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Utilization of wearable smartwatch and its application among Saudi population

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Study purpose: It is important to understand the users' perceptions toward the use of smartwatches and the various factors that affect the adoption of smart watches. These findings would contribute to the literature in understanding users' usage, preferences, needs, and expectations about smartwatches that would aid smartwatches designers and also decision-makers in integrating the smartwatch technology in various service-enabled areas such a healthcare, e-learning etc. To address this gap, the objective of this study was formulated to understand the actual consumers' perceptions of toward the use of smartwatches and explore the critical factors affecting the adoption and intention to use smartwatches in the Kingdom of Saudi Arabia.

Methods: A cross-sectional study was designed to assess the actual perception of use smartwatches and to investigate the influencing factors that affect the utilization among Saudi population using the survey technique. Questionnaire design was based on the domains of Technology Acceptance Model (TAM) to determine the factors affecting smartwatches utilization. The sample composed of Saudi Arabian residents aged 18 years and above. The response rate for the online questionnaire that was distributed through the social media applications was 58.61% representing 135 participants. The data was collected in November 2020 and analyzed using the Statistical Packages for Software Sciences (SPSS).

Results: The prevalence of participants who had knowledge about smartwatch was 94.1%. When comparing the demographic characteristics between those owning and not owning a smartwatch, it was found that educational level

(X2 = 9.365; $p = 0.025$) and knowledge about smartwatch (X2 = 7.897; $p = 0.005$) had significant relationship with owning a smartwatch. When comparing between design aesthetic, perceived usefulness, ease of use, enjoyment and healthology in relation to the socio demographic characteristics, it was found that respondents in the older age group (≥45 years) (F = 11.797; p<0.001) and those with master degree (F = 3.449; $p = 0.002$) observed to have significantly lower mean score in design aesthetic while females exhibited significantly higher score in perceived enjoyment and healthology (T = −3.629; $p = 0.001$) as well as design aesthetic (T = −2.070; $p = 0.043$).

Conclusion: Factors such as age, education, gender, income can significantly affect the adoption of wearable devices in Saudi Arabia.

KEYWORDS

wearable technology, smartwatch, Saudi Arabia, utilization and application, healthcare

Introduction

In the past few years, new types of wearable technologies have been evolving, which are referred as wearable smart devices or simply wearable devices. The wearable devices can be defined as computing devices that has advanced electronics and communication technologies and can be worn by individuals, facilitating interaction between the users and a smart platforms. Furthermore, the wearable devices, especially smartwatches, are getting significant attention and huge investments by big smartphone companies (Apple, Samsung, LG, Google, etc.) which illustrate the evolving era of smartwatches (Dehghani et al., 2018).

The smart wearable device is one of the fastest growing markets globally. In 2012, smartwatches drew the attention when the Pebble Smartwatch was introduced on the crowdfunding website (Choi and Kim, 2016). In 2016, the International Data Corporation (IDC) anticipated that smartwatch market would substantially grow by 2020, estimating a market of $17.8 billion (Afrouz and Wahl, 2019).

The smartwatch is a wrist-worn device with a portable computer that can connect to other devices via short range wireless connectivity. In addition to having an integrated clock, the smartwatch can provide alert notifications, collect data via sensors and upload personal data in a 24 x 7 manner in an attempt to improve the quality of daily life (Seneviratne et al., 2017). Smartwatches have the advantage of connecting to the skin since they are wrist mounted which facilitate their wide use in the fields of sports and healthcare. Smartwatches could decrease consumer's attention given to other devices, such as smartphones, as important information is conveniently displayed on the user's wrist (Chuah et al., 2016).

In a recent study conducted in Germany (Afrouz and Wahl, 2019), it was identified that attitude toward using wearable technology was the strongest predictor for the intention to purchase smartwatches followed by Perceived Behavioral Control. The smartwatch can be used for various purposes such as navigation, financial payments, physical and mental health monitoring, sport analytics, and medical insurance analytics (Seneviratne et al., 2017). It is worth mentioning that most smartwatch producers have merged the technology and fashion in an attempt to attract more consumers (Chuah et al., 2016; Moore, 2016).

International reports predict an increased demand for smartwatches in the future while the current actual sales are relatively less than what is forecasted (Chuah et al., 2016). This difference implies that what influences the consumers to own smartwatches is not sufficiently known; especially that smartwatches technology is in the initial stages of its lifecycle. Therefore, more studies are needed to address this gap in the knowledge.

There have been various studies (Baudier et al., 2020; Scott, 2020) identified in the literature that focused on the adoption and use of smart devices. Various influencing the adoption of smart watches. Scott (Scott, 2020) has identified that privacy concerns is one of the major factors affecting the smart watches adoption in USA. A similar study (Scott, 2020) conducted in four developed countries including USA, UK, France, and Germany has found that age and gender factors moderately impact the adoption of smart watches. In addition, it was found that perceived ease of use had no impact on the adoption attitudes. However, in a study conducted in South Korea, found that perceived ease of use had a significant impact on the intention to use of smart watches (Baudier et al., 2020). Other, factors such as prior experience, affective quality and technology-related anxiety impacted the adoption of smart watches among the older adults (Choe and Noh, 2018). Similarly, another study (Lazaro et al., 2020) conducted in Malaysia identified four dimensions including perceived benefits, healthology, IT innovation, and smartwatch as luxury products which

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TABLE 1 Socio demographic characteristics of participants in relation to the usage of smartwatch.

