diabetology

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Evaluating the Use of Web-Based Technologies for Self-Management among Arabic-Speaking Immigrants Living with Type 2 Diabetes Mellitus: A Cross-Sectional Study in Saudi Arabia

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Abstract: This study aimed to investigate the use of and willingness to adopt web-based technology for self-management of type 2 diabetes among Arabic-speaking immigrants in Saudi Arabia. Conducted in Taif in 2022, it involved participants with type 2 diabetes mellitus, utilizing a study-specific questionnaire to gather data on demographics, disease specifics, and attitudes towards using this technology for diabetes management. Out of the 109 individuals who responded, 91 completed the survey and reported accessing web-based technology and an average usage of two hours per day. The primary use was for social media (90.1%) and information searching (73.6%). The study found a high willingness to use web-based technology for dietary planning (85.7%), physical activity monitoring (94.5%), and communication with healthcare providers (93.41%). Notably, younger participants, those with higher education, and married individuals showed more inclination towards using such technology, as indicated by significant correlations ($p < 0.001$, CI = 0.03–0.38; $p < 0.039$, CI = 1.06–10.26; $p = 0.024$, CI = 1.23–19.74). Over half of the participants (56%) considered web-based technology beneficial for diabetes management, with many finding it time-saving (61.5%). In conclusion, a significant proportion of participants demonstrated a strong preference for integrating web-based technology into their diabetes self-management routines. This preference was particularly evident in key areas such as diet, physical activity, and glucose monitoring. These findings underscore the potential of web-based technologies in supporting effective diabetes management among Arabic-speaking immigrants, highlighting the need for targeted interventions that leverage these digital tools.

Keywords: Arabic-speaking immigrants; type 2 diabetes mellitus; web-based technology; diabetes self-management; Saudi Arabia

Citation: Althubyani, A.; Tang, C.; Thomas, J.; Gupta, S. Evaluating the Use of Web-Based Technologies for Self-Management among Arabic-Speaking Immigrants Living with Type 2 Diabetes Mellitus: A Cross-Sectional Study in Saudi Arabia. *Diabetology* **2024**, *5*, 85–95. https://doi.org/10.3390/diabetology5010007

Academic Editors: Andrej Belančić, Sanja Klobučar and Dario Rahelić

Received: 29 December 2023
Revised: 28 January 2024
Accepted: 26 February 2024
Published: 28 February 2024

1. Introduction

Type 2 Diabetes mellitus (T2DM) is a global epidemic [1], affecting 10.5% of adults around the world [2]. Additionally, 374 million individuals have impaired glucose tolerance, putting them at high risk of developing T2DM later in life [3]. The prevalence of T2DM has significantly increased particularly in high-income countries such as the Kingdom of Saudi Arabia (KSA) [4]. KSA is currently within the top 10 countries with the highest reported T2DM diagnosis globally [4].

T2DM poses a significant health challenge, especially for immigrants from low- and middle-income countries who have relocated to high-income nations [5]. This population

faces a unique set of risks, with studies indicating that immigrants, particularly those in the first generation, are more susceptible to developing T2DM compared to their host population counterparts [6]. This heightened risk is particularly pronounced among immigrants from the Middle East and North Africa, where a blend of genetic predispositions and environmental factors such as urbanization, mechanization, and shifts in nutrition and lifestyle behaviors contribute to the increased prevalence of T2DM [7].

In Saudi Arabia, managing diabetes for Arabic-speaking immigrants is challenging due to late diagnoses and poor control of blood sugar levels [8,9]. These issues are compounded by difficulties such as adherence to treatment plans, different beliefs, and knowledge about diabetes, money, and healthcare issues [10,11]. Because of the mix of genetic, environmental, and lifestyle factors that make Middle Eastern and North African immigrants more likely to get T2DM, there is a strong need for new, tailored ways to manage T2DM. Web-based technologies (WBT) offer a good solution by providing customized help that meets the specific needs of these communities, which could make diabetes management more effective for this group [12].

