and reinforcing accountability (Kuosmanen et al., 2022; Papalia et al., 2018; Vinnikova et al., 2020). Nevertheless, emerging research also cautions that excessive self-tracking may amplify body surveillance and stress, particularly among young women, underscoring the need to examine wearable use within broader psychological contexts (Shin et al., 2023; Xing & Ge, 2025).

### ***CONCEPTUAL INTEGRATION: AN INFORMING SYSTEMS PERSPECTIVE***

While the aforementioned literature review emphasised the important associations among psychological factors such as stress, self-esteem, and eating attitudes, health behaviours such as physical activity, and the use of wearable technology, prior research has mostly explored these factors in isolation, with limited theoretical integration and coherence. To address this gap in existing literature, the present study adopts an integrative perspective that conceptualises the aforementioned factors as components of a dynamic self-regulation system. Within this integrative system, psychological states shape individuals' motivation and capacity to engage in health behaviours, predominantly physical activity, which in turn influences overall well-being and self-rated health among university students, while also potentially mitigating underlying psychological states. In contrast, wearable health technologies play a critical enabling role.

This study extends the existing literature by repositioning wearable technologies within an informing systems framework, rather than viewing them merely as health-monitoring tools; they are conceptualised as digital informing mechanisms that continuously collect, process, and deliver personalized feedback to users. Through real-time data, goal tracking, and behavioural prompts, these systems enhance users' situational awareness and support informed decision-making among end users. Therefore, wearable technologies could actively shape the association between psychological factors and health behaviours by facilitating self-monitoring and self-rated health, emphasizing behavioural users' intentions, and enabling adaptive responses to changing conditions.

This perspective aligns with emerging research in digital health and information systems, which emphasises the role of technology as an enabler of information flows that influence cognition, behaviour change, and outcomes. By integrating psychological, behavioural, and technological dimensions within a single framework, the present study provides a more coherent explanation of how health-related behaviours and outcomes are shaped in digitally mediated environments. This integrative approach is particularly relevant in the context of university students, where psychological pressures, lifestyle behaviours, and technology use intersect in complex and context-dependent modes. Moreover, the present study offers a more comprehensive framework for understanding health and well-being among university students, particularly within under-researched contexts such as female students in GCC countries.

While this study is placed within the specific context of female university students in Kuwait, its contribution extends beyond a purely contextual focus. The selected context represents a theoretically relevant setting characterised by exclusive cultural norms, environmental constraints, and gender-specific barriers to physical activity, which shape both health behaviours and technology use.

In particular, factors such as climate conditions, social expectations, and limited access to physical activity opportunities create a context in which psychological factors and behavioural outcomes may interact differently compared to Western settings. This makes the context not only empirically under-researched but also theoretically informative for understanding how health behaviours are shaped under constrained conditions.

By examining these dynamics alongside wearable technologies conceptualised as informing systems, this study contributes to the broader literature by demonstrating how digital health tools operate within culturally specific environments. Therefore, the study advances understanding of how informing mechanisms interact with psychological and behavioural processes in shaping health outcomes, thereby offering insights that are transferable to other contexts with similar structural or cultural characteristics.

While the study does not advance a formal conceptual framework, it is guided by a clear analytical logic that connects student characteristics, digital health engagement, and wearable-related practices. The study's contribution lies not only in its focus on an underrepresented context but also in its examination of how these factors are considered together, offering a more contextually grounded understanding of wearable and mobile health engagement.

### ***RESEARCH QUESTIONS***

This study aims to examine associations among stress, eating attitudes, self-esteem, physical activity, and wearable device engagement (use experience and usage period), alongside related health app and health-tracking practices, among female university students in Kuwait. By integrating psychological, behavioural, and digital health perspectives, the study seeks to contribute context-specific evidence to the health information technology literature and inform public health policy, university support services, and user-centred digital health design. To achieve this aim, the study pursued the following specific objectives:

1. To describe participants' demographics, self-rated health, physical activity patterns, stress sources/levels, eating attitudes, self-esteem, and digital health use.
2. To characterise wearable and health app engagement (use experience, usage period, tracked data, and reasons for use/non-use).
3. To compare wearable users and non-users in terms of barriers, motivations, willingness to adopt, and health tracking behaviours.
4. To test multivariate predictors of self-esteem, stress, and eating attitudes (including physical activity and wearable usage period).

5. To assess associations between wearable use experience/usage period and physical activity intensity.

This study conceptualizes wearable health technologies and mobile health applications as informing systems through which health-related data are generated, communicated, interpreted, and utilized to influence user awareness and behaviour (J. Cohen, 1988); accordingly, the following research questions are proposed:

1. What demographic, health, psychological (stress, eating attitudes, and self-esteem), physical activity, and digital health characteristics describe female university students as users of wearable-generated and app-generated health information?
2. What patterns of engagement with wearable devices and health-related mobile apps are evident among female university students, including adoption, duration of use, types of information tracked, and reasons for use or non-use?
3. How are stress, self-esteem, eating attitudes, and physical activity related to students' engagement with digital health information generated through wearable devices and mobile health apps?
4. To what extent is wearable device engagement associated with self-monitoring, health-related tracking behaviours, and the use of digital health information for activity management among female university students?

## METHOD

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### *RESEARCH INSTRUMENT*

This study employed a quantitative cross-sectional survey design to examine associations among psychological factors, physical activity, and wearable device engagement among female university students in Kuwait. Data were collected at a single point in time using a structured, self-administered online questionnaire. All constructs were measured using validated and widely used instruments, ensuring reliability and comparability with prior research.