Study variables	Overall	Own Smartwatch		X2	*P*-value
	N (%) ($n = 135$)	Yes N (%) ($n = 65$)	No N (%) ($n = 70$)		
Age group					
• 18–34 years	34 (25.2%)	19 (29.2%)	15 (21.4%)	1.233	0.540
• 35–44 years	55 (40.7%)	26 (40.0%)	29 (41.4%)		
• ≥45 years	46 (34.1%)	20 (30.8%)	26 (37.1%)		
Gender					
• Male	75 (55.6%)	37 (56.9%)	38 (54.3%)	0.095	0.758
• Female	60 (44.4%)	28 (43.1%)	32 (45.7%)		
Highest education					
• High school degree	24 (17.8%)	06 (09.2%)	18 (25.7%)	9.365	**0.025** **
• Professional degree	22 (16.3%)	08 (12.3%)	14 (20.0%)		
• Bachelor's degree	63 (46.7%)	36 (55.4%)	27 (38.6%)		
• Master's degree	26 (19.3%)	15 (23.1%)	11 (15.7%)		
Occupational status					
• Employed	89 (65.9%)	43 (66.2%)	46 (65.7%)	2.055	0.726
• Self-employed	13 (09.6%)	07 (10.8%)	06 (08.6%)		
• Student	02 (01.5%)	0	02 (02.9%)		
• Unemployed	17 (12.6%)	08 (12.3%)	09 (12.9%)		
• Others	14 (10.4%)	07 (10.8%)	07 (10.0%)		
Monthly income (SAR)					
• <5,000	29 (21.5%)	13 (20.0%)	16 (22.9%)	3.961	0.266
• 5,000–10,000	27 (20.0%)	09 (13.8%)	18 (25.7%)		
• 10,001–20,000	55 (40.7%)	29 (44.6%)	26 (37.1%)		
• >20,000	24 (17.8%)	14 (21.5%)	10 (14.3%)		
Knowledge about smartwatch					
• Yes	127 (94.1%)	65 (100%)	62 (88.6%)	7.897	**0.005****
• No	08 (05.9%)	0	08 (11.4%)		

significantly influenced the adoption of smartwatches. Using a complex model smartwatches adoption among IT professionals was investigated in a study (Said et al., 2021) and it was found that self-efficacy, personal innovativeness, social media influence, social image, aesthetics and external social influence were major factors of influence. Similarly, various studies (Hsiao, 2017; Kranthi and Ahmed, 2018; Dutot et al., 2019; Pua, 2020; Visuri et al., 2021) identified different technical factors affecting the intention to use smart watches, while the behavioral and user-centered aspects were undermined.

As highlighted by Choia and Seongcheol (Choi and Kim, 2016), most academic studies on smartwatches have been driven by technology rather than audience. Thus, it is important to understand the users' perceptions toward the use of smartwatches and the various factors influencing the adoption of smartwatches. These findings would contribute to the literature in understanding users' usage, preferences, needs, and expectations that would aid smartwatches developers and also decision-makers in integrating the smartwatch technology in various service-enabled areas such as healthcare and e-learning. This study aims to understand the actual consumers' perceptions of using smartwatches and explore the critical

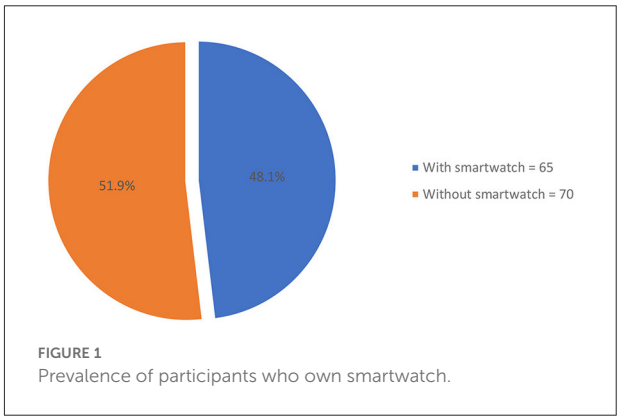

FIGURE 1
Prevalence of participants who own smartwatch.

TABLE 2 Descriptive statistics of Technology Acceptance Model (TAM) subscales.