In addressing this growing health concern, the integration of assistive WBT into T2DM self-management protocols emerges as a promising solution [13]. These technologies have the potential to significantly augment the diabetes care provided by healthcare professionals, offering crucial educational and motivational support [14]. Particularly when access to primary healthcare is limited or when patients face barriers like time constraints, financial limitations, or geographical isolation, WBT can play a pivotal role in expanding the availability and effectiveness of diabetes education and support [15]. Often, patients may struggle to regularly attend diabetes education classes or consult with diabetes educators due to these barriers [16]. However, through the use of WBT tools, essential education and training can be delivered remotely, enabling patients to learn and implement new practices and routines that are critical for effective diabetes management [15]. Furthermore, it is instrumental in facilitating daily self-management activities for T2DM, including blood glucose monitoring, physical activity, healthy eating, medication adherence, monitoring for potential complications, and developing problem-solving skills [17].

Despite the demonstrated clinical efficacy of WBT in enhancing blood sugar control and weight management for those who are receptive to using them [18–21], there remains a gap in research focusing on patient preferences and attitudes towards these technologies in real-world scenarios [22]. This gap is particularly noteworthy in the context of T2DM management among specific groups such as Arabic-speaking immigrants [23]. Therefore, given the scarcity of research specifically addressing Arabic-speaking immigrants with T2DM in KSA, the study is particularly significant. The study aims to delve into the attitudes and intentions of these individuals towards the adoption of WBT for T2DM self-management. This focus is essential to understand whether these individuals are inclined to incorporate technological strategies into their T2DM management routine. By doing so, the study provides valuable insights into tailoring these technologies to better meet their specific needs and preferences, thereby filling a critical gap in current research.

2. Materials and Methods

2.1. Study Design and Setting

In 2022, this study was carried out in Taif, a city located in western Saudi Arabia known for its diverse population, which includes immigrants from various Arabic-speaking countries. The study employed a convenience sampling method to recruit participants, specifically targeting patients with T2DM who sought care at a prominent tertiary hospital's diabetes clinic. Inclusion criteria encompassed individuals aged 18 and above who self-identified as both living with T2DM and Arabic-speaking immigrants in KSA. The study excluded individuals under the age of 18, those with type 1 diabetes, and those who did not come from Arabic-speaking immigrant backgrounds.

2.2. Questionnaire

In this study, a validated survey instrument originally developed by Dobson et al. [24,25] was adapted to explore the use of WBT for diabetes self-management among Arabic-speaking immigrants in KSA. To ensure accessibility and comfort for all participants, the survey was made available in both Arabic and English, allowing participants to choose the language in which they preferred to respond. Questions related to using apps for diabetes self-management were replaced by use of WBT for managing T2DM. Questions regarding the BMI were removed as the purpose of the study was not to measure the BMI or obesity levels. Additionally, questions from another study by Alzubaidi and colleagues were incorporated to address gaps in Dobson's survey [26]. These questions were related to the measure of self-satisfaction during the previous 7 days regarding diet, blood monitoring and physical activity, education, occupation, marital status, ethnicity, religion, and language spoken at home. These additions enhanced the applicability of the survey to our specific context. Our adoption of this survey was driven by its thoroughness and the validation it received in a similar research setting. This makes it a suitable and reliable tool for our study, allowing us to evaluate the use of WBT for diabetes self-management among Arabic-speaking immigrants in KSA with greater depth and accuracy.

The final questionnaire Survey S1, consisted of 35 questions divided into five sections: demographic information (13 items), disease information (6 items), use of WBT (5 items), intentions for using WBT for T2DM management (10 items), and general explanations (1 item)—this item is deliberately open-ended, allowing participants to share any additional thoughts, experiences, or insights that might not have been captured by the structured items in the previous sections. The demographic section included questions about gender, age, and residence status. The disease information section sought information about the duration of T2DM and other chronic illnesses; these could include, but are not limited to, hypertension, cardiovascular diseases, chronic kidney disease, chronic respiratory diseases, as well as difficulties with diabetes management such as diet, physical activity, communication with healthcare providers, and goal setting. The section on WBT asked about the devices used to access the internet and how they were used. The section of the questionnaire focusing on intentions and attitudes towards using WBT for diabetes management inquired about the types of services participants deemed necessary. It also evaluated their perspectives on employing WBT for self-management. This assessment was conducted using a 5-point Likert scale, where a score of 0 indicated 'highly unlikely' and 5 represented 'extremely likely' to use such technology. Likelihood of intention to use WBT for diabetes management was also ascertained. Prior to initiating data collection, the questionnaire underwent a pilot phase to ensure its readability and ease of understanding. Minor edits were made, such as replacing certain terms, for example, "control" and "management," with more easily understandable Arabic words, before it was administered to the participants.

