Health Information Seeking and Digital Tool Engagement Among Diabetes Patients: Post-COVID-19 Perspectives on Trust, Misinformation, and AI-Based MOH Services: cross-sectional

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Abstract

Background: The proliferation of digital health tools and online platforms has significantly transformed the ways in which patients with chronic conditions, such as diabetes, seek, interpret, and act on health information. This shift has been further accelerated by the COVID-19 pandemic, which intensified reliance on mobile health (mHealth) services and social media, while simultaneously heightening exposure to misinformation. Understanding how individuals with diabetes navigate this complex digital landscape is vital for informing safe and effective health communication strategies.

Objective: This study aimed to explore the health information-seeking behaviours of people living with diabetes in Saudi Arabia in the post-pandemic era, with a particular focus on their use of digital health tools, engagement with Ministry of Health (MOH) services, reliance on social media, and approaches to verifying online health information

Methods: A descriptive cross-sectional survey was conducted among 419 individuals living with diabetes. Participants were recruited using a stratified random sampling approach to ensure diversity in age, education level, and familiarity with digital health tools. Data were collected via a structured online questionnaire comprising demographic items, Likert-scale questions on digital health behaviours, and perceptions of MOH-provided AI services such as chatbots and self-assessment tools. Descriptive and inferential analyses were performed using SPSS and R. Structural equation modelling (SEM) and UpSet plots were employed to examine behavioural intersections and latent constructs.

Results: Participants reported a multidimensional approach to online health information-seeking, combining formal validation through physicians (n = 245), peer-reviewed sources (n = 213), and government-affiliated platforms (n = 187). Usage of MOH digital tools was high, with the 937-consultation hotline and Sehhaty virtual clinics among the most utilised services. However, trust in AI-based tools such as chatbots remained moderate; many participants viewed them as supportive but not sufficient for clinical decision-making. SEM results revealed a significant path from eHealth engagement to perceived trust in AI tools, while UpSet plots illustrated frequent co-occurrence of cautious behaviours, such as verifying information across multiple sources. Cronbach’s alpha scores for all core constructs ranged from 0.73 to 0.91, indicating high internal consistency. SEM analysis showed a significant positive association between eHealth engagement and trust in AI tools (? = 0.69, p < 0.001), while UpSet plots revealed common co-occurrence of cautious validation behaviours.

Conclusions: The findings highlight a digitally engaged yet critically reflective patient population that favours authoritative sources and cautiously adopts AI-supported health tools. These behaviours underscore the need for public health strategies that strengthen digital health literacy, embed trusted information within widely used platforms, and promote transparency in AI systems. By understanding how diabetes patients interact with digital health environments, stakeholders can design more effective interventions to combat misinformation and support informed, safe healthcare decisions.

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Abstract

Background: The proliferation of digital health tools and online platforms has significantly transformed the ways in which patients with chronic conditions, such as diabetes, seek, interpret, and act on health information. This shift has been further accelerated by the COVID-19 pandemic, which intensified reliance on mobile health (mHealth) services and social media, while simultaneously heightening exposure to misinformation. Understanding how individuals with diabetes navigate this complex digital landscape is vital for informing safe and effective health communication strategies. **Aim:** This study aimed to explore the health information-seeking behaviours of people living with diabetes in Saudi Arabia in the post-pandemic era, with a particular focus on their use of digital health tools, engagement with Ministry of Health (MOH) services, reliance on social media, and approaches to verifying online health information. **Methods:** A descriptive cross-sectional survey was conducted among 419 individuals living with diabetes. Participants were recruited using a stratified random sampling approach to ensure diversity in age, education level, and familiarity with digital health tools. Data were collected via a structured online questionnaire comprising demographic items, Likert-scale questions on digital health behaviours, and perceptions of MOH-provided AI services such as chatbots and self-assessment tools. Descriptive and inferential analyses were performed using SPSS and R. Structural equation modelling (SEM) and UpSet plots were employed to examine behavioural intersections and latent constructs. **Results:** Participants reported a multidimensional approach to online health information-seeking, combining formal validation through physicians (n = 245), peer-reviewed sources (n = 213), and government-affiliated platforms (n = 187). Usage of MOH digital tools was high, with the 937-consultation hotline and Sehhaty virtual clinics among the most utilised services. However, trust in AI-based tools such as chatbots remained moderate; many participants viewed them as supportive but not sufficient for clinical decision-making. SEM results revealed a significant path from eHealth engagement to perceived trust in AI tools, while UpSet plots illustrated frequent co-occurrence of cautious behaviours, such as verifying information across multiple sources. Cronbach’s alpha scores for all core constructs ranged from 0.73 to 0.91, indicating high internal consistency. SEM analysis showed a significant positive association between eHealth engagement and trust in AI tools (β = 0.69, $p < 0.001$), while UpSet plots revealed common co-occurrence of cautious validation behaviours. **Conclusion:** The findings highlight a digitally engaged yet critically reflective patient population that favours authoritative sources and cautiously adopts AI-supported health tools. These behaviours underscore the need for public health strategies that strengthen digital health literacy, embed trusted information within widely used platforms, and promote transparency in AI systems. By understanding how diabetes patients interact with digital health environments, stakeholders can design more effective interventions to combat misinformation and support informed, safe healthcare decisions.

Keywords: Health information seeking behaviour; Digital health literacy; Diabetes self-management; social media and health misinformation; Chatbots in health communication; eHealth trust and verification; Post-pandemic digital engagement

Introduction

The global COVID-19 pandemic significantly transformed healthcare delivery and accelerated the adoption of digital health technologies across the world. As traditional face-to-face healthcare interactions became restricted, individuals increasingly turned to online sources, mobile applications, and artificial intelligence (AI)-enabled tools to seek health information, conduct self-diagnoses, and manage chronic conditions [1-4]. For patients living with diabetes—a population particularly vulnerable to complications from COVID-19 the demand for accessible, timely, and trustworthy health information became critical [5-7]. This shift not only prompted wider utilisation of digital platforms but also raised concerns regarding the accuracy, credibility, and influence of online health information, particularly when disseminated via social media and non-regulated digital channels [7-9].

Saudi Arabia responded proactively to the health information crisis by strengthening its digital health infrastructure through initiatives such as the Sehhaty application and the 937-consultation service. These Ministry of Health (MOH) platforms offer a range of services, including symptom checkers, virtual clinics, AI-powered chatbots, and access to official health guidance [10, 11]. While these interventions aimed to improve health literacy, facilitate remote care, and reduce misinformation, their effectiveness relies heavily on user trust, awareness, and behavioural engagement. The complexity of navigating digital health ecosystems poses challenges, particularly for patients with chronic conditions who must evaluate the credibility of health messages, often without professional supervision [12, 13].

A growing body of research has explored digital health behaviour during the pandemic, yet few studies have focused specifically on individuals with chronic diseases in the Gulf region [14, 15]. Previous investigations have demonstrated varying degrees of digital health engagement, ranging from passive consumption to active self-diagnosis and health management [16-18]. In parallel, social media platforms have emerged as double-edged tools facilitating the rapid dissemination of public health guidance while simultaneously acting as conduits for misinformation, rumours, and unverified advice [19-21]. This is especially concerning for populations managing complex conditions such as diabetes, where misinformation can lead to delayed treatment, inappropriate self-care, or avoidance of professional consultation [22, 23].

Moreover, AI-integrated tools, such as chatbots and automated triage systems, have gained prominence in mHealth applications. These tools are designed to streamline patient support, reduce healthcare burden, and provide real-time, personalised guidance [14, 24]. However, public trust in such technologies remains tentative, especially in contexts where users prefer human reassurance and culturally responsive care [1, 25, 26]. Evaluating public perceptions of AI-powered services including their diagnostic authority, perceived safety, and influence on behaviour—therefore remains vital to successful implementation and long-term adoption.

This study builds upon this emerging discourse by providing a nuanced investigation into the digital health behaviours of diabetes patients in Saudi Arabia. It examines their patterns of online information-seeking, their trust in various health information sources, and their familiarity with key MOH digital tools. Additionally, the study explores the role of social media in shaping health behaviours and assesses the perceived reliability of AI-enabled services such as chatbots [27-29]. By employing a comprehensive questionnaire and leveraging both descriptive and inferential analyses including structural equation modelling (SEM) and UpSet plots this research offers novel insights into how patients interpret, validate, and act upon health information in a rapidly evolving digital ecosystem.

Crucially, this study also investigates how digital health behaviours intersect—how users triangulate information through multiple channels, combine official health tools with social media inputs, and selectively trust digital services based on their prior experiences and perceptions. This intersectional approach provides a richer understanding of the cognitive and behavioural strategies employed by patients navigating an often-fragmented digital health environment [30, 31]. The findings hold significant implications for policymakers, health educators, and technology developers seeking to strengthen digital health literacy, safeguard against misinformation, and optimise the usability and trustworthiness of national health platforms.

By focusing on a vulnerable yet digitally active population, this research contributes novel empirical evidence to the fields of health informatics, digital health communication, and chronic disease management. It underscores the importance of cultivating digitally literate environments in which patients are empowered to critically appraise information, engage with trusted AI-based health services, and make informed health decisions. As countries continue to digitise their healthcare infrastructure in the post-pandemic era, studies like this are crucial to informing sustainable, equitable, and culturally tailored digital health strategies [32, 33].

Study Aims:

To explore the digital health information-seeking behaviours, source validation strategies, and engagement with Ministry of Health (MOH) digital tools among diabetes patients in Saudi Arabia following the COVID-19 pandemic, with a focus on trust in AI-based technologies and exposure to health-related misinformation.

Study objectives:

- To examine the sources of health information used by diabetes patients, particularly the use of social media platforms and official MOH services.
- To assess the strategies used by patients to validate online health information and identify patterns in trust across different sources (e.g., physicians, peer-reviewed literature, influencers, family/friends).
- To evaluate the level of familiarity and usage of digital self-diagnosis tools, including the Sehhaty app, 937 consultation service, and AI-driven chatbots.
- To investigate patients' perceptions of reliability, safety, and authority of AI-assisted tools for self-assessment and diagnosis.
- To explore how digital health behaviours differ according to demographics and technology proficiency.
- To identify implications for public health practice, especially in mitigating the risks of misinformation and enhancing trust and engagement with digital health services.

What This Study Adds

- Provides unique insights into digital health behaviours specifically among individuals living with diabetes a high-risk population often underrepresented in digital health research.
- Captures how patients navigate health information in the aftermath of COVID-19, reflecting evolving behaviours in a digital-first healthcare environment.
- Assesses actual public engagement with Ministry of Health services in Saudi Arabia, including Sehhaty, the 937 hotline, and AI-based medical chatbots.
- Employs Structural Equation Modelling (SEM) and UpSet plots to explore behavioural overlaps, offering a layered understanding of how patients combine multiple sources and tools.
- Reveals that patients commonly cross-reference physicians, peer-reviewed sources, and official accounts to validate health information suggesting robust digital discernment.
- Shows that while patients accept AI-powered self-assessment tools, trust in automation remains conditional, with a continued preference for human oversight.
- Highlights the protective role of digital health literacy in filtering misinformation and supports targeted strategies for enhancing patient safety online.
- Informs developers and public health stakeholders on how to enhance digital health engagement through transparency, personalisation, and trust-building interventions.