Variables	Mean ± SD	Mean (%)	Median (min–max)	Cronbach Alpha	No. of Items
Perceived usefulness	15.5 ± 2.68	77.5%	16 (8–20)	0.764	04
Perceived ease of use	17.4 ± 2.24	87.0%	17 (9–20)	0.717	04
Perceived enjoyment and healthology	16.1 ± 3.20	80.5%	16 (4–20)	0.804	04
Design aesthetic	16.0 ± 2.99	80.0%	16 (8–20)	0.931	04
Attitude toward using smartwatch	14.2 ± 3.98	71.0%	16 (8–20)	0.916	04
Subjective norm	10.4 ± 4.07	52.0%	10 (4–20)	0.873	04
Perceived behavioral control	11.7 ± 2.47	58.5%	12 (6–15)	0.837	03
Purchase intention	9.79 ± 3.62	48.9%	11 (3–15)	0.964	03

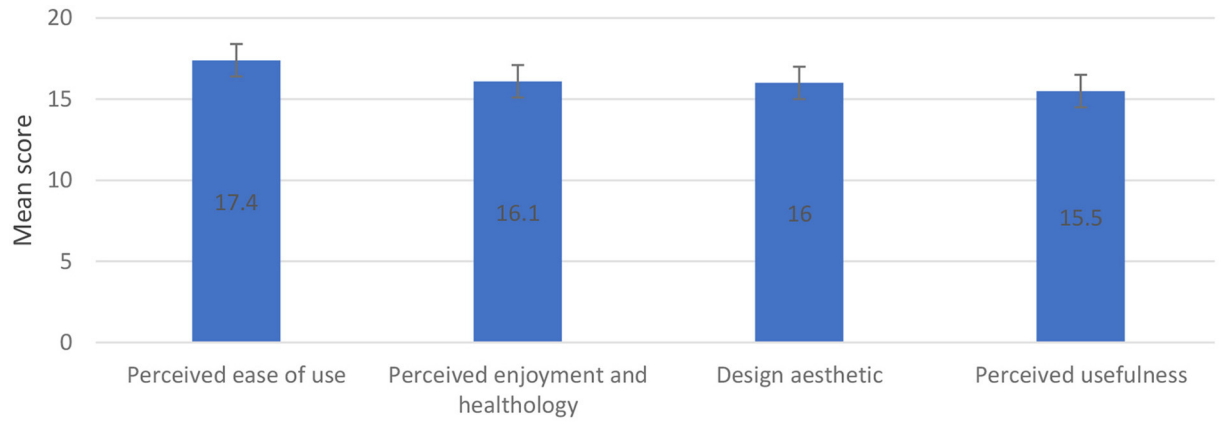

FIGURE 2
Mean distribution of design aesthetics perceived usefulness, ease of use, enjoyment and healthology.

factors influencing the intention to use smartwatches in the Kingdom of Saudi Arabia.

Methods

Study design

This is a cross-sectional study following the STROBE checklist for observational and cross-sectional studies (Equator-Network, 2021) that took place in November 2020. The study received the Institutional Review Board approval from Imam Abdulrahman Bin Faisal University, Saudi Arabia. The study follows the guidelines of Helsinki Declaration of 1975.

Questionnaire design

The questionnaire used was partially adopted from another study (Afrouz and Wahl, 2019) and contained 15 items to achieve the main objective of the study. The questionnaire was developed to measure the level of awareness, actual usage, and influencing factors to use smartwatches in the Kingdom of Saudi Arabia. Also, the questions were piloted before the actual use with the participants and the final questionnaire was confirmed clear and visible by two academic experts. In addition, the questionnaire was translated to Arabic language and validated using the back-and-forth translation process, and then distributed among Saudi targeted population.

Technology Acceptance Model (TAM) is one of the most used theoretical models to examine human behavior regarding potential acceptance or rejection of the new technology (Marangunić and Granić, 2014). This model helps to understand the individual's acceptance of new technologies or application. In this study we used eight domains of TAM which are Perceived ease of use (PE), Perceived usefulness (PU), Perceived Enjoyment and healthology (PEH), Design Aesthetic (DA), Attitude Toward Using (ATU), Subjective Norm (SN), Perceived Behavioral control (PBI) and Purchase Intention of use (PI).

The first five items in the questionnaire were obtaining demographic characteristics of the participants: gender, age, occupation, level of education, and monthly salary. Item 6 is dedicated to assess smartwatch awareness. Item 7 verifies the participants acquisition status of a smartwatch. Finally, items 8 to 15 are used, all items were measured on a 5-point Liker