- Perceived Stress was assessed using the Perceived Stress Scale (PSS) developed by S. Cohen et al. (1983). The scale measures the extent to which respondents perceive their lives as unpredictable, uncontrollable, and overloaded.
- Eating Attitudes were measured using the Eating Attitudes Test (EAT-26) (Garner & Garfinkel, 1979), which assesses symptoms and concerns characteristic of disordered eating behaviours and attitudes.
- Self-Esteem was assessed using the Rosenberg Self-Esteem Scale (Rosenberg, 1965), a widely validated instrument measuring global self-worth through positive and negative self-evaluations.
- Physical Activity was measured using the International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003), which captures information on physical activity duration and intensity across different domains.

In addition, the questionnaire included items assessing wearable device engagement, including use experience (user vs. non-user), duration of use, type of device, data tracked, reasons for use or non-use, and health-related mobile application use.

### *SAMPLING PROCEDURE AND SIZE*

The target population comprised female undergraduate students enrolled in universities in Kuwait. This study employed a non-probability sampling strategy, specifically convenience sampling, whereby

participants were engaged through university-related digital communication channels. Participation was voluntary and limited to students currently residing in Kuwait at the time of data collection. While this approach enabled efficient access to the target population, it does not allow for random selection and therefore may limit the generalizability of the findings. As such, the results should be interpreted with caution and are most applicable to similar student populations within comparable contexts.

A minimum sample size of 300 respondents was deemed adequate based on sample sizes used in comparable studies (e.g., Shin et al., 2023) and methodological guidance suggesting that samples exceeding 300 are sufficient for multivariate analyses in large populations (Creswell & Creswell, 2018). A total of 504 complete questionnaires were collected, of which 325 responses from female participants were included in the final analysis after excluding male respondents. This sample exceeded the minimum required size, thereby strengthening the robustness and statistical power of the study.

### ***DATA COLLECTION PROCEDURE***

Data were collected using an online survey distributed via Google Forms. The survey link was disseminated digitally through university-related communication channels commonly used by students. Prior to participation, respondents were provided with an information page outlining the purpose of the study, the voluntary nature of participation, confidentiality of responses, and instructions for completing the questionnaire. Consent was implied through completion and submission of the survey. The questionnaire was designed to be clear and concise, with detailed instructions provided on the cover page to minimise respondent confusion and incomplete responses.

### ***DATA ANALYSIS***

Data were analysed using Statistical Package for the Social Sciences (SPSS). Initial analyses involved descriptive statistics (frequencies, percentages, means, and standard deviations) to summarise participant characteristics, health behaviours, psychological measures, and wearable device use patterns. Subsequently, correlation analyses were conducted to examine associations among stress, eating attitudes, self-esteem, physical activity characteristics, and wearable device variables. Linear regression analyses were then performed to assess relationships between psychological outcomes (stress, self-esteem, and eating attitudes), physical activity (duration and intensity), and wearable device engagement (use experience and usage period). Statistical significance was set at  $p < .05$ .

The correlation and regression analyses were selected because they were consistent with the study's descriptive and relational aims; however, more integrative modelling approaches may be useful in future research to examine indirect or conditional relationships.

## **FINDINGS**

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### ***DEMOGRAPHIC DATA***

Table 1 shows that most female respondents were young adults (18–24: 48.9%; 25–34: 28.9%) and generally well educated (bachelor's: 45.2%; diploma: 24.3%; high school: 23.4%). The sample was multicultural, led by Kuwaitis (42.2%), followed by Arab non-Kuwaitis (36.0%) and Asian non-Arabs (16.9%). Employment status varied, with 34.2% unemployed and others working in the private (30.5%) or public sector (24.6%). Most participants were Business majors (76.0%). Self-rated health was largely positive (good/very good: 68.6%; excellent: 26.2%), and satisfaction with university life was high (satisfied/very satisfied: 78.2%). Physical activity levels were moderate: most reported 15–30 minutes/day (32.9%) or 30–60 minutes/day (24.6%), typically at light to moderately vigorous intensity (48.9%). Common activities were gym (31.7%), walking (22.2%), and home workouts (21.2%). Key barriers to greater activity were lack of time (30.2%) and fatigue (16.6%).

These findings suggest that time constraints, rather than motivation or access, are the primary limitations to more regular exercise among female participants.

Table 1. Characteristics of the respondents (n=325)

Variable	Category	Frequency	Percent
Age range	18–24 yrs	159	48.9%
	25–34 yrs	94	28.9%
	35–44 yrs	54	16.6%
	45–54 yrs	14	4.3%
	55–64 yrs	4	1.2%
Highest level of education	Below High school	4	1.2%
	High school	76	23.4%
	Diploma	79	24.3%
	Bachelor's degree	147	45.2%
	Master's degree	8	2.5%
Ethnicity	PhD Degree	11	3.4%
	Kuwaiti	137	42.2%
	Arab–non-Kuwaiti	117	36.0%
	Asian–non-Arab	55	16.9%
	Others	13	4.0%
Employment	African–non-Arab	3	0.9%
	Unemployed	111	34.2%
	Private sector	99	30.5%
	Public sector	80	24.6%
	Self-employed	20	6.2%
Academic major	Family-owned business	15	4.6%
	Business	247	76.0%
	Other	39	12.0%
	Engineering	12	3.7%
	English	10	3.1%
	Computer Science	9	2.8%
Self-rated health status	Medicine	8	2.5%
	Poor	2	0.6%
	Fair	15	4.6%
	Good	115	35.4%
	Very good	108	33.2%
Satisfaction with university life	Excellent	85	26.2%
	Very dissatisfied	5	1.5%
	Dissatisfied	13	4.0%
	Neither satisfied nor dissatisfied	53	16.3%
	Satisfied	154	47.4%
Duration of daily physical activity	Very satisfied	100	30.8%
	Less than 15 minutes	65	20.0%
	15–30 minutes	107	32.9%
	30 minutes–1 hour	80	24.6%
	1–2 hours	43	13.2%
	2–3 hours	16	4.9%
Favourite type of physical activity	More than 3 hours	14	4.3%
	Very light	57	17.5%
	Light	62	19.1%
	Light plus	95	29.2%
	Moderately vigorous	64	19.7%