Methods

Research Design

This study employed a descriptive cross-sectional survey design to investigate the health information-seeking behaviour of individuals living with diabetes in the post-COVID-19 period. The research aimed to explore how these individuals' access, evaluate, and respond to health information, particularly in relation to their use of social media and awareness of emerging digital health services such as the Ministry of Health's *Sehhaty* application. The cross-sectional approach enabled a comprehensive snapshot of the participants' information consumption habits, perceptions of misinformation, and trust in digital versus traditional health sources, all within the context of chronic disease self-management.

Study Population

The study targeted adult individuals diagnosed with diabetes (Type 1 or Type 2) residing in Saudi Arabia. Eligibility criteria included being aged 18 years or older, having a formal diagnosis of diabetes, and the ability to read and respond to a digital questionnaire in Arabic. Both patients actively receiving care and those managing their condition independently were considered eligible to participate. The population was particularly relevant due to the increased vulnerability of individuals with diabetes during the COVID-19 pandemic and the resulting rise in health-related digital content aimed at this group.

Sampling Strategy and Sample Size

A stratified sampling strategy was employed to enhance representativeness and reduce sampling bias. The population was stratified based on key demographic and clinical characteristics, including age group, gender, education level, and type of diabetes. Within each stratum, participants were recruited using targeted outreach to ensure proportional representation, particularly among individuals with varied levels of familiarity and engagement with digital health platforms.

Recruitment took place over a two-month period beginning in February 2024. Participants were recruited through a combination of web-based outreach (e.g. social media platforms and diabetes-related forums), patient support groups, and announcements in healthcare clinics. This approach ensured the inclusion of both digitally active individuals and those accessing traditional health services. A total of 419 participants successfully completed the questionnaire. The sample size was deemed adequate to support the application of inferential statistical techniques, including correlation analysis, multiple regression, and structural equation modelling (SEM), and to reflect the diversity of the target population.

Data Collection Instrument

The data collection instrument was a comprehensive digital questionnaire, developed based on previous literature and refined through expert feedback and a pilot test with 11 patients. The survey consisted of five structured sections. The first section introduced the study, outlined its objectives, and addressed ethical considerations such as anonymity, confidentiality, and voluntary participation. Informed consent was obtained electronically before the survey could be accessed.

The second section gathered demographic data and technology usage profiles, including age, gender, education level, employment status, diabetes type, and levels of familiarity and frequency of use of AI-integrated wearable health devices. This was followed by the third section, which assessed participants' digital health engagement and health information-seeking behaviours through a series of Likert-scale items. Respondents rated their agreement with statements regarding the reliability of various information sources—such as peer-reviewed literature, government social media accounts, health influencers, friends and family, and physicians—when verifying online health content. It also captured behaviours such as searching for health information before and after medical visits and the frequency of general online health searches.

The fourth section focused on participants’ experiences with Ministry of Health (MOH) digital services and self-diagnosis tools, particularly those offered through the Sehhaty application. This included familiarity and usage of features such as the COVID-19 symptom checker, general self-assessment tools, virtual consultation clinics, the 937-consultation hotline, and the AI-powered medical chatbot. Participants also evaluated how these services influenced their healthcare decisions—such as whether they sought in-person care or avoided unnecessary visits.

The fifth and final section of the questionnaire explored perceived reliability and trust in AI-driven tools. It included Likert-scale items measuring perceptions of safety, authority, and diagnostic competence of AI services, particularly the Sehaty chatbot. Questions assessed whether participants trusted the chatbot’s medical recommendations, whether they still preferred human doctor confirmation, and the extent to which they viewed such tools as viable alternatives or supplements to traditional healthcare interactions. this is the data collection instrument section.

The internal consistency of the instrument was evaluated using Cronbach’s alpha coefficient across the main constructs and for the overall scale. As shown in Table 1, the computed domains demonstrated acceptable to excellent reliability. The domain assessing *Digital Self-Diagnosis Tools* exhibited the highest internal consistency (α = 0.91), followed closely by *Information Validation Sources* and *Familiarity with MOH Digital Services*, both of which recorded alpha values of 0.88. The constructs *Online Information Seeking Behaviour* (α = 0.82) and *Perceived Reliability and Influence of Self-Assessment* (α = 0.80) also reflected strong internal reliability. The lowest, yet still acceptable, alpha coefficient was observed for *Perception of Chatbot Safety and Trust* (α = 0.73), indicating a moderate level of internal consistency. The Cronbach’s alpha for the full scale, encompassing all Likert-scale items, was 0.85, confirming the overall reliability of the measurement instrument for capturing the targeted health information-seeking behaviours and technology-related perceptions among individuals with diabetes.

Table 1: Internal Consistency (Cronbach’s Alpha) for Core Constructs Related to Health Information-Seeking and Trust in Digital Tools Among Diabetes Patients

Main Variables	**Cronbach Alpha**
Information Validation Sources	0.88
Digital Self Diagnosis Tools	0.91
Online Information Seeking Behaviour	0.82
Familiarity with MOH Digital Services	0.88
Perceived Reliability and Influence of Self-Assessment	0.80
Perception of Chatbot Safety and Trust	0.73
All Items	0.85

Data Collection Procedure

The questionnaire was administered online via a secure and encrypted platform (Google Forms), ensuring anonymity and voluntary participation. Links to the survey were distributed through patient networks, social media groups, and outpatient clinics treating diabetic patients. Reminder messages were sent at the third and sixth weeks of the data collection period to encourage participation. On average, participants required 10–12 minutes to complete the survey.

Data Analysis

Quantitative data were analysed using SPSS (version 29) and R (version 4.3.0). Descriptive statistics, including means, standard deviations, frequencies, and percentages, were used to summarise participant characteristics and Likert-scale responses. Cronbach's alpha was computed to assess internal consistency and reliability of the multi-item scales. Inferential analyses included t-tests and ANOVA to examine group differences, Spearman's rank correlation to evaluate associations between key variables, and structural equation modelling (SEM) using the lavaan package in R to explore theoretical relationships among constructs such as eHealth engagement, trust in digital tools, and social media behaviours. Visualisation of SEM results and UpSet plots was conducted using the semPlot and UpSetR packages, respectively.

Result

The demographic distribution of participants is summarised across three variables: age group, education level, and employment status (see Figure 1. The age distribution reveals that the majority of participants (183) fell within the 26–35 age range, with 81 participants in the 36–45 age group. The older age ranges had a limited number of participants, with only three individuals aged 66–75. The data indicates that most participants were young to middle-aged adults.

In terms of educational background, the majority of participants (294) possessed a graduate degree, while 68 participants held a postgraduate degree. Other educational levels, including primary school (3 participants) and elementary school (3 participants), were under-represented. Government employees represented the largest group, comprising 226 participants, whereas 89 participants indicated unemployment. A total of 43 participants were employed in the private sector, while 63 participants were retired. The findings indicate a primarily educated and employed sample, with the government sector constituting the largest employment category.

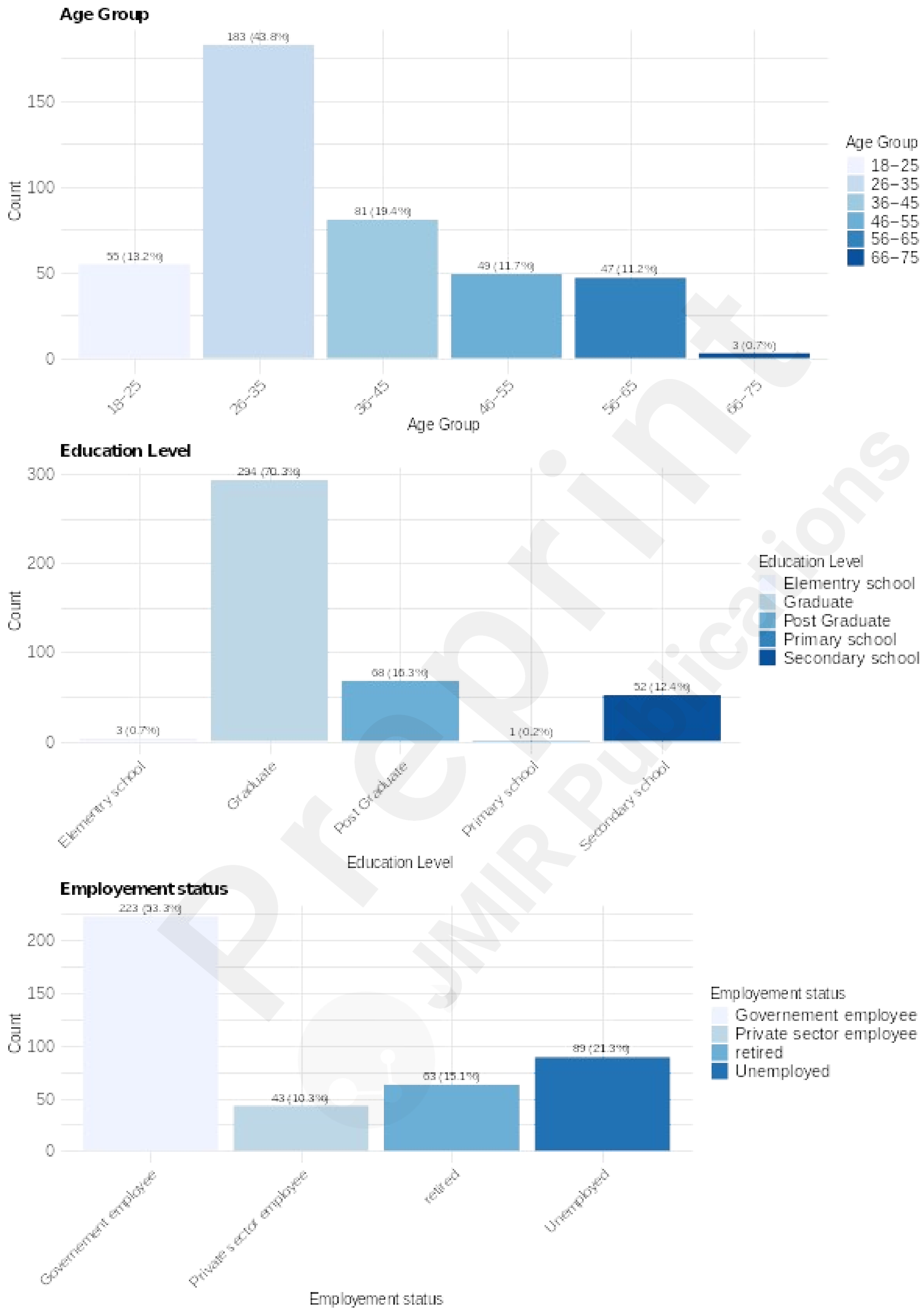

Figure 1: Distribution of participants by age group, education level, and employment status

The demographic and usage characteristics of the participants are represented that include only two option of responses generated in five pie charts (see Figure 2). The sample comprised 65.4% males (286 participants) and 34.6% females (153 participants). The majority of participants (69.3%, 303 individuals) reported having Type 2 diabetes, whereas 30.7% (170 individuals) reported having Type 1 diabetes.

Data indicates that 78.2% of participants (327) utilised devices in Arabic, whereas 21.8% (91 participants) employed English. In response to enquiries regarding self-diagnosis through online health information, 71.9% (306 participants) stated they did not engage in self-diagnosis, whereas 28.1% (120 participants) reported having done so. The Sehhaty app exhibited low usage, with 74.3% (316 participants) reporting they had never utilised the app, in contrast to 25.7% (109 participants) who had used it. The findings reveal a predominantly Arabic-speaking sample, with a notable proportion choosing not to participate in self-diagnosis or utilise digital health management tools such as Sehhaty.