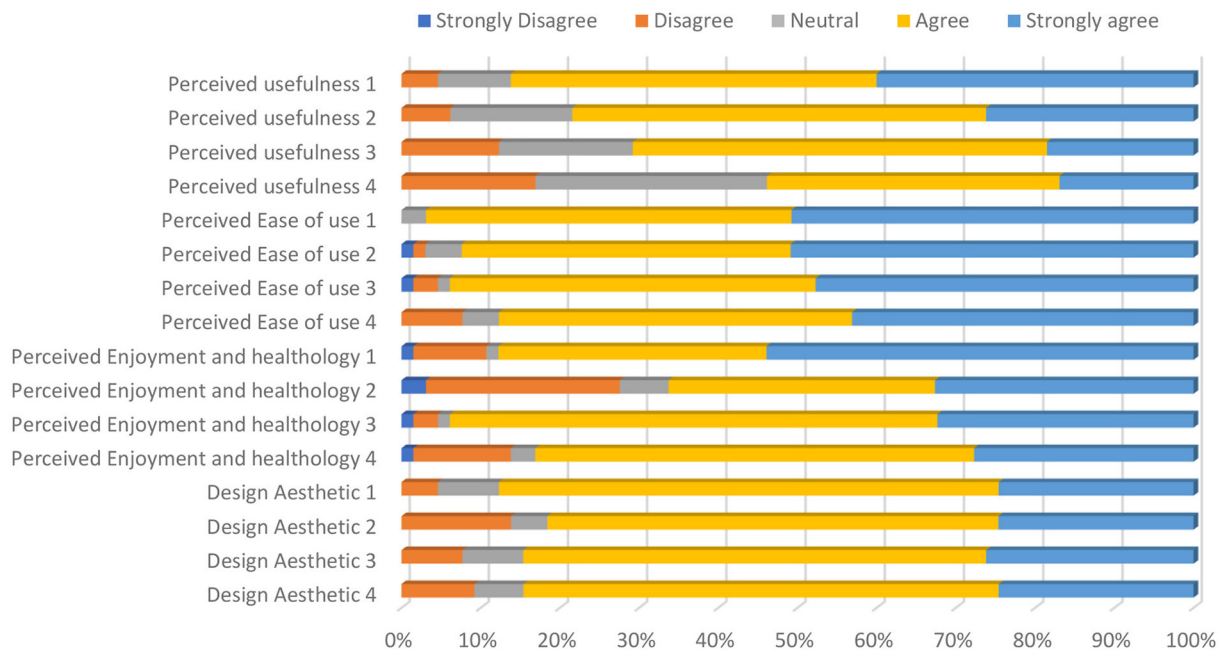

FIGURE 3
Explanation for each domain affects the smartwatch user on Saudi Arabia.

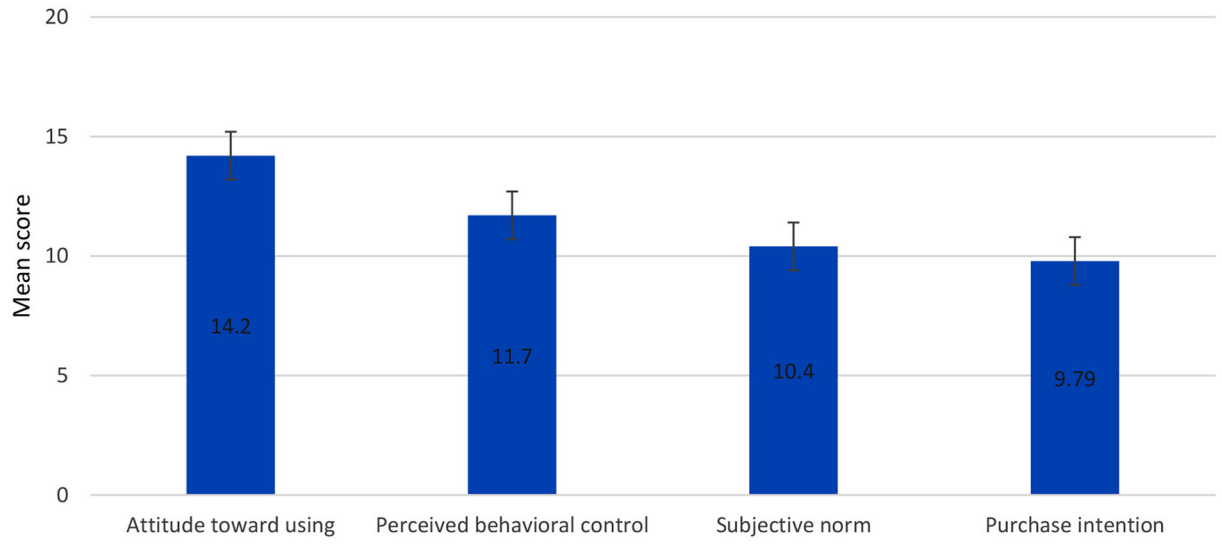

FIGURE 4
Mean distribution of attitude toward using, perceived behavioral control, subjective norm and purchase intention.

scale where 1 strongly disagree, 2 disagree, 3 neutral, 4 agree, and 5 is strongly agree. If the responses for item 7 is yes, then a set of having smartwatch questions were asked from item 8 to 11 to assess the perception of users toward the smartwatch utilization. If the responses for item 7 is no, then a set of don't own smartwatch questions were asked from item 12 to 15 to assess the perception of Saudi participants toward the smartwatch utilization.