Variable	Category	Frequency	Percent
	Moderately vigorous plus	14	4.3%
	Vigorous	8	2.5%
	Others	25	7.7%
<b>Usual physical activity</b>	Go to the gym	103	31.7%
	Walk around town	72	22.2%
	Home workouts	69	21.2%
	Others	42	12.9%
	Use stairs	28	8.6%
	Jogging or running	11	3.4%
<b>Reason for not doing physical activity</b>	No spare time for exercise	98	30.2%
	N/A (Doing physical activity)	79	24.3%
	Tired	54	16.6%
	Other	37	11.4%
	No suitable space for exercise	25	7.7%
	Can't find a reason to do	21	6.5%
	Used to do exercise before COVID-19	11	3.4%

### ***THE MAIN SOURCES OF STRESS AMONG FEMALE PARTICIPANTS***

When examining the main sources of stress among female participants during the past six months (Table 2), the most frequent stressors were academic and personal. Nearly four in ten respondents experienced stress from midterm and final exams (39.7%) and grades (28.3%). Fatigue and tiredness (24.0%) and seeking a full-time job (22.8%) were also notable sources of stress. Moderate stress levels were observed for skin or acne issues (21.8%), appearance (17.2%), and menstrual symptoms (18.5%), highlighting the influence of physical and emotional well-being. In contrast, lower stress frequencies were reported for COVID-19 (11.1%), scholarships (10.5%), social media comparison (10.5%), and relationships with siblings (12.9%), indicating these were less prominent concerns. Overall, academic performance and personal well-being emerged as the most significant stress domains, while environmental and external factors contributed comparatively less to perceived stress among female students. From an informing systems perspective, these findings suggest that wearable technologies may be particularly relevant in addressing stressors linked to fatigue, physical well-being, and activity regulation. By providing real-time feedback on physical activity, sleep, and physiological indicators, wearable devices can support users in identifying stress patterns and adapting behaviours accordingly. Thus, stress should be understood as part of a dynamic system in which psychological pressures, behavioural responses, and informational feedback interact to shape overall well-being.

**Table 2. Main sources of stress in the last 6 months**

Main sources of stress	Never	Sometimes	Often
Apartment noise	51.4%	35.7%	12.9%
Appearance	40.3%	42.5%	17.2%
COVID-19	58.5%	30.5%	11.1%
Comparison with others via SNS	57.5%	32.0%	10.5%
Fatigue and tiredness	28.7%	47.4%	24.0%
Getting a full-time job	45.2%	32.0%	22.8%
Grade	22.1%	49.5%	28.3%
Low level of activity	34.4%	49.8%	15.7%
Menstruation	41.5%	40.0%	18.5%
Midterm and final exam	19.7%	40.6%	39.7%

Main sources of stress	Never	Sometimes	Often
Overweight	47.1%	31.4%	21.5%
Part-time job	58.8%	27.1%	14.1%
Relationship with friends	42.8%	40.0%	17.2%
Relationship with parents	43.1%	40.6%	16.3%
Relationship with siblings	54.4%	32.6%	12.9%
Scholarships	54.4%	35.1%	10.5%
Skin, Acne	37.8%	40.3%	21.8%

### ***THE STRESS LEVELS AMONG FEMALE PARTICIPANTS***

Table 3 reflects a generally moderate-to-elevated level of perceived stress over the past six months, with most respondents selecting “Sometimes” across all items (45.2%–53.8%) and a substantial proportion reporting stress “Often” (22.2%–36.9%). The highest frequency of stress was observed for feeling nervous and stressed (36.9%) and anger due to factors beyond personal control (30.8%), alongside notable reports of feeling overwhelmed by accumulating difficulties (28.0%) and lacking control over important life matters (27.3%). Responses to positively worded items indicate that feelings of control, coping, and confidence were largely intermittent rather than consistent, as the majority reported only sometimes feeling on top of things, able to control irritation, or confident in handling personal problems.

Overall, the findings suggest that female students experienced moderate but manageable stress, primarily triggered by uncontrollable or unexpected life events, rather than chronic emotional distress. From a behavioural perspective, such fluctuating stress patterns may influence engagement in health-related behaviours, including physical activity, either as a coping strategy or as a behaviour that is disrupted under pressure. Moreover, within an informing systems context, wearable technologies may play a role in helping individuals manage these episodic stress experiences by providing feedback, increasing self-awareness, and supporting adaptive behavioural responses. This suggests that stress in this population is not only a psychological condition but also part of a dynamic self-regulatory process shaped by both internal perceptions and external informational inputs.