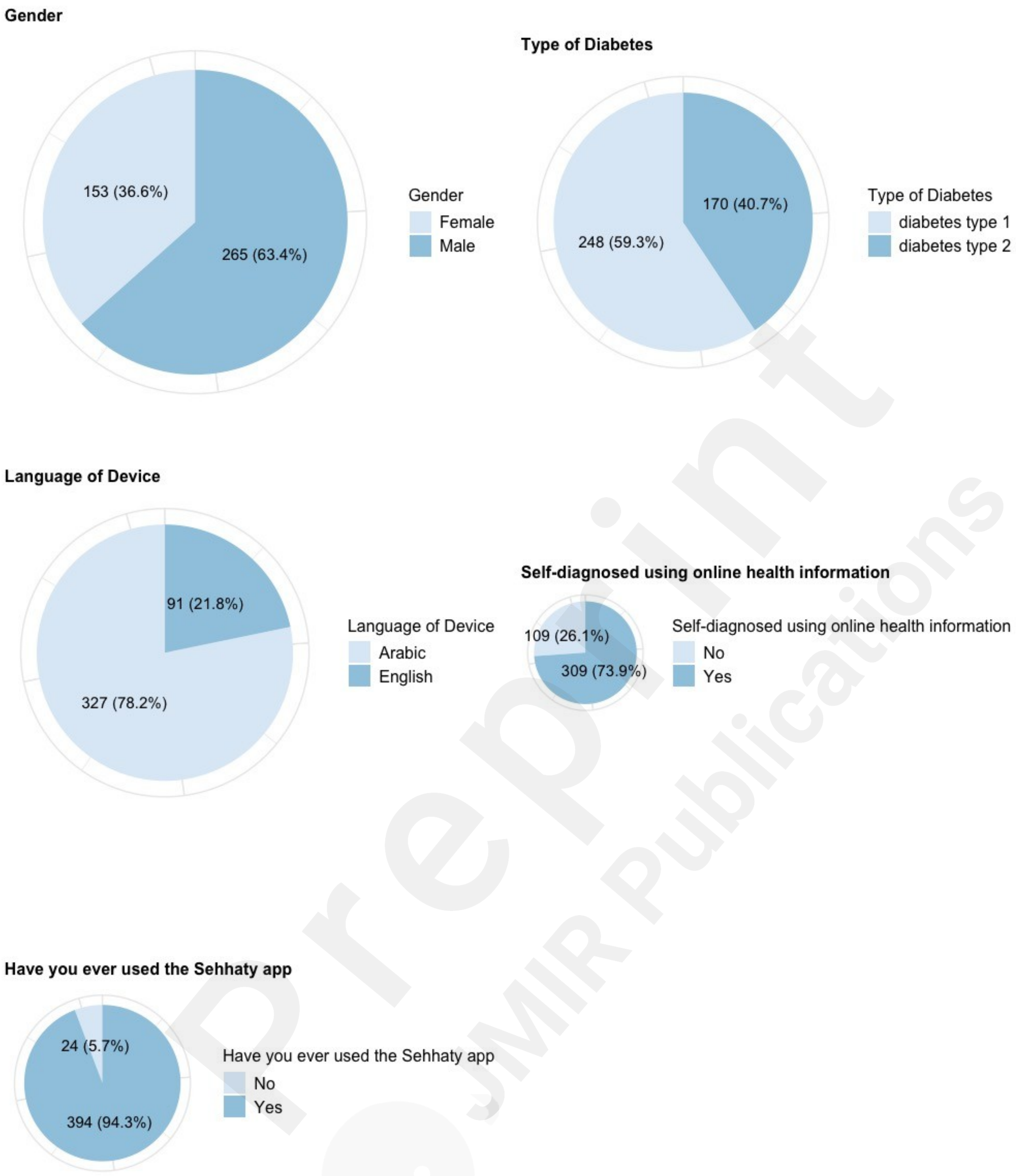

Figure 2: Distribution of participants by gender, type of diabetes, device language, self-diagnosis behaviour, and prior use of the Sehhaty app

The data on device usage for health information seeking indicates that the predominant choice among participants was smartphones, with 401 individuals reporting their use. In contrast, only a small number utilised desktops (3 participants), laptops (9 participants), or tablets (5 participants). This underscores the central role of smartphones as the main instrument for obtaining health information (see Figure 3).

Most participants classified their experience with technology as either elementary users (180) or advanced users (174). A total of 60 participants reported being professional users, whereas only 24 identified as beginners. The analysis of mobile phone usage revealed that the predominant duration reported was 3–4 hours per day, with 141 participants indicating this range, followed by 5–6 hours, reported by 121 participants. A smaller number of participants indicated mobile phone usage exceeding 6 hours (87) or falling below 1 hour (64). The findings suggest a technologically adept sample that predominantly utilises smartphones for health information and allocates considerable daily time to mobile devices.

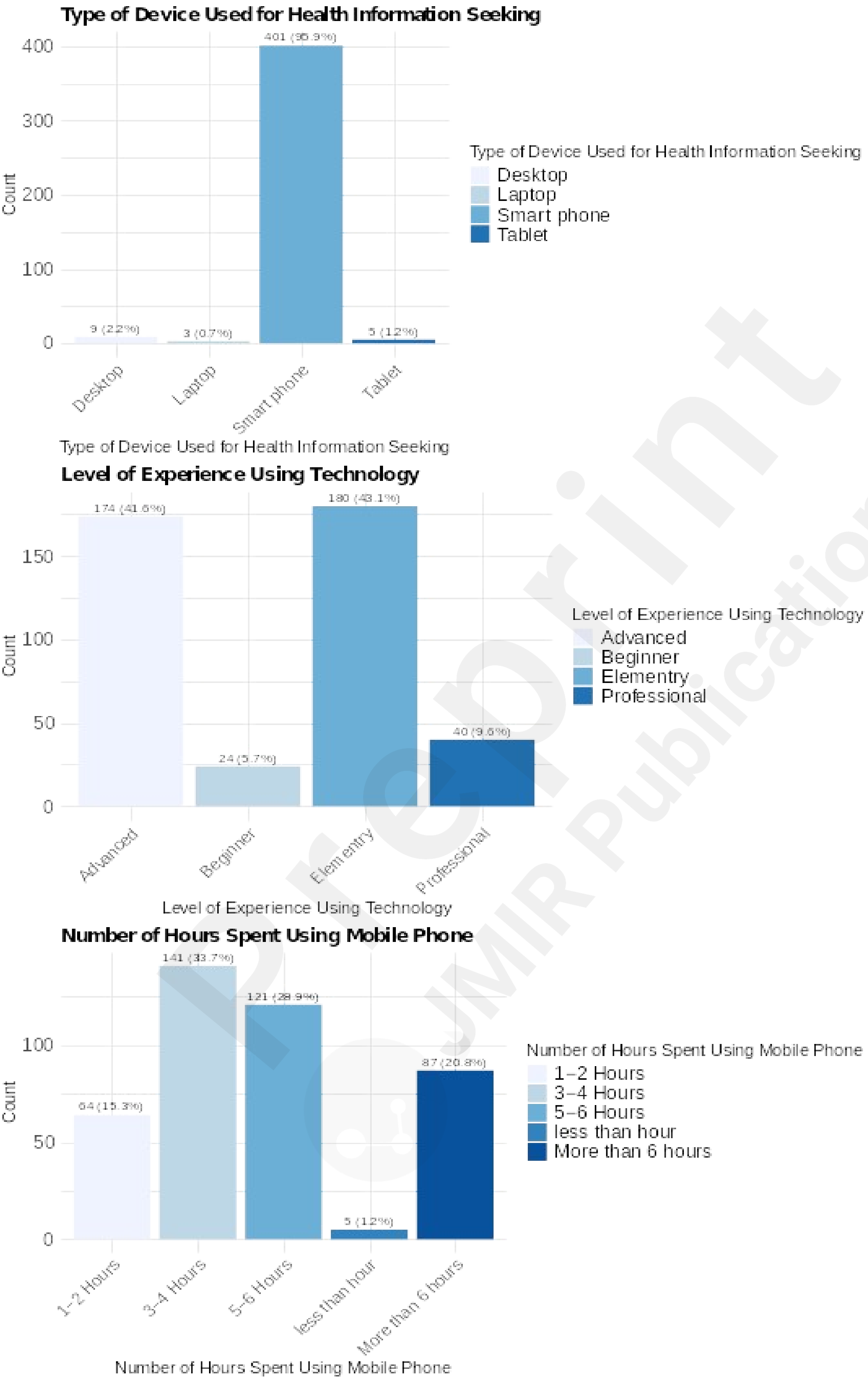

Figure 3: Participants’ technological profiles: device types used for health information seeking, level of technology experience, and time spent on mobile phone use.

The findings concerning health information messaging behaviour and responses to advice are Findings illustrated in three treemaps (see Figure 4). The majority of participants indicated that they received health information messages on a “Weekly” basis (44.5%) or “Daily” (23.7%), whereas a smaller proportion received them “Monthly” (12.9%) or “Never” (18.9%). Upon receiving health messages, 52.2% of individuals verified the reliability of the information, whereas 28.2% disregarded spam messages. Sharing messages with family occurred at a rate of 8.9%, while directly attempting the advice was reported by 6.9%. Public sharing of the information was the least common, at only 3.8%.

Analysis of participants' responses to health advice indicated that 57.9% did not attempt to use any medications as a result of the messages received. Among those who participated, 20.3% reported health improvements, whereas 18.4% indicated no change in their condition. A minor proportion (1.7%) reported experiencing either minor or severe side effects. The findings suggest that the majority of participants assess the reliability of health messages and approach the advice with caution, frequently avoiding action without further validation.