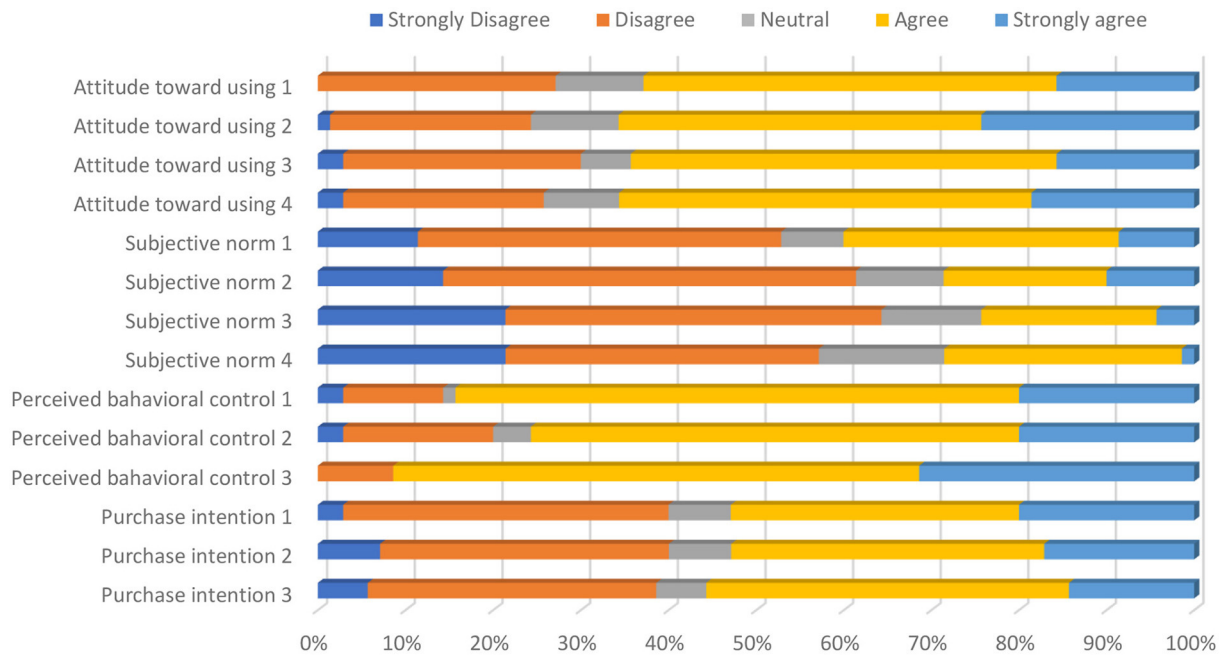

FIGURE 5
Explanation for each domain affects the customer who don't won smartwatch on Saudi Arabia.

TABLE 3 Correlation (Pearson-R) between design aesthetic, perceived usefulness, ease of use, enjoyment and healthology.

SN	Variables	I	II	III	IV
I	Perceived usefulness	1			
II	Perceived ease of use	**0.599****	1		
III	Perceived enjoyment and healthology	**0.357****	**0.452****	1	
IV	Design aesthetic	**0.318****	**0.509****	**0.610****	1

**Correlation was significant at the 0.01 level 2-tailed.

TABLE 4 Correlation (Pearson-R) between attitude toward using smartwatch, subjective norm, perceived behavioral control and purchase intention.

SN	Variables	I	II	III	IV
I	Attitude toward using smartwatch	1			
II	Subjective norm	0.488**	1		
III	Perceived behavioral control	0.395**	0.289**	1	
IV	Purchase intention	0.783**	0.499**	0.414**	1

**Correlation was significant at the 0.01 level 2-tailed.

Study setting and participants

The sample population size was constituted by Saudi citizens all over the kingdom of Saudi Arabia. The participants have provided their agreement to participate in the questionnaire of this. Participation is entirely voluntary, and the responses were anonymized.

Inclusion and exclusion criteria

All of the Saudi citizens aged 18 years and older, whether or not using a smartwatch, were considered eligible in this study. All other residents of other nationalities were excluded.

Data collection

The questionnaire was distributed to the participants using online social media platforms and the data were collected from 14 to 29 November 2020. The survey link was forwarded to 231 participants through various social media channels including twitter, WhatsApp, Instagram, and Facebook. By the end of two-weeks, 135 responses were received indicating a response rate of 58.6%.

Statistical analysis

Categorical variables were presented as frequency and percentages (%) while continuous variables were presented as mean and standard deviation, whenever

TABLE 5 Comparison between design aesthetic, perceived usefulness, ease of use, enjoyment and healthology in relation to the socio demographic characteristics of participants.