2.3. Data Collection

Data collection for the study was approved by the Human research ethics committee of La Trobe University (HEC21273). Data collection occurred from February 2022 to August 2022. The researcher (AA) visited the clinic and explained the study objectives and how to complete the questionnaire to patients in the waiting room. Individuals who self-identified as having T2DM, being from an immigrant background, and being interested in participating could access the survey either via a QR code or use of an iPad provided by the researcher at the time of recruitment. Participants were informed that completion of the survey implied consent to the study. A member of the research team (AA) was present to clarify any questions that participants may have had whilst completing the questionnaire.

2.4. Statistical Analyses

Data were analyzed using SPSS version 22.0 [27]. Demographic information, the use of or intention to use WBT and difficulties with self-management questions were descriptively analyzed. The study utilized the median to represent the central point of Likert scale

responses and the interquartile range (IQR) to indicate the data's variability. This approach was chosen as it provides a clear and succinct representation of ordinal data, highlighting the main trends while considering potential outliers. Intention score was determined through a single item, "I intend to use WBT for assisting in my diabetes management in the future", with answer options ranging from 0 (not at all) to 5 (very much). To examine the relationship between demographic characteristics like age, gender, educational level, marital status, employment, disease duration, and the intention to use WBT, regression analysis was employed, setting the threshold for statistical significance at $p < 0.05$.

3. Results

Out of the 221 individuals contacted, a total of 109 responded to the survey, with 91 completing it fully, yielding a response rate of 83.49%. Table 1 presents the demographic information of 91 participants. Of the 91 participants, the majority (54%) were female, with ages ranging from 25 to over 65 years. Only 2 participants were aged over 65, while the largest age group consisted of 44 participants in the 45–54-year age bracket. Most of the participants were married (71%) and were employed full-time (71%). As many as 39% of the participants had a bachelor's degree as the highest level of education. Nearly half of the participants were temporary residents (49%), while 31% were permanent residents of KSA. The largest group of immigrants came from Egypt (36%), followed by Yemen (27%). Approximately 41% of the participants had been living with T2DM for more than 5 years. 40% of the participants also had a family history of diabetes.

Table 1. Participants' demographic and disease details.

Demographic Details (N = 91)	n (%)
Gender	
Female	50 (55)
Male	41 (45)
Age Range	
25–34	4 (4)
35–44	33 (36)
45–54	44 (48)
55–64	8 (8)
65 or over	2 (2)
Marital status	
Married	65 (71)
Widowed	12 (13)
Single	8 (8)
Divorced	6 (6)
Employment	
Retired	6 (6)
Full-time employment	65 (71)
Part-time employment	6 (6)
Unemployed	14 (15)
Education level	
Elementary school	1 (1)
Middle school	8 (8)
High school	22 (24)
Diploma	23 (25)
University undergraduate degree	36 (39)
Postgraduate (Master's or PhD)	1 (1)

Table 1. *Cont.*

Demographic Details (N = 91)	n (%)
Current residential status	
Citizen	17 (18)
Permanent resident	29 (31)
Temporary resident	45 (49)
Ethnicity	
Egyptian	33 (36)
Yemenis	25 (27)
Syrians	16 (17)
Jordanians	5 (5)
Palestinians	6 (6)
Sudanese	4 (4)
Lebanese	1 (1)
Duration of the disease	
1 to 3 years	15 (16)
3 to 5 years	36 (39)
5 years and longer	38 (41)
Unknown/not applicable	2 (2)
Family history	
Yes	37 (40)
No	54 (59)
Other chronic diseases	
Yes	24 (26)
No	24 (26)
Do not know	43 (47)