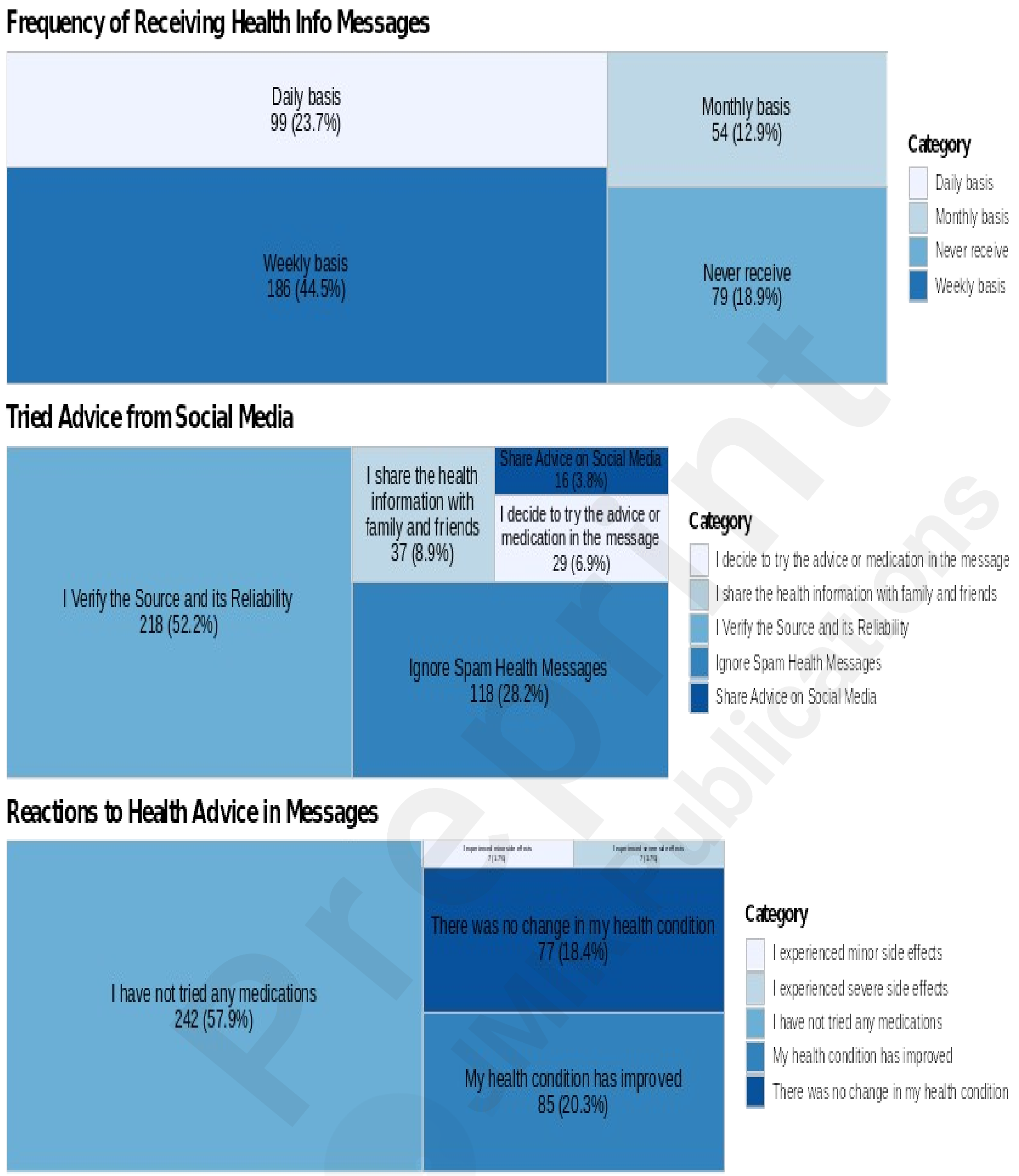

Figure 4: Patterns of engagement with unsolicited health messages: frequency of receipt, response to advice from social media, and reported outcomes after acting on received health information

The findings regarding health information messaging behaviour and responses to advice are illustrated through three treemaps (see Figure 5). The majority of participants indicated that they received health information messages on a “Weekly” basis (44.5%) or “Daily” (23.7%), whereas a smaller proportion received them “Monthly” (12.9%) or “Never” (18.9%). Upon receiving health messages, 52.2% verified the reliability of the information, whereas 28.2% disregarded spam messages. Sharing messages with family occurred at a rate of 8.9%, while directly trying the advice was reported by 6.9%. Public sharing of the information was noted by only 3.8% of participants.

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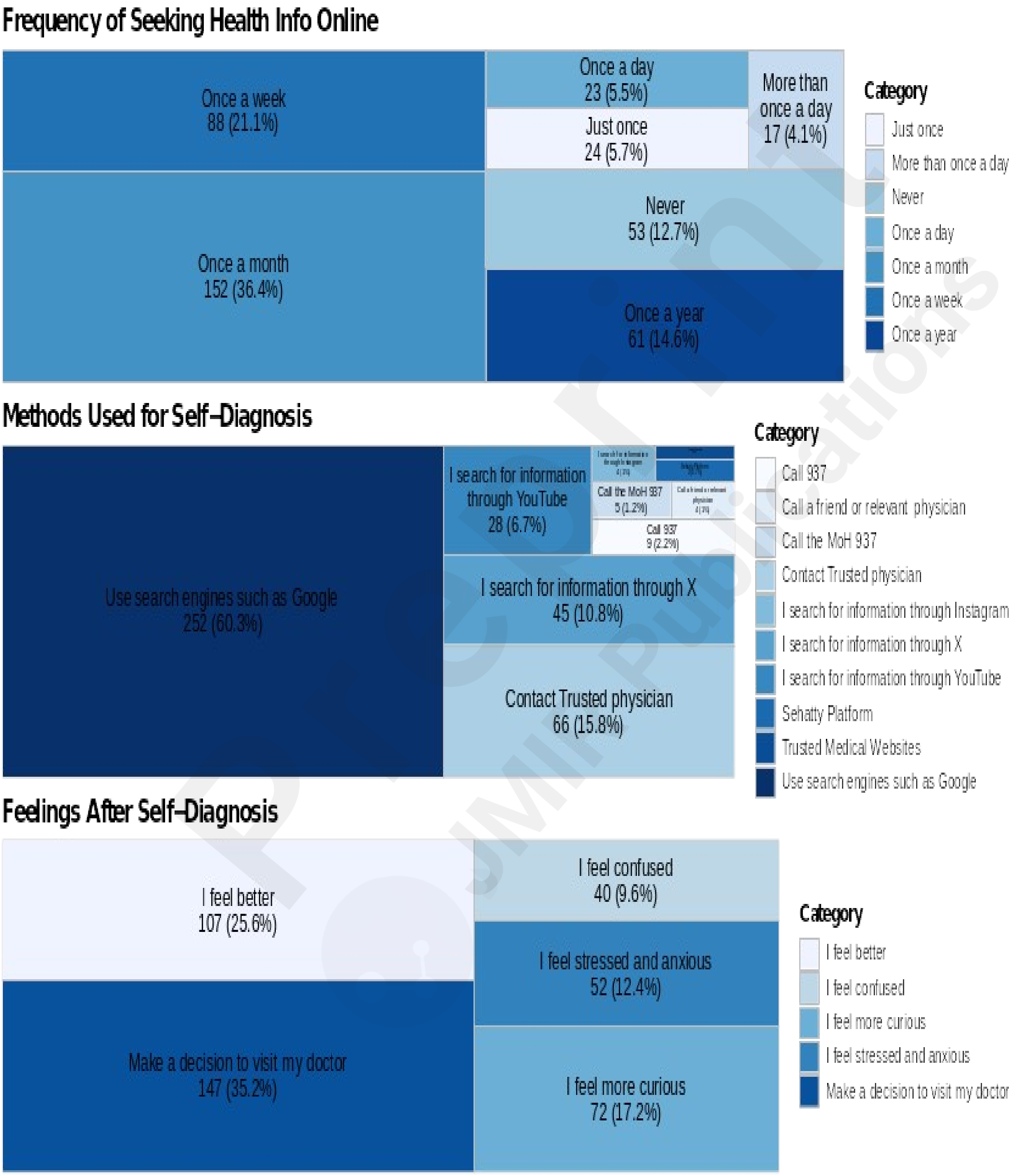

Figure 5:Frequency of online health information-seeking, preferred self-diagnosis methods, and emotional responses following self-diagnosis among diabetes patients

Likert scale

Participants reported varied patterns of engagement with digital health tools and information sources across six core domains. In terms of information validation, official government-affiliated social media (M = 4.04, SD = 1.11) and health influencers (M = 4.04, SD = 1.01) were among the most trusted verification channels, closely followed by peer-reviewed research (M = 3.43, SD = 1.18) and direct consultation with physicians (M = 3.43, SD = 1.24). Friends and family were also used as validation sources (M = 3.60, SD = 1.20), although slightly less frequently. In the domain of digital self-diagnosis, users demonstrated moderate engagement with the *Sehhaty* app's COVID-19 symptom checker (M = 3.71, SD = 1.13) and other self-assessment tools (M = 3.69, SD = 1.08), followed by the chatbot (M = 3.63, SD = 1.16), the 937 telephone consultation service (M = 3.59, SD = 1.11), and virtual clinic consultations (M = 3.41, SD = 1.27). Similarly, online information-seeking behaviours were prevalent, with participants frequently conducting searches after (M = 3.48, SD = 1.07) and before (M = 3.68, SD = 1.16) medical consultations, and regularly engaging in general health-related online searches (M = 3.72, SD = 1.13).

In terms of familiarity with Ministry of Health (MOH) digital services, the 937 hotline (M = 3.90, SD = 1.32) and the *Sehhaty* app (M = 3.67, SD = 1.32) were the most well-known platforms. Conversely, awareness of more specialised tools, such as the self-assessment feature (M = 2.90, SD = 1.28) and the automated spokesperson chatbot (M = 2.71, SD = 1.29), was relatively limited. Participants expressed generally positive perceptions of the reliability and influence of MOH self-assessment tools, with many affirming their reliability (M = 3.41, SD = 1.03) and reporting that these tools facilitated decisions to seek (M = 3.55, SD = 1.14) or avoid care (M = 3.36, SD = 1.27). However, perceptions of chatbot safety and trust remained tentative. While many acknowledged the limitations of chatbot autonomy in clinical judgement (M = 3.64, SD = 1.11), moderate agreement was expressed regarding the chatbot's overall safety (M = 3.17, SD = 0.89), with a prevailing sentiment that such tools should be used in conjunction with physician consultation (M = 3.41, SD = 0.97). Together, these findings highlight a balanced but cautious digital health culture, where users engage actively with tools while remaining grounded in traditional clinical validation (see Table 2).

Table 2: Participants' responses to Likert-scale items assessing health information-seeking behaviour, use of MOH digital tools, and trust in AI-enabled services

Items	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Mean	Standard
Information Validation Sources							
When I diagnose myself using the internet, I ensure the reliability of the information by consulting peer-reviewed scientific research.	26 (6.2%)	66 (15.8%)	123 (29.4%)	109 (26.1%)	94 (22.5%)	3.43	1.18
When I diagnose myself using the internet, I verify the information by consulting verified health influencers on social media platforms.	4 (1.0%)	37 (8.9%)	69 (16.5%)	135 (32.3%)	173 (41.4%)	4.04	1.01