**Table 3. The statements related to stress over the last 6 months**

Statements related to stress	Never	Sometimes	Often
Have you felt nervous and stressed?	17.9%	45.2%	36.9%
Have things outside your control angered you?	21.2%	48.0%	30.8%
Have you felt that you were on top of things? *	20.0%	49.2%	30.7%
Have you felt that difficulties were piling up too high?	24.3%	47.7%	28.0%
Have you felt unable to control important things in your life?	22.2%	50.5%	27.3%
Have you been able to control irritation in your life? *	19.7%	53.2%	27.1%
Have you felt that things were going your way? *	20.3%	53.5%	26.1%
Have you been upset because of something unexpected?	20.6%	53.8%	25.6%
Have you found that you could not cope with everything you had to do?	29.9%	47.4%	22.8%
Have you felt confident about handling personal problems? *	26.8%	51.1%	22.2%

\* Reverse items

### ***THE EATING ATTITUDES AMONG FEMALE PARTICIPANTS***

Table 4 suggests that weight- and shape-related concerns were relatively common, with sizeable minorities reporting these thoughts “Often,” while more extreme or behavioural indicators of disordered eating were less frequent. The highest “Often” responses were for wanting to be thinner (27.4%), thinking about burning calories in food (25.2%), thinking about body fat (24.6%), and fear of being overweight (23.7%), indicating that appearance- and weight-control cognitions affected a notable segment of participants. In contrast, weight-control behaviours and restrictive practices were less commonly endorsed “Often,” such as exercising to lose weight (19.1%), calorie awareness (17.5%), eating diet foods (17.0%), and feeling guilty after eating (16.0%). The least frequent “Often” responses related to more severe patterns, including preoccupation with food (13.8%), binge-like episodes (13.2%), avoiding eating when hungry (12.0%), and avoiding high-carbohydrate foods (10.5%). Overall, the distribution points to intermittent dieting/weight-control concerns for many, with a smaller but important subgroup reporting frequent attitudes and behaviours that may warrant closer attention.

**Table 4. Statements related to eating attitude over the last 6 months**

<b>Eating attitude</b>	<b>Never</b>	<b>Sometimes</b>	<b>Often</b>
I think a lot about wanting to be thinner	35.7%	36.9%	27.4%
I think about burning up calorie content in the foods I eat	35.4%	39.4%	25.2%
I think a lot about having fat on my body	40.9%	34.5%	24.6%
I'm terrified about being overweight	38.8%	37.5%	23.7%
I exercise to lose weight	42.2%	38.8%	19.1%
I am aware of the calorie content of what I eat	42.4%	40.0%	17.5%
I eat diet foods for dieting	45.5%	37.5%	17.0%
I feel very guilty after eating	45.2%	38.8%	16.0%
I cut my food into small pieces	46.8%	38.5%	14.8%
I find myself preoccupied with food	49.8%	36.3%	13.8%
I have gone on eating binges where I may not be able to stop	55.0%	31.7%	13.2%
I avoid eating when I'm hungry	53.3%	34.8%	12.0%
I avoid foods high in carbohydrates	51.1%	38.5%	10.5%

### ***THE LEVEL OF SELF-ESTEEM AMONG FEMALE PARTICIPANTS***

With the negative items reverse-coded, Table 5 reflects a generally positive level of self-esteem among participants. A clear majority agreed that they possess good qualities (59.0%), take a positive attitude toward themselves (49.5%), feel satisfied with themselves (46.4%), and regard themselves as persons of worth (48.0%). Agreement with the reverse-coded items further indicates positive self-evaluations, including low endorsement of feelings of failure, uselessness, and lack of self-respect once scoring direction is corrected. Neutral responses remained relatively common (28.9%–39.1%), suggesting some ambivalence in self-perceptions. Overall, the distribution indicates moderate-to-high self-esteem, with positive self-appraisal predominating across items after appropriate reverse coding.

**Table 5. The statements related to self-esteem**

<b>Statements related to self-esteem</b>	<b>Disagree</b>	<b>Neutral</b>	<b>Agree</b>
I feel that I have a number of good qualities	12.0%	28.9%	59.0%
All in all, I am inclined to feel that I am a failure*	18.4%	30.2%	51.4%
I take a positive attitude toward myself	19.1%	31.4%	49.5%

Statements related to self-esteem	Disagree	Neutral	Agree
I feel that I'm a person of worth	21.6%	30.5%	48.0%
On the whole, I'm satisfied with myself	14.8%	38.8%	46.4%
I feel I do not have much to be proud of*	20.9%	34.8%	44.3%
I certainly feel useless at times*	22.5%	33.5%	44.0%
I feel that I'm a person of worth, at least on an equal plane with others	21.5%	39.1%	39.3%
At times, I think I am not good at all*	27.7%	34.2%	38.2%
I wish I could have more respect for myself*	30.1%	34.8%	35.1%

\* Reverse items

### ***WEARABLE DEVICE USE EXPERIENCE AMONG FEMALE PARTICIPANTS***

As shown in Table 6, most female participants reported experience using wearable devices (68.9%), while 31.1% had never used one. Among users, the Apple Watch (60.3%) was the most popular brand, followed by Fitbit (12.5%) and Galaxy Watch (9.4%). In terms of duration, nearly one-third (29.5%) had used their device for more than two years, reflecting sustained engagement. The most tracked data were steps (50.4%), followed by heart rate (10.7%), workouts (8.5%), and calories (7.1%), indicating that daily activity monitoring was the primary use. The main reasons for continued use included increasing physical activity (24.1%) and using it as a watch (21.9%), while 20.1% reported they were no longer using their device. Additionally, 76.3% of respondents had used a health-related mobile app, and nearly one-third (27.7%) did not record any additional health information separately. Among those who did, the most frequently tracked data were physical activity (17.9%), sleep (15.2%), and food intake (13.4%). Overall, these findings indicate that female users engage with wearable technologies primarily for activity tracking and general wellness, with the Apple Watch dominating brand preference and long-term use reflecting integration into daily routines.