Table 2 displays the general findings of the participants' use of WBT and their intention to use it to manage T2DM. Ninety of the ninety-one (94%) participants had access to a smart device. As many as 43% of participants had more than one device. Overall, participants spent about 2–3 h per day accessing WBT content, with 41 (45%) spending 2–3 h per day on the internet, while 35 (38%) spent more than 3 h. The participants primarily used their mobile phones for social media n = 82 (90%), watching movies or TV n = 74 (81%), searching for information n = 67 (73%), and reading news or books n = 67 (73%). Moreover, most participants reported they would use WBT for diet planning 78 (85%), physical activity planning 86 (94%), monitoring blood glucose 77 (48%), communicating with healthcare providers 85 (93%), and connecting with other diabetic patients 82 (90%).

Table 2. Use and intention to use web-based technology for diabetes control.

Variables	n (%)
Current technology use	
Having a mobile phone	
Yes	90 (94)
No	1 (5)
Having a computer	
Yes	38 (24)
No	53 (75)
Having a tablet	
Yes	29 (18)
No	62 (81)

Table 2. *Cont.*

Variables	n (%)
Intention to use web-based technology for diabetes control	
Dietary planning	
Yes	78 (85)
No	7 (7)
Don't know	6 (6)
Planning physical activity	
Yes	86 (94)
No	3 (3)
Don't know	2 (2)
Text messaging monitoring and/or reminders	
Yes	63 (69)
No	10 (10)
Don't know	18 (19)
Image messaging monitoring and/or reminders	
Yes	67 (73)
No	11 (12)
Don't know	13 (14)
Glucose reading and tracking option	
Yes	77 (84)
No	7 (7)
Don't know	7 (7)
Contacting healthcare providers	
Yes	85 (93)
No	4 (4)
Don't know	2 (2)
Contacting other patients with diabetes	
Yes	82 (90)
No	5 (5)
Don't know	4 (4)
Average daily use of web-based technology	
from 1–2 h	15 (16)
From 2–3 h	41 (45)
More than 3 h	35 (38)

In addition, Figure 1 illustrates that participants held positive perceptions of WBT for self-management across various descriptors. In this section of the survey, participants were asked about their perceptions and attitudes towards using WBT for diabetes self-management, where a score of 0 indicates 'Strongly Disagree' and 5 signifies 'Strongly agree'. Across a spectrum of descriptors such as 'Good Idea', 'Enjoyable', 'Comforting', 'Exciting', and 'Interesting', participants consistently assigned a median score of 4, indicative of their overall positive perception of WBT in these domains. It is noteworthy that 'Time-saving' garnered the highest rating with a median score of 5, underscoring the participants' strong preference for the efficiency and convenience offered by WBT in managing their T2DM. The IQRs, typically ranging from 3 to 5, signify a degree of agreement among participants, although some variability exists, especially in their assessments of the enjoyability, excitement, and interest associated with WBT usage.