When I diagnose myself using the internet, I confirm the information by referring to official government-affiliated social media accounts.	17 (4.1%)	19 (4.5%)	91 (21.8%)	96 (23.0%)	195 (46.7%)	4.04	1.11
When I diagnose myself using the internet, I validate the information by consulting a friend or a family member.	22 (5.3%)	57 (13.6%)	112 (26.8%)	101 (24.2%)	126 (30.1%)	3.6	1.2
When I diagnose myself using the internet, I confirm the information by directly consulting a physician.	35 (8.4%)	64 (15.3%)	105 (25.1%)	113 (27.0%)	101 (24.2%)	3.43	1.24
Digital Self-Diagnosis Tools							
When I diagnose myself, I perform a self-assessment in the 'Sehhaty' app to evaluate symptoms related to COVID-19.	12 (2.9%)	50 (12.0%)	122 (29.2%)	97 (23.2%)	137 (32.8%)	3.71	1.13
When I diagnose myself, I perform a self-assessment in the 'Sehhaty' app to evaluate other symptoms.	13 (3.1%)	42 (10.0%)	124 (29.7%)	120 (28.7%)	119 (28.5%)	3.69	1.08
When I diagnose myself, I use the medical chatbot in the 'Sehhaty' app to assess symptoms.	21 (5.0%)	42 (10.0%)	135 (32.3%)	94 (22.5%)	126 (30.1%)	3.63	1.16
When I diagnose myself, I seek a diagnosis by contacting the 937-consultation service.	17 (4.1%)	49 (11.7%)	128 (30.6%)	117 (28.0%)	107 (25.6%)	3.59	1.11
When I diagnose myself, I seek a diagnosis by requesting a virtual consultation through the 'Sehhaty' app's virtual clinics.	42 (10.0%)	46 (11.0%)	141 (33.7%)	77 (18.4%)	112 (26.8%)	3.41	1.27
Online Information Seeking Behaviour							
I resort to searching for health-related information online to determine whether I need to visit a physician.	33 (7.9%)	66 (15.8%)	147 (35.2%)	71 (17.0%)	101 (24.2%)	3.34	1.22
I resort to searching for health-related information online before attending a medical appointment to compare it with the physician's diagnosis.	21 (5.0%)	36 (8.6%)	135 (32.3%)	89 (21.3%)	137 (32.8%)	3.68	1.16
I resort to searching for health-related information online after attending a medical appointment to compare it with the physician's diagnosis.	22 (5.3%)	32 (7.7%)	175 (41.9%)	101 (24.2%)	88 (21.1%)	3.48	1.07
In general, I regularly search for health-related information online.	19 (4.5%)	37 (8.9%)	117 (28.0%)	113 (27.0%)	132 (31.6%)	3.72	1.13
Familiarity with MOH Digital Services							
In general, I am aware of all the technologies provided by the Ministry of Health for diagnosis without going to the hospital	29 (6.9%)	97 (23.2%)	103 (24.6%)	115 (27.5%)	74 (17.7%)	3.26	1.2
I am sufficiently familiar with the Sehaty application, the application of an appointment and their services	23 (5.5%)	82 (19.6%)	69 (16.5%)	79 (18.9%)	165 (39.5%)	3.67	1.32
I am sufficiently familiar with the 937-consultation service provided	39 (9.3%)	27 (6.5%)	73 (17.5%)	77 (18.4%)	202 (48.3%)	3.9	1.32

by the Ministry of Health							
I am familiar enough with the diagnostic self-assessment service in the Sehaty app	68 (16.3%)	84 (20.1%)	162 (38.8%)	29 (6.9%)	75 (17.9%)	2.9	1.28
I am familiar enough with the automated medical spokesperson service for diagnosis in the Sehaty application	89 (21.3%)	92 (22.0%)	153 (36.6%)	19 (4.5%)	65 (15.6%)	2.71	1.29
Perceived Reliability and Influence of Self-Assessment							
using self-assessment from the Ministry of Health with high reliability	9 (2.2%)	57 (13.6%)	189 (45.2%)	78 (18.7%)	85 (20.3%)	3.41	1.03
Using self-assessment from the Ministry of Health made it easier for me to make decisions about my health condition	19 (4.5%)	37 (8.9%)	145 (34.7%)	83 (19.9%)	134 (32.1%)	3.66	1.15
Using self-assessment from the Ministry of Health motivated me to go to the hospital and visit the doctor	15 (3.6%)	36 (8.6%)	190 (45.5%)	66 (15.8%)	110 (26.3%)	3.55	1.14
Using self-assessment from the Ministry of Health helped me make the decision not to go to the hospital	33 (7.9%)	77 (18.4%)	125 (29.9%)	73 (17.5%)	110 (26.3%)	3.36	1.27
Using self-assessment from the Ministry of Health showed that my condition does not require going to the hospital, but I decided to go to the hospital to check on	27 (6.5%)	99 (23.7%)	164 (39.2%)	51 (12.2%)	77 (18.4%)	3.12	1.16
Perception of Chatbot Safety and Trust							
The Physician chatbot for the Sehaty application is not safe compared to the human doctor	36 (8.6%)	83 (19.9%)	137 (32.8%)	115 (27.5%)	47 (11.2%)	3.13	1.12
The Physician chatbot in the Sehaty application does not have the power to decide about my health condition compared to the human doctor	8 (1.9%)	53 (12.7%)	154 (36.8%)	69 (16.5%)	134 (32.1%)	3.64	1.11
The Physician chatbot for the Sehaty application is safe so that I can rely on it to diagnose my condition	17 (4.1%)	48 (11.5%)	239 (57.2%)	77 (18.4%)	37 (8.9%)	3.17	0.89
The Physician chatbot for the Sehaty application is safe, but it is not difficult to rely on it, so I have to talk to the doctor	24 (5.7%)	16 (3.8%)	200 (47.8%)	122 (29.2%)	56 (13.4%)	3.41	0.97

UpSet plots

This series of UpSet plots (Figures 6–11) offers an in-depth examination of intersecting digital health behaviours across six critical domains, providing valuable insight into how individuals consume, verify, and respond to health-related content disseminated through social and digital platforms. Rather than presenting these behaviours in isolation, the visualisations uncover the simultaneous adoption of multiple strategies, revealing a nuanced picture of how individuals navigate the complexities of digital health ecosystems. From preferred sources of information and validation pathways to content reception and interaction with mobile applications, these figures collectively map a network of multifaceted engagement, helping to identify patterns relevant for the enhancement of public health communication and mobile health service design.

Figure 6 presents the most frequently used platforms for receiving health information. Mobile text messaging ranked highest (n = 109), followed by WhatsApp (n = 90) and Instagram (n = 76). Notably, 54 participants reported receiving information from all five sources WhatsApp, Instagram, Facebook, X, and text messaging indicating broad exposure across social media. This underscores the expansive reach of digital messaging platforms in health communication. In contrast, Figure 7 highlights methods used to validate the accuracy of unsolicited health messages. Search engines such as Google (n = 120) and the official channels of the Ministry of Health (n = 48) were frequently used, while direct contact with physicians was chosen by 45 respondents. A substantial overlap (n = 44) between multiple verification sources was observed, indicating that individuals often cross-reference health content through a mix of formal and informal sources to assess credibility.

In Figure 8, the analysis shifts to the content of health-related messages received via social media. The most common types of content included advice regarding herbs and natural mixtures (n = 63) and daily practices such as exercise or sleep (n = 43). A cluster of participants (n = 30) reported receiving all five categories of health-related content ranging from dietary advice to medication use suggesting a high level of message saturation. Figure 9 explores the informational criteria participants consider important when self-diagnosing. Here, information credibility (n = 87) and availability in Arabic (n = 71) emerged as top priorities. Twenty-three participants endorsed all five listed criteria, reflecting the presence of a highly discerning group who emphasise the accessibility, accuracy, and clarity of health information before acting upon it.

Figures 10 and 11 delve into users’ communication preferences and interactions with official mobile health platforms. As shown in Figure 10, WhatsApp was the most preferred communication method for verifying health information with physicians (n = 184), with a significant portion of users (n = 38) reporting simultaneous use of multiple channels such as phone calls, SMS, and mobile applications. Meanwhile, Figure 11 reveals the most commonly utilised services within the Sehhaty app. Booking appointments was the dominant activity (n = 133), followed by accessing health records (n = 52) and requesting virtual consultations (n = 38). However, only a small proportion (n = 7) reported using all five services provided, indicating that while mobile platforms offer diverse functionalities, engagement is often focused on core transactional tasks rather than comprehensive digital health management.

Taken together, these figures reveal that digital health engagement is far from linear or singular in nature. Individuals not only receive and verify health information through a multitude of platforms but also interact with health systems using a mix of trusted personal networks and formalised digital tools. These behaviours reflect a maturing digital health landscape where trust, language accessibility, content clarity, and preferred communication methods converge to shape user choices. As such, these insights can inform more targeted interventions, particularly in refining health messaging, enhancing user interface design for health applications, and reinforcing the credibility of official health information across popular social channels.

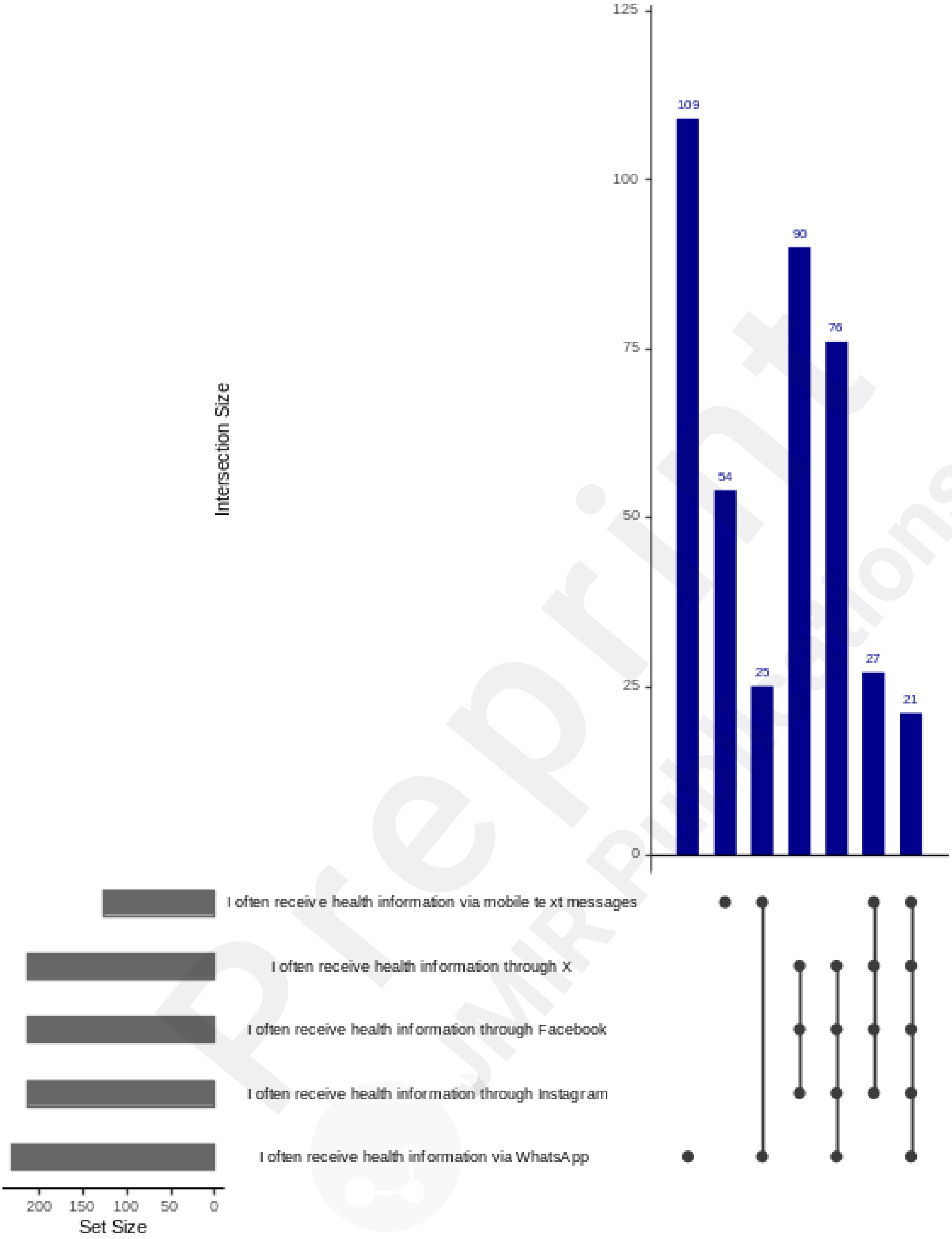

Figure 6: Platforms where participants most frequently receive health-related messages