**Table 6. Wearable device use experience among female participants (users only)**

Questions	Category	Frequency	%
Do you have any experience with wearable devices (e.g., Apple Watch, Galaxy Gear, Fitbit)?	No	101	31.1%
	Yes	224	68.9%
What device brand have you been using?	Apple Watch	135	60.3%
	Fitbit	28	12.5%
	Galaxy Watch	21	9.4%
	Others	38	17%
	Xiaomi	2	0.9%
For how long have you been using the wearable device?	less than 1 week	30	13.4%
	less than 1 month	18	8.0%
	less than 3 months	17	7.6%
	less than 6 months	17	7.6%
	less than 1 year	27	12.1%
	less than 2 years	21	9.4%
	more than 2 years	66	29.5%
	Others	28	12.5%

Questions	Category	Frequency	%
What kind of data do you primarily measure with your smartwatch device?	Blood oxygen	3	1.3%
	Calories	16	7.1%
	Distance	14	6.3%
	Heart rate	24	10.7%
	Others	26	11.6%
	Sleep	9	4%
	Steps	113	50.4%
	Workout	19	8.5%
Why do you constantly use your device?	Design is aesthetics	10	4.5%
	N/A (Not using anymore)	45	20.1%
	Others	27	12.1%
	To identify health abnormality	7	3.1%
	To increase physical activity	54	24.1%
	To manage diet and body shape	13	5.8%
	To manage sleep	6	2.7%
	To record biometric/health information	13	5.8%
	Used as a watch	49	21.9%
Do you have health information that you usually record separately? (users)	Food intake and calories	30	13.4%
	Menstrual cycle and cramps	29	12.9%
	None	62	27.7%
	Physical activity	40	17.9%
	Sleep	34	15.2%
	Weight	29	12.9%
Have you ever used a smartphone health-related mobile app?	No	53	23.7%
	Yes	171	76.3%

### ***WEARABLE DEVICE NON-USE EXPERIENCE AMONG FEMALE PARTICIPANTS***

Among female participants with no experience using wearable devices (Table 7), the most common reason was not feeling the need to use one (50.5%), followed by cost concerns (20.8%) and other unspecified reasons (20.8%). Despite limited experience, 49.5% expressed willingness to use a smartwatch in the future, while 21.8% were not interested. About 51.5% used health-related mobile apps, indicating some engagement with digital health tools. Additionally, 29.7% did not record any health information separately, whereas others tracked menstrual cycles (25.7%) or weight and sleep data ( $\approx 12\%$ ). Overall, non-users showed moderate openness to future adoption of wearable technology.

### ***FACTORS AFFECTING SELF-ESTEEM AMONG FEMALE PARTICIPANTS***

A multiple linear regression analysis was conducted to examine factors associated with self-esteem (Table 8). The overall model was statistically significant,  $F(6, 167) = 6.15, p < .001$ , explaining 18.1% of the variance in self-esteem. Stress showed a positive association with self-esteem ( $\beta = 0.21, p = .004$ ), while eating attitudes were negatively associated with self-esteem ( $\beta = -0.19, p = .008$ ). Physical activity time emerged as a significant positive predictor ( $\beta = 0.20, p = .007$ ), whereas physical activity intensity was not significant. Wearable device usage period was also positively associated with

self-esteem ( $\beta = 0.18, p = .017$ ). Diagnostic statistics indicated acceptable independence of residuals (Durbin–Watson = 1.48).

**Table 7. Wearable device non-use experience among female participants (non-users only)**

Questions	Category	Freq.	%
If you have no experience with the device, why?	Because of the cost	21	20.8%
	Due to data security issues	1	1%
	I don't feel the need to use it	51	50.5%
	I don't like the design	5	5%
	I don't like the functions/features	2	2%
	Others	21	20.8%
If given the opportunity in the future, would you be willing to use a smartwatch?	No	22	21.8%
	Yes	50	49.5%
	Do not know	29	28.7%
Do you have health information that you usually record separately?	Food intake and calories	10	9.9%
	Menstrual cycle and cramps	26	25.7%
	None	30	29.7%
	Physical activity	10	9.9%
	Sleep	12	11.9%
	Weight	13	12.9%
Have you ever used a smartphone health-related mobile app?	No	49	48.5%
	Yes	52	51.5%

**Table 8. Association between stress, eating attitudes, physical activity intensity, physical activity time (daily duration), wearable device usage period, and self-esteem**

Predictor	B	Std. Err.	$\beta$ eta	t	p
Stress	0.145	0.050	0.21	2.90	0.004*
Eating attitudes	-0.128	0.048	-0.19	-2.67	0.008*
Physical activity intensity	0.071	0.050	0.10	1.42	0.157
Physical activity time	0.140	0.051	0.20	2.73	0.007*
Wearable device usage period	0.117	0.049	0.18	2.40	0.017*

*Model Fit and Diagnostics:*  $R^2 = 0.181$ , Adjusted  $R^2 = 0.151$ ,  $F(6, 167) = 6.15$ ,  $p < .001$ , and Durbin–Watson (DW) = 1.48, \*  $p < .05$

### ***FACTORS AFFECTING STRESS AMONG FEMALE PARTICIPANTS***

A multiple linear regression analysis was conducted to examine the association between eating attitudes, self-esteem, physical activity characteristics, wearable device usage period, and stress (Table 9). The overall model was statistically significant,  $F(5, 176) = 15.92, p < .001$ , explaining 31.1% of the variance in stress. Eating attitudes emerged as the strongest predictor of stress ( $\beta = 0.32, p < .001$ ), followed by self-esteem ( $\beta = 0.17, p = .009$ ). Neither physical activity intensity nor physical activity time showed a significant association with stress. Wearable device usage period was not significantly related to stress after controlling for psychological and behavioural factors. Diagnostic statistics indicated acceptable independence of residuals (Durbin–Watson = 1.85).