Factor	PU Mean ± SD	PE Mean ± SD	PEH Mean ± SD	DA Mean ± SD
Age group[a]				
• 18–34 years	15.4 ± 2.24	17.9 ± 1.76	16.4 ± 2.78	17.3 ± 2.40
• 35–44 years	15.9 ± 2.63	17.4 ± 2.16	16.9 ± 2.17	16.9 ± 1.98
• ≥45 years	15.2 ± 3.15	17.1 ± 2.73	14.8 ± 4.27	13.7 ± 3.36
F-test	*0.454*	*0.624*	*2.739*	*11.797*
P-value	*0.637*	*0.539*	*0.072*	*<0.001***
Gender[b]				
• Male	15.2 ± 2.72	17.5 ± 2.30	14.9 ± 3.11	15.4 ± 2.78
• Female	15.9 ± 2.62	17.3 ± 2.18	17.6 ± 2.68	16.9 ± 3.09
T-test	*−0.915*	*0.389*	*−3.629*	*−2.070*
P-value	*0.364*	*0.699*	*0.001***	*0.043***
Highest education[a]				
• High school degree	16.0 ± 2.76	17.0 ± 2.00	17.8 ± 2.71	17.2 ± 4.31
• Professional degree	16.4 ± 2.72	17.7 ± 2.05	15.5 ± 5.01	16.9 ± 1.64
• Bachelor's degree	15.2 ± 2.67	17.5 ± 2.54	16.3 ± 3.04	16.5 ± 2.56
• Master's degree	15.6 ± 2.77	17.3 ± 1.75	15.4 ± 2.56	14.0 ± 3.27
F-test	*0.506*	*0.170*	*0.951*	*3.449*
P-value	*0.679*	*0.916*	*0.422*	*0.022***
Occupational status[a]				
• Employed	15.1 ± 2.85	17.3 ± 2.43	16.1 ± 2.69	16.4 ± 2.17
• Self-employed	16.0 ± 2.52	18.4 ± 1.99	14.9 ± 5.89	16.3 ± 5.22
• Unemployed	15.9 ± 2.36	16.7 ± 1.75	16.5 ± 3.46	15.8 ± 4.27
• Others	17.0 ± 1.63	17.9 ± 1.57	17.1 ± 2.61	13.9 ± 2.73
F-test	*1.171*	*0.807*	*0.628*	*1.518*
P-value	*0.328*	*0.495*	*0.600*	*0.219*
Monthly income (SAR)[a]				
• <5,000	15.3 ± 3.04	16.8 ± 2.19	15.2 ± 4.90	16.2 ± 3.74
• 5,000–10,000	16.6 ± 2.13	18.0 ± 2.00	17.7 ± 2.00	16.9 ± 1.76
• 10,001–20,000	15.4 ± 3.05	17.5 ± 2.63	16.5 ± 2.77	16.4 ± 2.61
• >20,000	15.2 ± 1.72	17.5 ± 1.51	15.2 ± 2.39	14.5 ± 3.35
F-test	*0.540*	*0.496*	*1.571*	*1.717*
P-value	*0.656*	*0.686*	*0.206*	*0.173*

PU, Perceived Usefulness; PE, Perceived Ease of use; PEH, Perceived Enjoyment and Healthology; DA, Design Aesthetic.
[a]P-value has been calculated using One-way Anova test.
[b]P-value has been calculated using independent t-test.
**Significant at $p < 0.05$ level.

appropriate. Between comparisons of variables, Chi-square test, independent *t*-test and One-way ANOVA test were applied. Correlation procedures were also conducted to determine the linear agreement between Technology Acceptance Model domains. $P \leq 0.05$ was considered statistically significant while $p \leq 0.01$ were considered highly statistically significant. All data analysis was performed using the Statistical Packages for Software Sciences (SPSS) version 21, IBM Corporation.

Results

A total of 135 responses were received to evaluate their use of wearable devices (smartwatch). As seen in Table 1, the most common age group was 35–44 years (40.7%) with more than a half (55.6%) were males and 46.7% had a bachelor's degree.

With regards to their occupational status, nearly two third (65.9%) were employed with 40.7% of them earned 10,001–20,000 SAR per month. The prevalence of participants who had information about smartwatch was 94.1% (Figure 1).

TABLE 6 Comparison between attitude toward using, subjective norm, perceived behavioral control and purchase intention in relation to the socio demographic characteristics of participants.