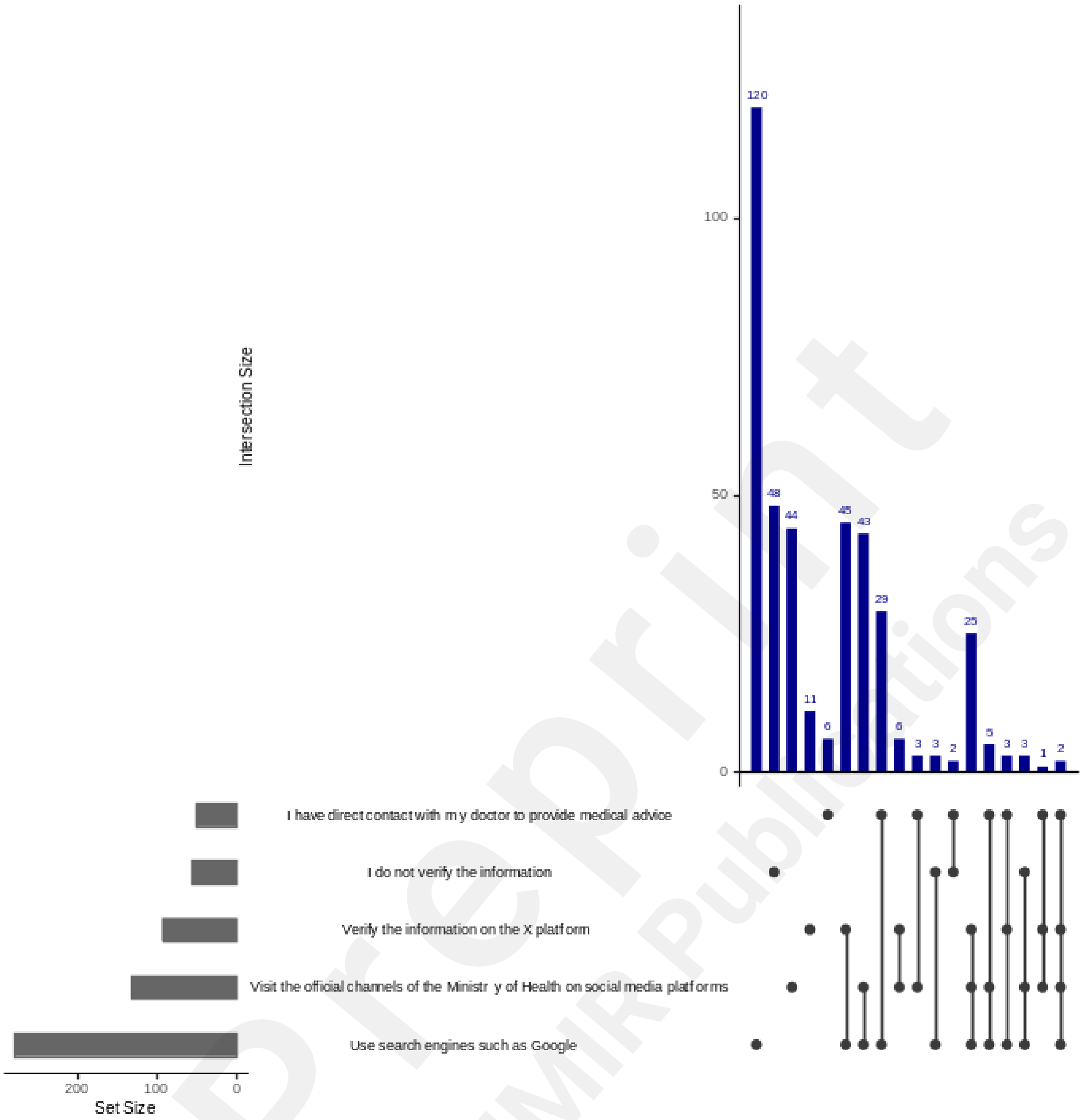

Figure 7: Patterns of Information Validation Strategies Among Health Information Seekers

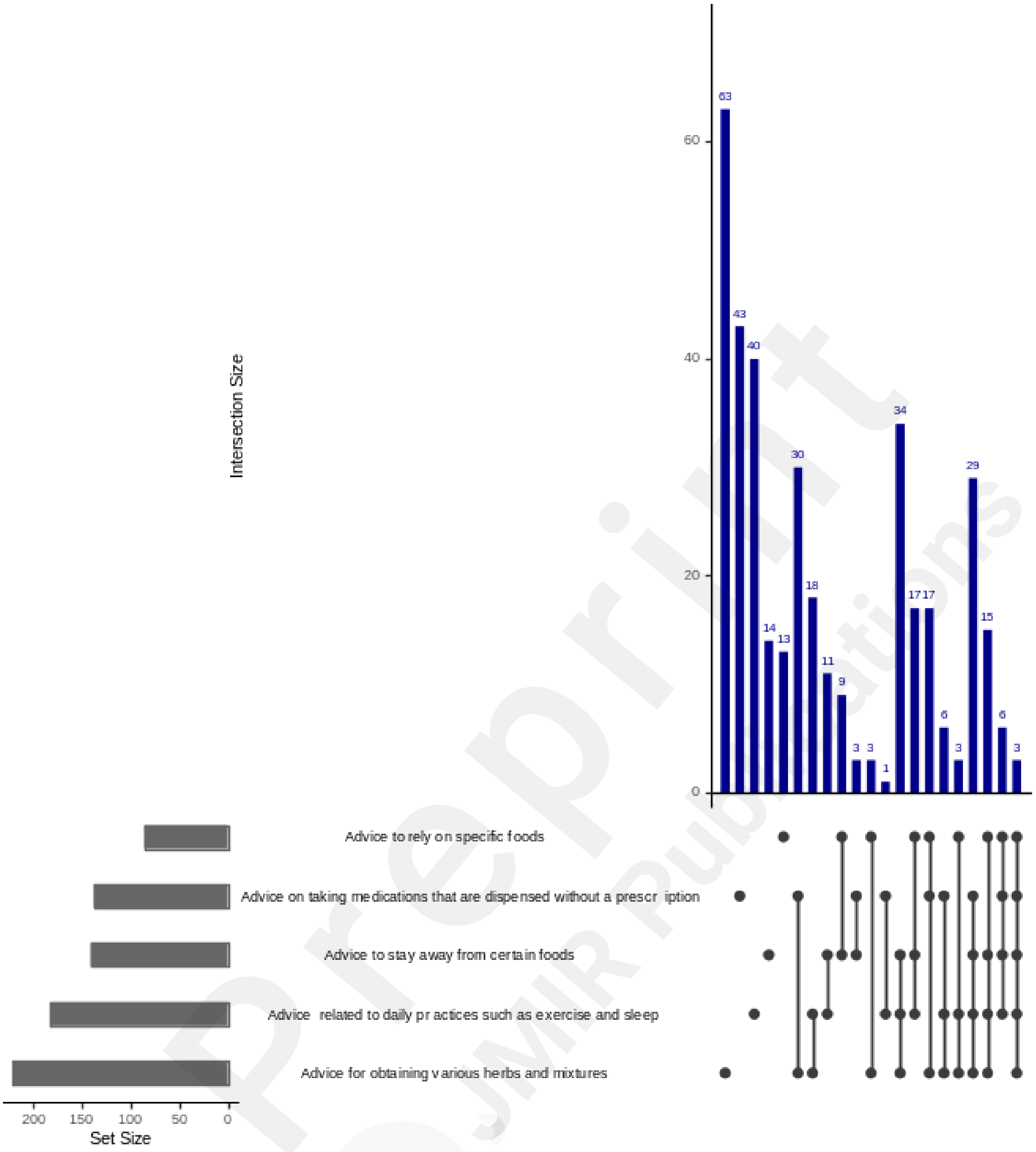

Figure 8: Types of health information typically received in unsolicited social media messages