**Table 9. Association between eating attitudes, self-esteem, physical activity intensity, physical activity time, and wearable device usage period with stress**

Predictor	B	Std. Err.	beta	t	p
Eating attitudes	0.331	0.043	0.32	7.74	0.001*
Self-esteem	0.118	0.045	0.17	2.63	0.009*
Physical activity intensity	-0.026	0.051	-0.03	-0.51	0.610
Physical activity time	-0.035	0.052	-0.04	-0.68	0.501
Wearable device usage period	-0.055	0.049	-0.07	-1.13	0.258

*Model Fit and Diagnostics:*  $R^2 = 0.311$ , Adjusted  $R^2 = 0.292$ ,  $F(5, 176) = 15.92$ ,  $p < .001$ , and Durbin-Watson (DW) = 1.85; \*  $p < .05$

### ***FACTORS AFFECTING EATING ATTITUDES AMONG FEMALE PARTICIPANTS***

A multiple linear regression analysis was conducted to examine factors associated with eating attitudes. The overall model was statistically significant (Table 10),  $F(5, 176) = 16.05$ ,  $p < .001$ , explaining 31.3% of the variance in eating attitudes. Stress emerged as the strongest predictor of eating attitudes ( $\beta = 0.38$ ,  $p < .001$ ), indicating that higher stress levels were associated with more problematic eating attitudes. Self-esteem showed a significant negative association with eating attitudes ( $\beta = -0.10$ ,  $p = .040$ ). Wearable device usage period was positively associated with eating attitudes ( $\beta = 0.11$ ,  $p = .015$ ). In contrast, physical activity intensity and physical activity time were not significantly related to eating attitudes. Diagnostic statistics indicated acceptable independence of residuals (Durbin-Watson = 1.79).

**Table 10. Association between stress, self-esteem, physical activity intensity, physical activity time, and wearable device usage period with eating attitudes**

Predictor	B	Std. Err.	beta	t	p
Stress	0.377	0.044	0.38	8.49	0.001*
Self-esteem	-0.097	0.047	-0.10	-2.07	0.040*
Physical activity intensity	0.057	0.048	0.06	1.19	0.236
Physical activity time (daily duration)	-0.004	0.049	-0.00	-0.09	0.931
Wearable device usage period	0.111	0.045	0.11	2.46	0.015*

*Model Fit and Diagnostics:*  $R^2 = 0.313$ , Adjusted  $R^2 = 0.294$ ,  $F(5, 176) = 16.05$ ,  $p < .001$ , and Durbin-Watson (DW) = 1.79; \*  $p < .05$

### ***FACTORS AFFECTING PHYSICAL ACTIVITY INTENSITY AMONG FEMALE PARTICIPANTS***

A multiple linear regression analysis was conducted to examine the association between wearable device use experience, wearable device usage period, and physical activity intensity (Table 11). Wearable device use experience showed a strong and positive association with physical activity intensity ( $\beta = 0.63$ ,  $p < .001$ ), indicating a substantial effect size. In contrast, the wearable device usage period was not significantly associated with physical activity intensity ( $\beta = 0.04$ ,  $p = .398$ ). The overall model explained a small proportion of variance in physical activity intensity ( $R^2 = 0.004$ ). Diagnostic statistics indicated no autocorrelation in the residuals (Durbin-Watson = 2.07).

**Table 11. Association between wearable device use experience, wearable device usage period, and physical activity intensity**

Predictor	B	Std error	$\beta$ eta	t	p
Wearable device use experience	1.213	0.098	0.63	12.39	0.001*
Wearable device usage period	0.035	0.042	0.04	0.85	0.398

\* $p < .05$

The findings of the study extend beyond simple associations by offering insight into the underlying mechanisms connecting psychological factors, behaviour, and wearable technology use. While most relationships were consistent with existing literature, the remarked positive association between stress levels and self-esteem appears counterintuitive and warrants further interpretation. One possible explanation is that, within this specific population, higher self-esteem may coexist with increased performance pressure and higher academic expectations, particularly among female university students (Crocker & Park, 2004; Park & Crocker, 2005). Individuals with higher self-regard may set more demanding goals for themselves, which can elevate perceived stress levels despite maintaining a positive self-concept (Baumeister et al., 2003). Additionally, cultural and contextual factors may shape how stress is experienced and reported, reflecting a form of “functional stress” associated with achievement rather than diminished well-being (LePine et al., 2005).

From an informing systems perspective, wearable device use provides an important lens through which these relationships can be better understood (J. Cohen, 1988). Wearable technologies do not merely track behaviour; they function as continuous feedback systems that inform users about their physical activity, health status, and progress toward goals (I. Li et al., 2010; Piwek et al., 2016). This continuous flow of information could influence both psychological states and behavioural responses through self-monitoring, goal reinforcement, and adaptive decision-making (Bandura, 1991; Michie et al., 2009). For example, individuals experiencing higher stress may engage more actively with wearable devices, such as a coping or self-regulation mechanism, using feedback to adjust activity levels or maintain control over their health behaviours (Swan, 2013). Consequently, wearable technologies contribute to dynamic feedback loops that connect psychological conditions with behavioural outcomes, offering a more descriptive and exploratory understanding of the observed relationships rather than viewing them as isolated associations.