Factor	ATU Mean ± SD	SN Mean ± SD	PBC Mean ± SD	PI Mean ± SD
Age group[a]				
• 18–34 years	13.8 ± 4.41	9.67 ± 3.72	12.3 ± 2.28	8.87 ± 3.81
• 35–44 years	13.7 ± 4.09	10.3 ± 4.54	11.9 ± 2.08	9.48 ± 3.60
• ≥45 years	14.9 ± 3.63	10.9 ± 3.78	11.3 ± 2.95	10.7 ± 3.46
F-test	*0.706*	*0.453*	*0.867*	*1.350*
P-value	*0.497*	*0.638*	*0.425*	*0.266*
Gender[b]				
• Male	14.5 ± 3.72	9.58 ± 3.53	11.5 ± 2.29	9.84 ± 3.45
• Female	13.8 ± 4.30	11.4 ± 4.49	12.0 ± 2.68	9.72 ± 3.85
T-test	*0.657*	*-1.907*	*-0.797*	*0.141*
P-value	*0.513*	*0.061*	*0.428*	*0.888*
Highest education[a]				
• High school degree	14.3 ± 4.67	10.2 ± 4.66	11.1 ± 3.34	9.61 ± 4.27
• Professional degree	13.1 ± 4.50	10.5 ± 4.38	11.9 ± 2.25	9.21 ± 3.53
• Bachelor's degree	14.4 ± 3.51	11.1 ± 3.95	11.6 ± 2.24	9.96 ± 3.45
• Master's degree	14.8 ± 3.43	9.00 ± 2.86	12.9 ± 1.14	10.4 ± 3.32
F-test	*0.430*	*0.722*	*1.251*	*0.238*
P-value	*0.732*	*0.542*	*0.298*	*0.870*
Occupational status[a]				
• Employed	13.7 ± 3.62	10.2 ± 3.93	11.8 ± 2.05	9.76 ± 3.46
• Self-employed	13.5 ± 4.18	8.67 ± 2.73	11.7 ± 3.39	8.33 ± 4.41
Student	18.5 ± 2.12	6.50 ± 2.12	13.0 ± 2.83	9.00 ± 4.24
• Unemployed	13.1 ± 5.30	11.0 ± 5.45	11.2 ± 3.35	9.11 ± 4.11
• Others	18.0 ± 2.00	13.4 ± 2.94	11.7 ± 3.45	12.3 ± 2.93
F-test	*2.836*	*1.854*	*0.227*	1.195
P-value	*0.031***	*0.129*	*0.922*	0.322
Monthly income (SAR)[a]				
• <5,000	14.9 ± 4.94	11.1 ± 5.15	11.9 ± 2.91	9.75 ± 3.68
• 5,000 – 10,000	13.4 ± 3.91	10.7 ± 3.63	11.7 ± 2.49	9.39 ± 4.02
• 10,001 – 20,000	14.0 ± 3.49	10.1 ± 4.12	11.7 ± 2.21	9.77 ± 3.36
• >20,000	15.0 ± 3.89	9.60 ± 2.95	11.7 ± 2.71	10.6 ± 3.84
F-test	*0.548*	*0.356*	*0.044*	*0.234*
P-value	*0.651*	*0.785*	*0.988*	*0.872*

ATU, Attitude toward use; SN, Subjective Norm; PBC, Perceived Behavioral Control; PI, Purchase Intention.
[a]P-value has been calculated using One-way ANOVA test.
[b]P-value has been calculated using independent t-test.
**Significant at $p < 0.05$ level.

When comparing the socio-demographic characteristics against owning a smartwatch. It was found that educational level (X2 = 9.365; $p = 0.025$) and knowledge about smartwatch (X2 = 7.897; $p = 0.005$) had significant association with owning a smartwatch.

The descriptive statistics of Technology Acceptance Model (TAM) subscales are shown in Table 2. Based on the results, the mean score of perceived usefulness, ease of use, enjoyment and healthology, and design aesthetic were 15.5, 17.4, 16.1, and 16, respectively (Figures 2, 3), while the mean score of attitudes toward using smartwatch, subjective norm, perceived behavioral control and purchase intention were 14.2, 10.4, 11.7, and 9.79, respectively (Figures 4, 5). With regards to reliability analysis, the Cronbach Alpha was higher on purchase intention domain (Cronbach Alpha: 0.964), followed by design aesthetic domain (Cronbach Alpha: 0.931) and attitude toward using smartwatch

(Cronbach Alpha: 0.916) while perceived ease of use was the lowest (Cronbach Alpha: 0.717).

Table 3 showed the correlation procedure between design perceived usefulness, ease of use, enjoyment and healthology. It revealed that the correlation between perceived usefulness, perceived ease of use, perceived enjoyment and healthology, and design aesthetic were positively highly statistically significant ($p < 0.01$).

In Table 4, the correlation between attitude toward using smartwatch, subjective norm, perceived behavioral control, and purchase intention had high statistical significance as well ($p < 0.01$).

When comparing between design aesthetic, perceived usefulness, ease of use, and enjoyment and healthology in relation to the socio demographic characteristics (Table 5), it was found that respondents in the older age group (≥45 years) ($F = 11.797$; $p < 0.001$) and those with master degree ($F = 3.449$; $p = 0.002$) observed to have significantly lower mean score in design aesthetic while females exhibited significantly higher score in perceived enjoyment and healthology ($T = -3.629$; $p = 0.001$) as well as design aesthetic ($T = -2.070$; $p = 0.043$).

Table 6, shows that only occupational status showed significant difference with attitude toward the use of smartwatch with students exhibited significantly higher score compared to the other groups ($F = 2.836$; $p = 0.031$). Other socio demographic characteristics did not differ significantly when compared to attitude toward use, subjective norm, perceived behavioral control and purchase intention (all $p > 0.05$).