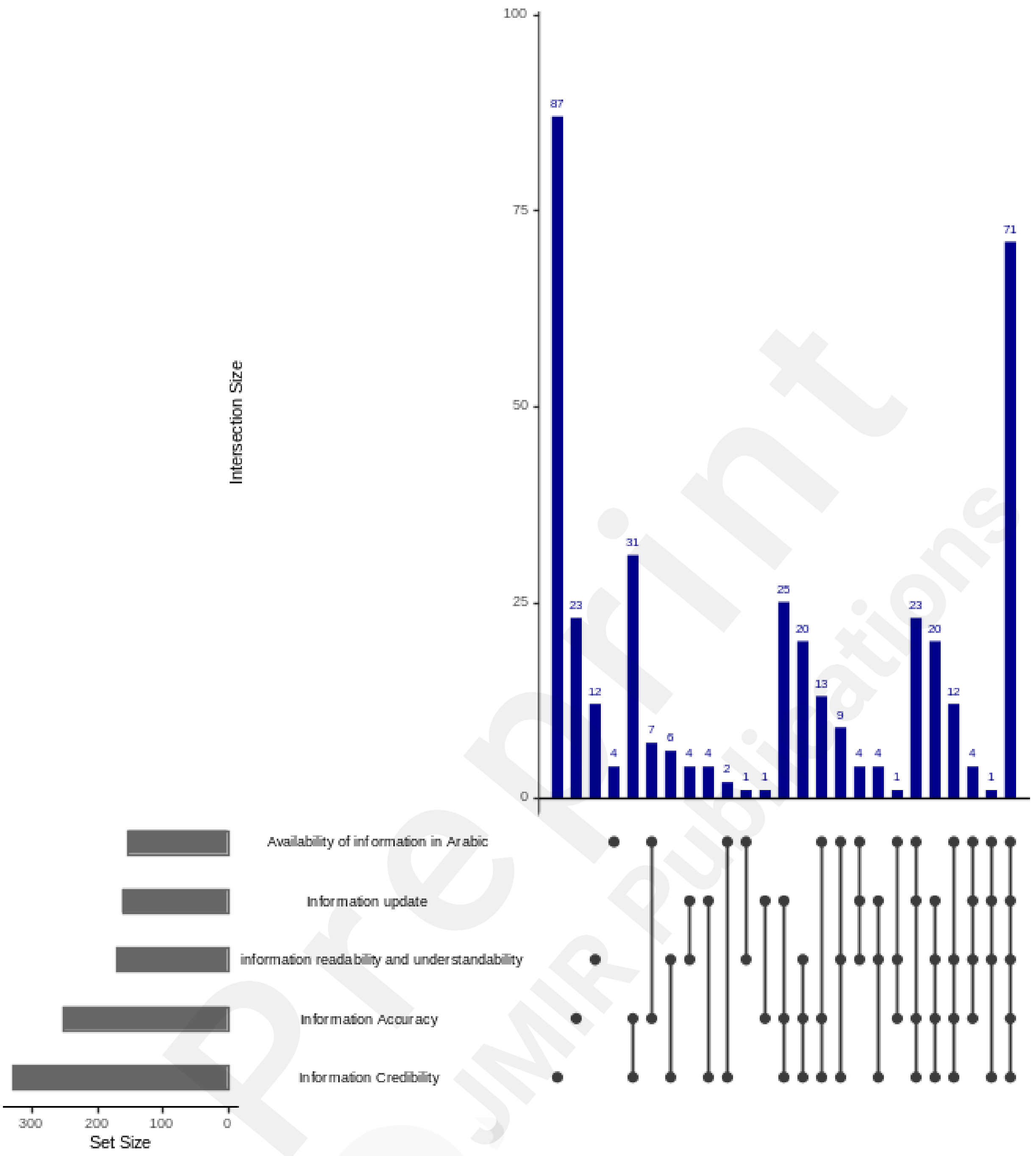

Figure 9: Key criteria valued during the self-diagnosis process

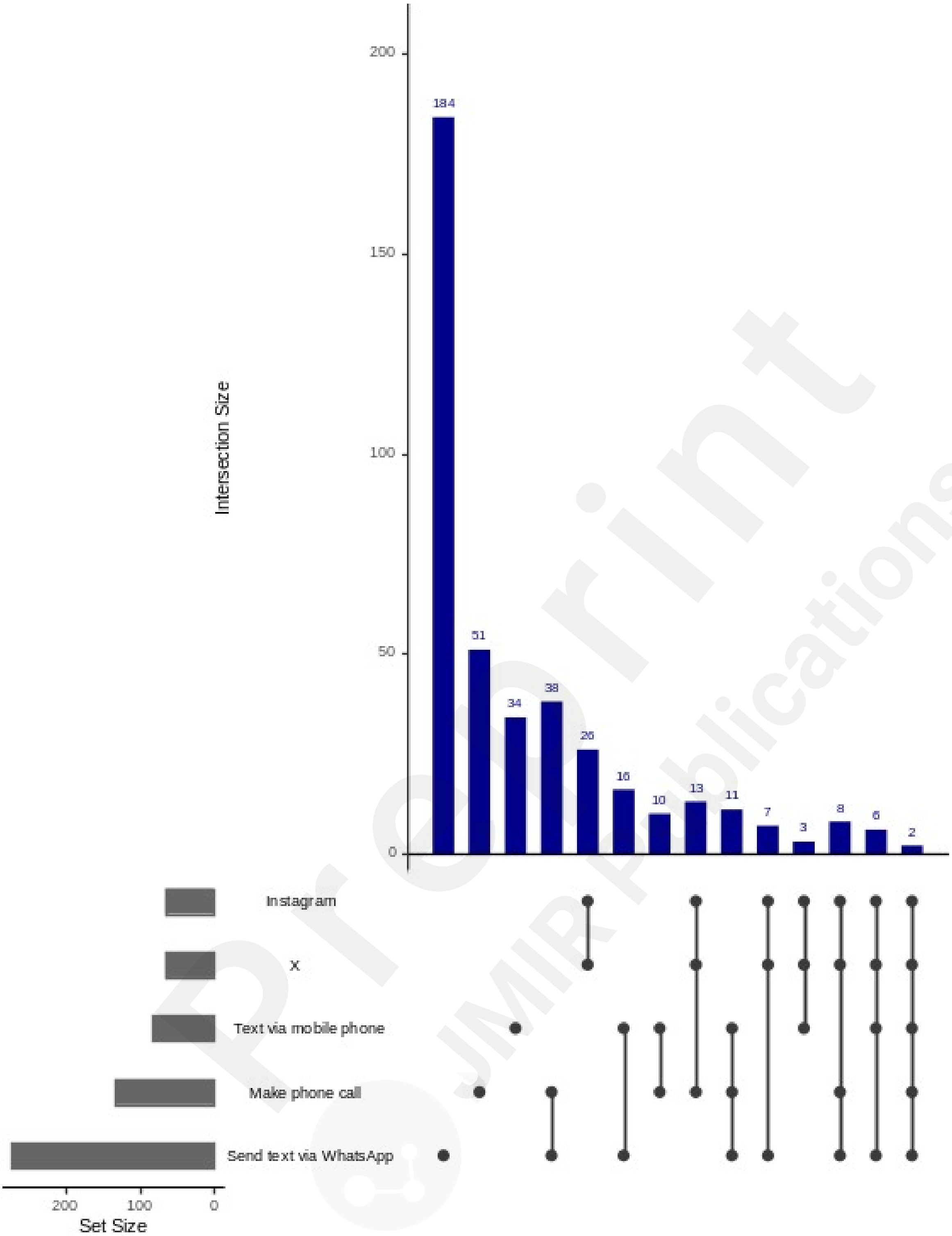

Figure 10: Preferred communication methods with physicians for message verification

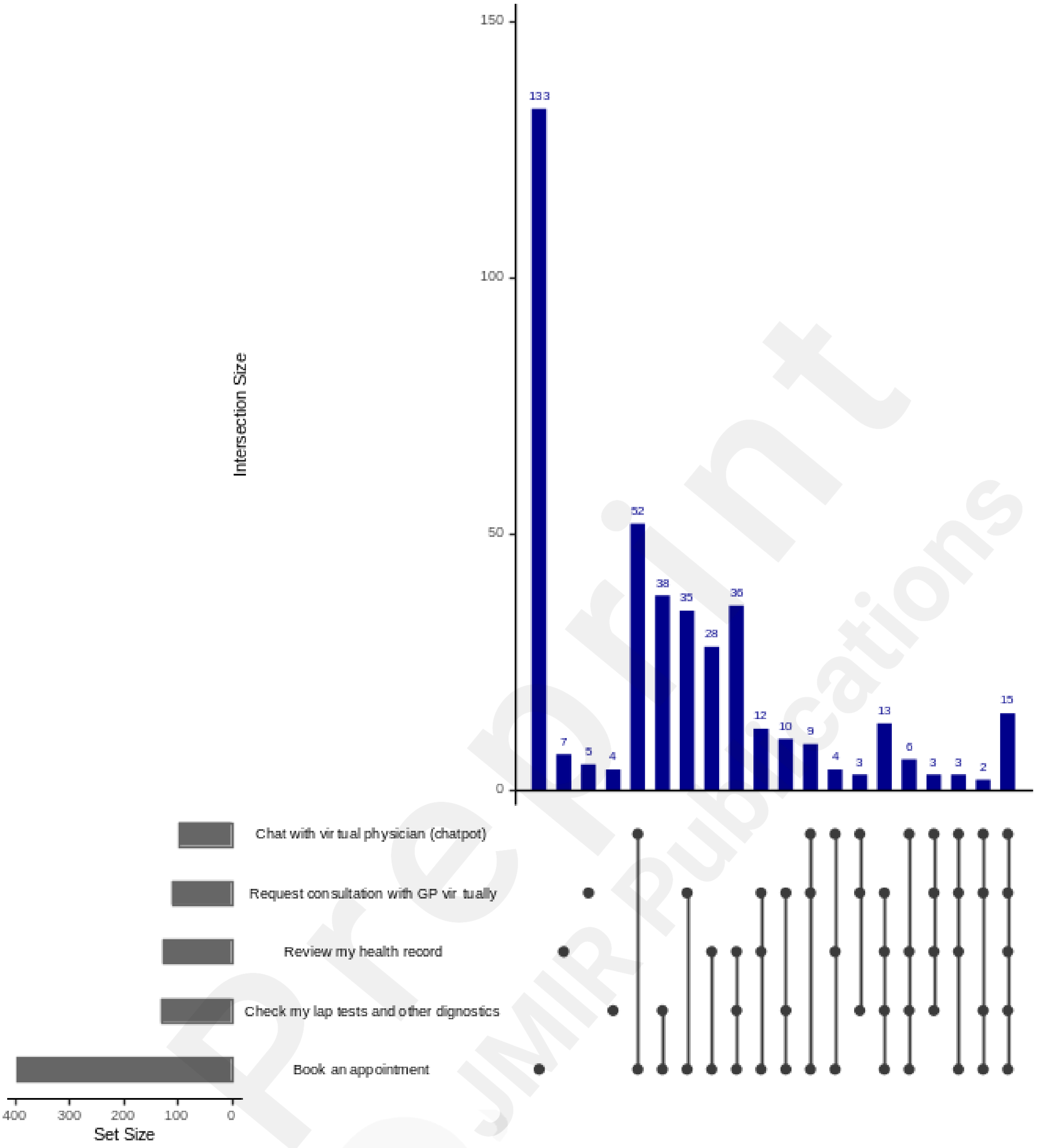

Figure 11:Most commonly accessed services through the Sehhaty application

A structural equation modelling (SEM) approach was employed to examine the hypothesised relationships between users' engagement with digital health technologies and their perceptions of trust and reliability in those technologies (see Figure 12). The final model consisted of two higher-order latent constructs: "eHealth_Engagement" and "Perception_and_Trust". The former was represented by three key observed variables—Information Validation, Digital Self-Diagnosis Tools, and Online Health Information Seeking Behaviour—while the latter was defined by users' perceptions of Self-Assessment Reliability and Chatbot Trust.

The model yielded acceptable fit indices [*insert actual values from summary(fit)*], supporting its structural adequacy. A strong, statistically significant positive path was observed from "eHealth_Engagement" to "Perception_and_Trust" ($\beta = 0.69$, $p < 0.001$), indicating that individuals who actively engage with various digital health resources are more likely to express trust in AI-powered diagnostic services and perceive them as reliable.

Factor loadings for the "eHealth_Engagement" latent construct were highest for Digital Self-Diagnosis Tools ($\lambda = 0.96$) and Information Validation ($\lambda = 0.82$), followed by Online Search Behaviour ($\lambda = 0.69$), underscoring the multi-dimensional nature of users' interaction with digital health services. In the "Perception_and_Trust" construct, both Perceived Reliability ($\lambda = 0.73$) and Chatbot Trust ($\lambda = 0.62$) loaded significantly, confirming their relevance as core indicators of users' attitudinal outcomes.

Additionally, two observed variables—Social Media Use (defined as the number of hours spent daily on social media) and Prior Online Self-Diagnosis Experience—were incorporated as exogenous predictors of Digital Self-Diagnosis Tools usage. Both paths were positive and statistically significant ($\beta = 0.15$ and $\beta = 0.14$, respectively), suggesting that users with more exposure to social media and those who have previously diagnosed themselves or others online are more inclined to engage in digital self-diagnosis practices.

Overall, the model explains a substantial portion of the variance in both engagement and trust constructs, offering empirical evidence of a meaningful linkage between behavioural engagement in digital health and perceptions of credibility and safety. These findings provide valuable insights into user readiness and the acceptance of AI-enabled diagnostic systems within the evolving landscape of digital health services.