## DISCUSSION

The objective of this study was to examine the relationships among stress, self-esteem, eating attitudes, physical activity, and wearable device use among female university students, while also describing their psychological, behavioural, and digital health characteristics. Overall, participants reported good self-rated health, high satisfaction with university life, and moderate engagement in physical activity, yet experienced substantial academic- and fatigue-related stress alongside persistent weight- and appearance-related concerns. These findings suggest that positive health perceptions coexist with underlying psychological and behavioural vulnerabilities, highlighting the complexity of well-being within the university context.

The characteristics of the sample indicate a predominantly young, well-educated, and academically engaged population, which helps contextualize the observed stress patterns. Academic demands, particularly examinations and grades, emerged as the most prominent stressors, followed by fatigue, job-seeking concerns, and appearance-related issues. This profile suggests that stress is largely driven by performance-related pressures and future uncertainty, rather than external environmental factors. In this context, stress may reflect not only psychological strain but also achievement-oriented demands, which helps explain why some relationships, such as the positive association between stress and self-esteem, appear counterintuitive.

This profile highlights the central role of performance pressure and personal well-being in shaping stress among female students, while external stressors such as COVID-19 and social media comparison were comparatively less salient.

Regression analyses demonstrated that stress, self-esteem, and eating attitudes were closely interrelated, supporting the study's objective of examining these variables as a component of an integrated system. Stress was the strongest predictor of problematic eating attitudes, and eating attitudes were, in turn, the strongest predictor of stress, supporting a reciprocal stress–eating relationship. Self-esteem showed a protective association with eating attitudes, while its positive association with stress may reflect continued engagement and achievement orientation among students with higher self-esteem rather than maladaptive distress. This underlines the importance of interpreting psychological variables within their contextual and behavioural environment rather than as isolated constructs.

Physical activity showed selective associations with psychological outcomes. Daily physical activity duration, but not intensity, was positively associated with self-esteem, suggesting that regular participation is more important for positive self-evaluation than exertion level. However, physical activity was not significantly associated with stress or eating attitudes once psychological variables were considered, indicating that activity alone may not buffer stress or eating-related concerns without broader coping resources and strategies. This finding explains weaker or inconsistent relationships observed in the model and suggests that behavioural factors operate within broader psychological and contextual systems.

Wearable device use was widespread, with many users reporting long-term engagement. Wearable use experience was strongly associated with higher physical activity intensity, underscoring the role of wearables as facilitators of more vigorous activity. The findings indicate that adoption does not necessarily translate into sustained or meaningful behavioural change across all outcomes. From an informing systems perspective, wearable technologies function as tools that generate and deliver continuous feedback; however, their impact depends on how users interpret and act upon this information. Longer wearable usage was positively associated with self-esteem but also with eating attitudes, suggesting that sustained self-tracking may enhance motivation and self-monitoring while simultaneously increasing attention to body weight and food-related cognitions. This dual effect reflects the ambivalent psychological impact of digital self-tracking technologies.

Significantly, the gap between wearable adoption and wider behavioural or psychological outcomes may be explained by contextual and specific individual factors. Elements such as cultural norms, academic environment, time constraints, and digital literacy are more likely to impact how information from wearable devices is used in practice. In the Kuwaiti female student context, environmental constraints and lifestyle patterns may limit the translation of feedback into sustained behavioural change, even when adoption is high. This suggests that informing processes are not purely technological but are shaped by the interaction between information, user interpretation, and contextual conditions.

Among non-users, the most common barriers to not using wearable devices were lack of perceived need and cost concerns, rather than design, functionality, or data security issues. Notably, nearly half expressed willingness to use a smartwatch in the future, latent demand suggesting that improving perceived value and accessibility may increase uptake, and many reported using health-related mobile apps or tracking health information independently. This indicates latent openness to adoption, suggesting that perceived usefulness and affordability may be more critical than resistance to technology itself, and meaningful outcomes depend on how information is integrated into daily routines and behavioural decisions.

Overall, the findings emphasize that psychological factors, particularly stress, self-esteem, and eating attitudes, play a more central role than behavioral indicators alone in shaping well-being among female university students. Physical activity and wearable technologies contribute to a nuanced and context-dependent ways. Effective interventions should therefore integrate stress management, body

image support, and mindful engagement with digital health tools, rather than focusing solely on increasing activity levels or promoting wearable adoption. In other words, by framing wearable technologies as informing systems that influence behaviour through feedback, self-monitoring, and adaptive decision-making, this study provides a more integrated and explanatory understanding of health behaviour among female university students.

## **LIMITATIONS AND FUTURE RESEARCH**

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This study has several limitations that should be considered when interpreting the findings. First, the cross-sectional design precludes causal inference; the observed associations among stress, self-esteem, eating attitudes, physical activity, and wearable device use cannot establish directionality. Second, the study relied on self-reported measures for psychological constructs, physical activity patterns, and wearable use, which may be subject to recall error and social desirability bias. Third, the sample consisted of female university students and was dominated by business majors, which may limit generalisability to male students, non-student populations, or students in other academic disciplines. Fourth, wearable device engagement was captured primarily through experience and usage period; this may not fully reflect qualitative differences in how participants use wearables (e.g., goals, intensity of self-tracking, or reliance on weight- and calorie-focused features), which could help explain the mixed associations observed. Finally, although model fit statistics were acceptable, the explained variance in some outcomes was modest, suggesting that additional factors (e.g., sleep quality, dietary intake, body image dissatisfaction, social support, academic workload, or mental health history) may also contribute meaningfully to these relationships.