Discussion

The purpose the study is to assess the actual perception of use of smartwatches and to investigate the influencing factors for utilizing them among Saudi population. This study enrolled 135 respondents to evaluates perception of the Saudi, regardless of owning a smartwatch or not, and their adoption intention toward this device. The findings of this study revealed that most Saudis, around 94%, have pre-existing knowledge about smart watches, approximately half (48%) of the Saudi who own smartwatch were: male (56.95%), had Bachelor's degree (55.4%), employed (66.2%) and their monthly income 10.000–20.000SR (44.6%). However, in a study conducted in Indonesia (Anggraini et al., 2019), it was identified that most respondents heard about smartwatches, half of them have a smartwatch and more than 70% of the remaining half don't have a smartwatch due to high price.

With regards to coefficient reliability during the study analysis, the reliability was higher in PI, followed gradually by DA, ATU, SN, BPI, PEH, PU, while PE was the lowest. This study revealed a strong association and positive relationship between the four domains: PU, PE, PEH and DA which were affected by the responder owning a smartwatch. It also showed strong association and positive correlation between the other four domains: ATU, SN. PBC, and PI which were affected by the responder who doesn't own a smartwatch among Saudi population. This is consistent with Hakroh et al.'s paper (Hokroh et al., 2020) where they investigated the association between: Heart Health (HH), Weight Management (WM), and Sleep Improvement (SI) as antecedents for Perceived Usefulness (PU). Also, Wearable Design (WD), Graphical User Interface (GUI) and Health Information Support (HIS) as antecedents for Perceived Ease of Use (PEU) as influences factors among Saudi population.

In this study, it is identified that Saudi citizens who own a smartwatch are usually highly educated and knowledgeable about smartwatches. Saudi users over the age of 45 as well as those with master degree level both observed with low interest in design aesthetic for smartwatches while female users had remarkable interest in perceived enjoyment and healthology as well as design aesthetic. According to Dehghani et al. (Dehghani et al., 2018) gender plays an important role in smartwatch adoption intention and actual usage. Most of smartwatches companies don't pay attention to the aesthetic features but they focus on technology features in designs. Furthermore, Companies need to consider marketing pending on the customer needs, gender and different setting. In a study conducted in Taiwan (Hsiao, 2017), it was identified that perceived product contributes effectively on adoption intention of smartwatches.

Moreover we observed that Saudi students who don't own a smartwatch showed positive attitude toward the use of smartwatch technology, in other words, student believe that using a smartwatch is a good decision compared to the other occupational status groups. In a study (Arpaci et al., 2021) conducted in Malaysia, machine learning techniques were applied in assessing the adoption and it was the first study to gather a novel assistance to the information systems (IS) literature by assessing the student behavioral intention for adoption of wearable technologies (smartwatch).

The total number of participants in the study was only 135, which is considered a key limitation therefore, the generalization of findings in this study must be done with care by future researchers. In addition, this study focused on smartwatches in general. However, the functionalities of the smartwatches may vary with the brand, their purpose, features and functionalities. Therefore, our findings may not be applicable to all types of smartwatches. However, researchers can develop many future research projects from this study. The study can be taken forward in a larger scale with the use of mixed-methods such as interviews

and surveys for in-depth analysis of the results. In addition, the future studies may focus on comparing the users' perceptions, adoption, and intention to use according to the smartwatches analyzed by brand, functions and features, and purpose.

Finally, our study carries both practical and theoretical implications. The findings from this study, such as the usage behavior of males vs. females; younger vs. older population; married vs. single; highly educated vs. low educated. can help in understanding the users' perceptions among the different groups, which can help the designers and developers of smartwatches in developing the devices according to the users' expectations and can streamline their marketing strategy by targeting a specific group of customers. Most importantly, our study contributes to enriching the knowledge gap in the literature about the users' perceptions, use, and adoption of smartwatches in the Middle East, and contributes significantly in understanding the users' preferences and adoption traits in this region, which can serve as a reference for future work in this domain.

Conclusion

Nowadays, Wearable's are becoming more mercantile and used among customers all over the world. Smartwatches are the most popular wearable's device known by most of the population. This study found the actual consumers' perceptions of smartwatch utilization in kingdom of Saudi Arabia, using TAM show the significant relationship between the 8 domains: PU, PE. PEH, DA, ATU, SN, PBC, and PI that used to determine the smartwatches acceptance among the Saudi population whether they own a smartwatch or not. These domains are considered as effective factors toward smartwatch utilization to provide wearable devices designed according to the user's preferences and needs. Finally, we can say, perceived product contributes effectively on adoption intention of smartwatches. Further related research is needed in order to further explore the influential factors for adoption intention, that were found to be significant in this study, for the sake of better understanding of consumers' needs.

Data availability statement

The raw data supporting the conclusions of this article can be provided by the authors upon request without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the Institution Review Board (IRB) at Imam Abdulrahman bin Faisal University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

Author DuA is an employee of Saudi Aramco. Author HM is an employee of Johns Hopkins Aramco Healthcare.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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