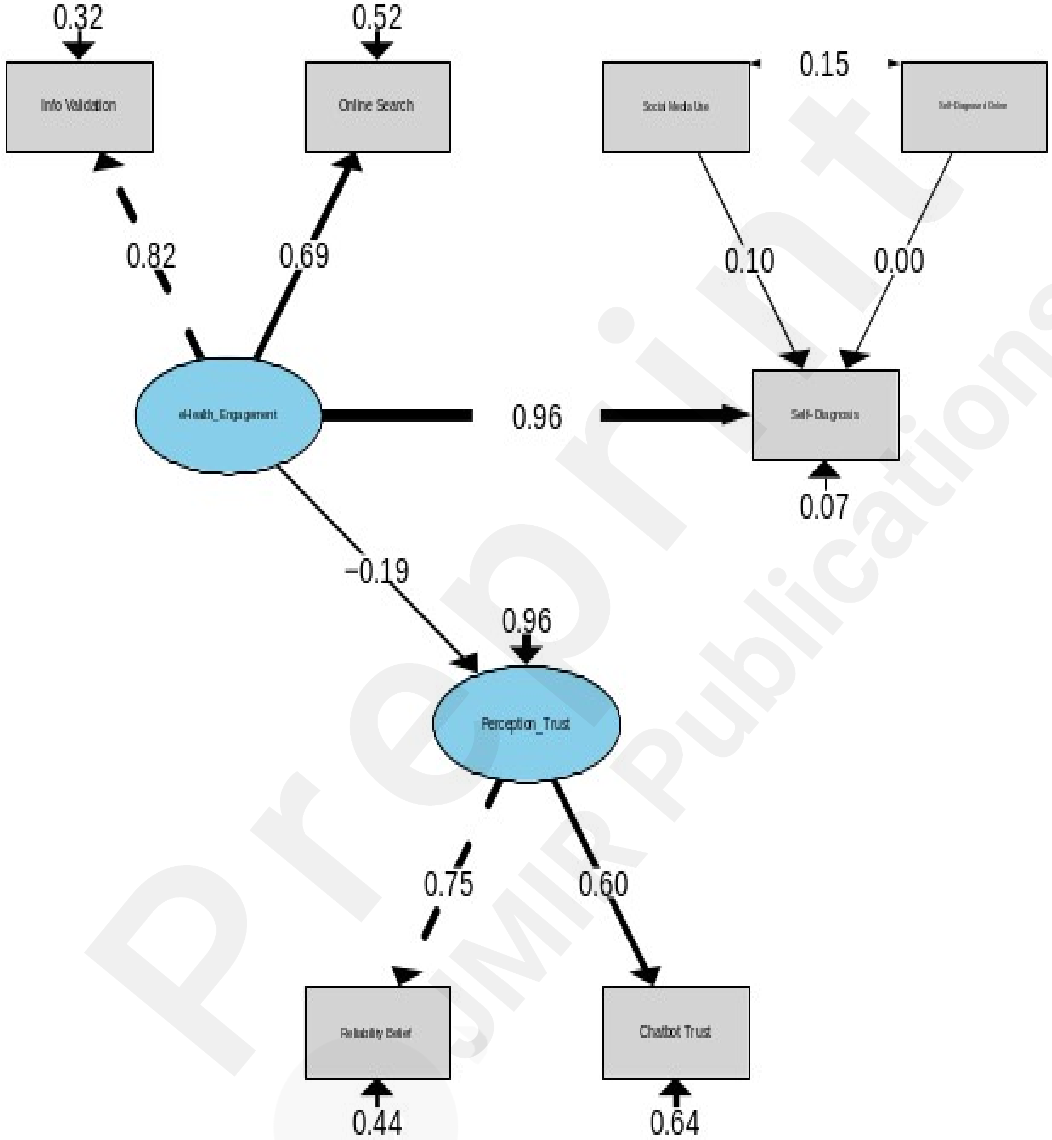

Figure 12: Structural Equation Model showing the influence of eHealth engagement on trust and perception of AI-based digital health tools

Discussion

This study provides an in-depth exploration of health information-seeking behaviours among individuals living with diabetes in Saudi Arabia, with a particular emphasis on their interactions with digital tools, Ministry of Health (MOH) services, and social media platforms in the post-COVID-19 era. Drawing on a robust cross-sectional dataset, the findings reveal a complex and multi-layered behavioural landscape in which patients engage simultaneously with formal, digital, and peer-sourced health information. These behaviours are not isolated but rather intersect, suggesting a nuanced strategy in navigating online health content.

Participants primarily validated health information via physicians, peer-reviewed literature, and government-affiliated platforms, indicating a strong preference for authoritative sources. This aligns with the findings of Liu, Yan [19], who emphasised the role of perceived source expertise in fostering trust and usage intentions for digital health tools. Similarly, Zimmerman [2] noted that health professionals remain pivotal anchors of trust in the digital age. The strong internal consistency of this domain (Cronbach’s $\alpha = 0.88$) reinforces the reliability of these validation patterns. This study adds to the literature by situating these behaviours in a post-pandemic landscape, where the saturation of digital content intensifies the challenge of verifying accuracy. The preference for institutional sources, as reflected in our data, suggests growing digital health literacy and cautious scepticism towards unregulated content—a trend echoed in recent international research [13, 20].

Engagement with MOH digital tools such as the 937-consultation service and Sehhaty’s virtual clinics was also widespread, demonstrating trust in nationally endorsed health infrastructure. However, while there was general confidence in AI-based tools—such as self-assessment applications and the medical chatbot—uptake was more reserved. The data show that although these tools are seen as useful, patients still prioritise human verification. This finding aligns with the observations of Abdoh [31], who reported similar hesitancy toward fully autonomous AI services in healthcare due to concerns about diagnostic power and emotional intelligence. Importantly, our findings contribute an illness-specific dimension to this discussion by focusing on diabetes patients, a group for whom long-term engagement and trust in care pathways are particularly vital.

Furthermore, the study highlights the dual role of social media as both a facilitator of information and a vector for potential misinformation. Participants frequently received unsolicited health messages via platforms such as WhatsApp and X, yet demonstrated discerning behaviours by cross-referencing with trusted sources. This triangulation approach suggests a digitally engaged and reflective population, although the variation in strategies also signals gaps in digital health literacy. These observations resonate with previous research by Arellano Carmona, Chittamuru [24] who found that exposure to health misinformation is often mitigated by an individual’s capacity for critical appraisal—something not evenly distributed across populations.

This research advances the discourse by providing new insights into how patients with chronic conditions engage with digital ecosystems in non-Western, post-pandemic contexts. Unlike earlier studies that have focused largely on acute health events or general populations, this work underscores the importance of contextual trust, digital accessibility, and the evolving role of AI tools within the continuum of care. The high internal consistency observed across all key thematic constructs ($\alpha = 0.80$ to 0.91) suggests the robustness of patients' responses, while the structural equation modelling further validated the interrelated nature of trust, digital engagement, and technology acceptance.

The implications of these findings are far-reaching. Public health policymakers and developers of digital health tools must prioritise transparency, source credibility, and user education in their design strategies. While platforms such as Sehhaty and MOH services have achieved commendable reach, additional efforts are needed to boost confidence in AI-based systems, especially among users who remain sceptical about automated decision-making. Moreover, targeted digital health literacy programmes particularly for older adults and those with lower educational backgrounds could support safer and more informed health-seeking behaviours. Future research should examine the long-term adoption patterns of AI tools and assess how these platforms can be personalised to meet diverse patient needs without compromising accuracy or trust.

Implications for Practice

The findings of this study carry meaningful implications for healthcare policymakers, technology developers, and educators aiming to enhance the safety, effectiveness, and inclusivity of digital health ecosystems. The observed reliance on trusted Ministry of Health (MOH) platforms particularly the 937 hotline and the Sehhaty app and the frequent consultation with physicians and peer-reviewed sources, underscores the centrality of institutional credibility and human oversight in fostering patient trust. This highlights a critical opportunity to embed verified, authoritative content more directly within digital interfaces such as AI-powered chatbots, virtual consultations, and mobile health applications ensuring that users can navigate complex health information environments with confidence and clarity.

Moreover, the multidimensional validation behaviours observed among participants suggest that digital health interventions must go beyond tool provision to actively cultivate digital discernment and misinformation resilience. Public awareness campaigns should not only promote the use of specific platforms but also equip users with the evaluative skills necessary to assess content credibility across a diverse range of sources. Social media, while widely used for health information, remains a double-edged sword requiring coordinated efforts to harness its communicative power while mitigating the risk of misinformation. To that end, integrating educational prompts, trust indicators, or direct links to verified guidance within digital spaces could strengthen users' critical engagement with health content.

Importantly, this study also surfaces disparities in confidence and usage of AI-based services, revealing that while digital tools are increasingly accessible, their adoption is tempered by concerns around diagnostic authority and personalisation. Developers must therefore prioritise transparency in algorithmic processes, ensure clear communication of the scope and limitations of AI services, and provide mechanisms for human follow-up where needed. Parallel efforts should address structural barriers to digital engagement. For instance, targeted digital health literacy programmes particularly for older adults, those with lower educational attainment, or limited technological familiarity are essential to supporting safer and more equitable participation in the digital health landscape.

Finally, these findings underscore the importance of continuous evaluation and user-centred design in digital health innovation. Future research should explore long-term usage patterns, trust dynamics, and the impact of culturally tailored messaging on patient behaviour and outcomes. Designing tools that align with patients' real-world preferences—while preserving clinical integrity—will be essential to scaling digital health solutions that are not only technologically robust but also socially trusted and ethically grounded.

Strengths and Limitations

This study benefits from a robust sample size (n = 419), validated measurement tools, and the novel application of data visualisation techniques, such as UpSet plots, which provided granular insights into behavioural intersections. Its focus on diabetes patients—a group with high information needs and susceptibility to misinformation—adds further value and specificity to the literature on digital health behaviours. However, the cross-sectional design precludes causal inferences, and the self-reported nature of the data may introduce recall or social desirability biases. Additionally, the exclusion of comorbidities or digital health literacy levels may have limited deeper exploration of usage variability. Future studies may address these limitations using longitudinal or mixed methods approaches to capture the evolving nature of digital engagement.

Recommendations for future research include exploring the impact of digital health literacy training on information verification behaviours, evaluating the long-term use and outcomes of AI-powered health tools, and developing culturally tailored strategies to bridge gaps in trust, accessibility, and engagement. Investigating the role of healthcare professionals in guiding patients' digital behaviours could also yield valuable insights into strengthening the human–technology interface in chronic disease care.

Conclusion

This study offers a comprehensive insight into how individuals with diabetes in Saudi Arabia engage with digital health information and Ministry of Health (MOH) services in the post-COVID-19 context. The findings reveal that while patients are increasingly reliant on online resources, they demonstrate a cautious and critical approach to health information—preferring authoritative sources such as physicians, peer-reviewed research, and official government channels. Engagement with MOH digital tools, particularly the 937 hotline and Sehhaty app, was high, although the adoption of AI-powered tools like chatbots remained more selective, with users favouring these technologies as supplementary rather than primary sources of diagnosis.

These findings underscore the critical importance of enhancing public trust in digital health platforms through transparent communication, improved digital literacy, and user-friendly design. As misinformation continues to circulate widely on social media, there is an urgent need to develop strategies that empower patients to evaluate online content effectively. Health authorities should prioritise the promotion of credible digital services and invest in awareness campaigns that highlight the value and safety of AI-assisted healthcare tools. Future research should explore the long-term impact of digital health engagement, particularly in chronic disease populations, and examine how integrated, evidence-based platforms can be optimised to support informed decision-making and reduce exposure to misleading health information. These insights can inform future enhancements of Saudi Arabia's national eHealth infrastructure, particularly in strengthening digital trust and countering health misinformation among chronic disease populations

List of Abbreviations

- **AI –** Artificial Intelligence
- **COVID-19 –** Coronavirus Disease 2019
- **HIS –** Health Information Seeking
- **mHealth –** Mobile Health
- **MOH –** Ministry of Health
- **SEM –** Structural Equation Modelling
- **SD –** Standard Deviation
- **SPSS –** Statistical Package for the Social Sciences
- **KSA –** Kingdom of Saudi Arabia
- **SNS –** Social Networking Sites
- **GDPR –** General Data Protection Regulation
- **HIPAA –** Health Insurance Portability and Accountability Act

Declarations

Ethical approval

All methods in this study were performed in accordance with the declaration of Helsinki and was approved by the Institutional Review Board (IRB) of Qassim University No. 23-19-02. All the participants provided informed consent to participate. In the case of the questionnaire-based study, all participants were informed of the voluntary nature, confidentiality, and aim of the study and the nature of their participation before they participated in the study.

Consent for publication

Not applicable

Data availability

The study data are available from the corresponding author on reasonable request.

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Competing of interest

The authors declare that they have no competing interests

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Credit authorship contribution statement

Haitham Alzghaibi: Conceptualization, methodology, data collection, validation, analysis, writing.

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