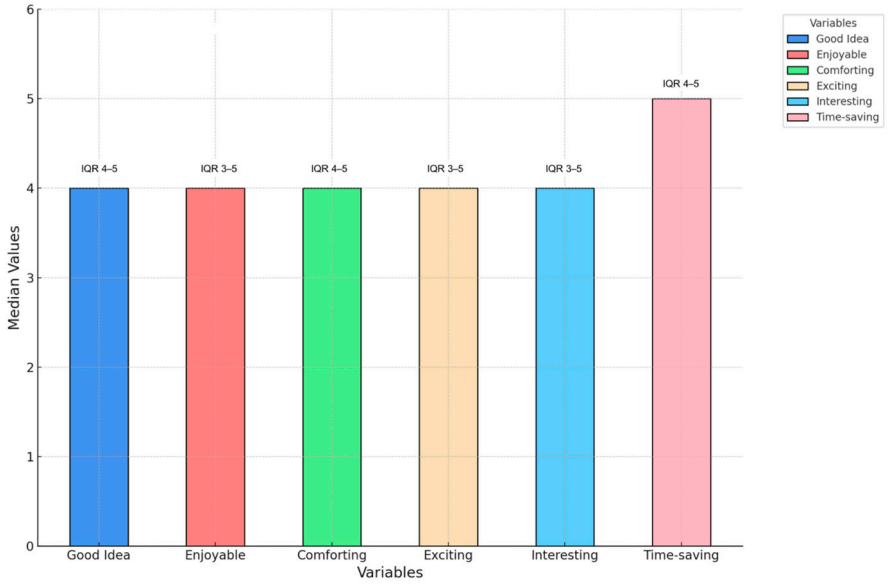

Figure 1. Perceptions of Arabic-Speaking Immigrants on Using Web-Based Technology for Diabetes Self-Management.

The study investigated the relationships between demographic factors and the use of WBT for diabetes self-management, uncovering significant correlations (Table 3). Utilizing binary regression analysis, a negative correlation was observed between age and the willingness to use WBT tools for diabetes care, indicating that older participants were generally less inclined to use these methods (OR = 0.101, $p < 0.001$, 95% CI = 0.027–0.381). Conversely, a positive correlation was found between higher educational attainment and the adoption of WBT tools, suggesting that individuals with more education were more likely to employ this technology for supporting their diabetes management (OR = 3.30, $p < 0.039$, 95% CI = 1.063–10.261). Furthermore, the analysis showed that married people were more likely to use WBT for diabetes self-management (OR = 4.92, $p < 0.024$, 95% CI = 1.230–19.740).

Table 3. Multiple regression analysis of factors influencing intention to use web-based technology for diabetes self-management.

Model	B	SE	Exp(B)	*p* Value	95% C.I. for Exp(B)	
					Lower	Upper
Age	−2.294	0.678	0.101	<0.001 *	0.027	0.381
Gender	0.206	0.554	1.228	0.710	0.415	3.636
Education level	1.195	0.578	3.303	0.039 *	1.063	10.261
Marital status	1.595	0.708	4.928	0.024 *	1.230	19.740
Employment status	0.710	0.650	2.035	0.274	0.569	7.270
Disease duration	−3.086	1.714	0.046	0.072	0.002	1.314

*: Correlation is significant at the 0.05 level.

4. Discussion

According to the data collected in this study, a significant majority (94%) of the Arabic-speaking immigrants living with T2DM in KSA reported having access to the Internet through devices such as mobile phones, computers, and tablets. This aligns with the general population trends according to the Communications, Space, and Technology Commission, who suggest 98.6% of the general population in KSA have access to or use WBT [28]. This result suggests that access to technology is not an issue regardless of migration status, making it possible for more people to be able to access telemedicine and telehealth via smart devices. Several studies have reported similar findings, revealing that a majority

of participants, often from lower socioeconomic backgrounds and diverse cultural and linguistic backgrounds, own mobile phones that are equipped with advanced internet capabilities and a range of app features [29–31]. This result is significant for immigrant groups, who typically encounter difficulties in accessing conventional healthcare services in their new countries due to a lack of familiarity with the local healthcare systems [32]. The ability to access health services via smart devices can significantly mitigate these challenges, providing a more inclusive and accessible healthcare environment for these populations [33]. Moreover, the high level of technology access among immigrants also suggests the potential for a broader adoption of telemedicine and telehealth services [33]. This can lead to improved healthcare outcomes, as telehealth not only offers convenience but also ensures continuity of care, particularly for chronic conditions such as diabetes, where regular monitoring and consultations are crucial [34].

While access to technology did not seem to differ greatly between immigrants and the general population in KSA, the study did find that time spent on the internet by an immigrant (average of 2 h/day) was far shorter than the general population in KSA (average of 7 h/day) [28]. This difference may be because of different online habits among the participants or might be a reflection of the general population, which includes more younger people. This trend is substantiated by reports showing that younger individuals exhibit a higher preference for online activities and spend more time engaged in them compared to older age groups [35,36].