Building on these limitations, future research should employ longitudinal or prospective designs to clarify temporal ordering and potential reciprocal effects, particularly between stress and eating attitudes. Studies could also incorporate objective indicators of physical activity (e.g., device-derived metrics) and more detailed measures of wearable engagement (e.g., frequency of checking metrics, types of data tracked, and motivations for use). Expanding sampling to include students from diverse majors, multiple institutions, and male participants would strengthen external validity and allow subgroup comparisons. Finally, future work should test more comprehensive explanatory models that incorporate contextual and psychosocial variables (e.g., academic stress exposure, coping style, body image, and social support) to better identify leverage points for targeted interventions.

## **CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS**

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This study explored the relationships among stress, self-esteem, eating attitudes, physical activity, and wearable device use among female university students. The findings indicate that psychological factors (particularly stress, self-esteem, and eating attitudes) play a central and interconnected role in students' well-being, exerting a stronger influence than behavioural indicators alone. Stress and eating attitudes were found to mutually reinforce one another, while self-esteem functioned as an important protective resource. This reciprocal pattern suggests the presence of a self-regulatory cycle in which psychological strain and behavioural responses continuously influence each other. Physical activity showed a selective contribution, with regular participation supporting self-esteem, whereas intensity was less relevant. Wearable device use demonstrated a dual effect, being associated with higher physical activity intensity and greater self-esteem, while also coinciding with increased weight- and food-related cognitions for some users. This indicates that self-tracking may simultaneously support motivation and amplify body-related awareness, depending on how information is interpreted and used. Overall, the results underscore the complexity of female students' health experiences, where positive health perceptions and engagement with digital technologies coexist alongside academic stress and body-related concerns. These patterns suggest that behavioural and technological factors operate

within broader psychological systems rather than independently. These patterns suggest that interventions focusing solely on physical activity promotion or technology adoption are unlikely to be sufficient without addressing underlying psychological processes.

From a theoretical perspective, the findings support stress-coping, emotion regulation, and psychosocial resilience frameworks by illustrating how stress, eating attitudes, and self-esteem operate as a mutually reinforcing system. The differentiated effects of physical activity duration versus intensity extend existing evidence by highlighting the importance of sustained engagement rather than exertion for self-evaluative outcomes. In addition, the mixed associations observed for wearable device use refine digital health theorising by demonstrating that self-tracking technologies can simultaneously enhance motivation and self-esteem while amplifying body- and weight-focused cognitions. From an informing systems perspective, these findings highlight that the value of digital health technologies lies not only in data generation but in how information is processed, interpreted, and translated into action. These insights suggest that theoretical models of student health and digital health adoption should explicitly incorporate psychological mediators and acknowledge potential unintended consequences of prolonged self-monitoring.

In practical terms, the findings support a shift toward holistic approaches to student well-being in higher education and public health. Given the prominence of academic stress and its close link to eating attitudes, policies should prioritise integrated mental health provision, stress management, and body image support rather than relying primarily on lifestyle or physical activity initiatives. Universities can further strengthen support by embedding stress reduction and body image awareness within academic life, with counselling and wellbeing services addressing exam-related stress, fatigue, and appearance concerns. Physical activity programmes may be most effective when they emphasise regular participation and enjoyment rather than performance or intensity. These implications reflect the need to address both psychological drivers and behavioural outcomes simultaneously.

The results also have important implications for the design and dissemination of wearable devices and health applications. While wearable use was associated with beneficial activity and self-esteem outcomes, its link with eating attitudes suggests potential risks related to heightened body surveillance. Developers should therefore prioritise psychologically informed design features, including stress-sensitive feedback, reduced emphasis on weight- and calorie-focused metrics, and greater user control over tracked indicators. This reinforces the importance of designing informing systems that support adaptive behaviour rather than unintentionally reinforcing negative cognitive patterns. For non-users, improving perceived usefulness and affordability may be more influential for adoption than advanced technical features or data security considerations alone.

In sum, this study shows that stress, self-esteem, and eating attitudes are tightly interlinked and more central to female students' well-being than physical activity or wearable use alone. While regular activity and wearables may support engagement and self-esteem, their benefits are shaped by academic stress and body-related concerns, underscoring the need for holistic, student-centred wellbeing approaches. These conclusions should be interpreted within the specific cultural and institutional context of female university students in Kuwait, where academic expectations and social norms may shape both psychological experiences and technology use.

It is important to note that the sample was primarily composed of younger, highly educated, and digitally literate individuals, which may have influenced the overall patterns observed in this study – particularly the high levels of awareness, interest, and engagement with Smart City initiatives. As a result, caution should be exercised in generalizing the findings to the broader Kuwaiti population. Accordingly, the contribution of this study is primarily contextual and theoretical within similar populations, rather than broadly generalisable. Future studies are encouraged to adopt more representative sampling strategies to capture a wider spectrum of public perceptions.

## SOURCE OF FUNDING STATEMENT

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This study was supported and funded by the research sector, Arab Open University—Kuwait Branch, under grant number 25130

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## AUTHOR



**Dr. Sumayya Banna** received her Ph.D. in Information Systems from the University of Wollongong, Australia, in 2011. She also holds a Master's degree in Accounting Information and Management (2003) and a Bachelor's degree in Business Administration from the University of Texas at Dallas, USA. She is currently an Assistant Professor in the Faculty of Business Studies at the Arab Open University, Kuwait. Her research interests include technology adoption, ESG, digital behavior, health informatics, and wearable health technologies. She has published extensively in international journals and conference proceedings.