The results from the study found that the majority of participants had the intention to use WBT, particularly for planning their diet, monitoring blood glucose levels, and organizing physical activities. More importantly, they perceived WBT favorably, with many citing that the use of such technology facilitated time-saving and improved enjoyment and engagement with self-management of T2DM. These findings were of no surprise as they are consistent with research conducted in Canada, the United States, and The Netherlands [37–39], where the majority of participants expressed positive attitudes towards the use of technology. While the intention to use WBT was generally positive, this study did not evaluate if participants had previously utilized WBT for diabetes self-management. It is highly plausible that despite best intentions to use WBT, immigrants in KSA may still choose not to engage with the use of such technology for their diabetes management. As shown in the study by Boyle and colleagues, people living with diabetes did not utilize WBT when asked to do so. Reasons for this may have related to their lack of awareness of its existence or potential benefits, lack of recommendation from healthcare providers, lack of confidence in using such technology, and feeling fatigued after its use [40]. Future research should focus on assessing the actual utilization of WBT for diabetes self-management among respondents who expressed intentions to use it, to determine the extent to which these technologies are effectively employed in managing T2DM.

The study, in line with the findings of Dobson et al. [24], revealed significant positive correlations between specific demographic factors such as age, level of education, marital status, and the use of WBT for diabetes self-management. It was observed that younger patients exhibited a heightened interest and a stronger intention to utilize WBT in the future. Moreover, individuals with higher educational levels demonstrated a more favorable attitude towards the use of WBT, corroborating the findings of Song et al. [41] and Jafari et al. [42], which suggest that higher education is linked with increased confidence and better judgment in employing mHealth technologies. In addition, married participants demonstrated a greater interest in utilizing WBT for diabetes management. This finding suggests a potential direction for future research to investigate how health professionals can utilize this knowledge to identify individuals best suited for receiving mHealth technologies and support. Further studies could delve into how individuals' existing knowledge and support systems can be harnessed to optimize the effective use of digital tools in managing chronic conditions such as diabetes.

To the best of our knowledge, our study is the first to investigate the attitudes and intentions of Arabic-speaking immigrants with T2DM in KSA regarding the use of WBT

for diabetes self-management. It should be noted that our study was conducted with a sample of 91 patients using convenience sampling, which could be considered a limitation. While the study survey was based on validated questionnaires, the survey was not tested for its face validity to ensure that all questions were presented in a culturally appropriate manner for Arabic-speaking immigrants. However, the lead researcher from this study is an insider to the culture in KSA and did adapt the questionnaire to best suit the cultural needs of the participants.

5. Conclusions

Among Arabic-speaking immigrants residing in KSA and living with T2DM, WBT is commonly used for social interactions and information-seeking purposes. Overall, access to technology does not appear to be a limiting factor, and the majority of participants were positive towards utilizing such technology as a tool for managing their diabetes. Most of these individuals expressed a willingness to integrate WBT into their diabetes care, specifically for diet planning, blood glucose monitoring, and communication with healthcare professionals. Future research needs to evaluate if Arabic-speaking immigrants indeed will utilize WBT when asked to manage T2DM. If utilization of WBT differed from the intention to use WBT, further studies should focus on exploring barriers to utilization of WBT for T2DM management.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/diabetology5010007/s1, Survey S1: the survey instruments.

Author Contributions: Conceptualization, S.G., C.T. and J.T.; methodology, A.A.; formal analysis, A.A.; data collection, A.A.; writing—original draft preparation, A.A.; writing—review and editing, S.G., C.T. and J.T.; funding acquisition, no formal funding; however, A.A. is a PhD student who received full scholarship from University of Tabuk (KSA). All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of La Trobe university (Ethics Application Number (HEC21273).

Informed Consent Statement: Implied informed consent was obtained by completing the survey.

Data Availability Statement: The data presented in this study are available on request from the corresponding author (due to ethical restrictions).

Acknowledgments: The authors wish to extend their sincere gratitude to Al Ameen Hospital, Taif City, Saudi Arabia, for their invaluable support in facilitating the data collection process for this study. The hospital's cooperation was instrumental in providing a conducive environment for gathering essential research data, thereby significantly contributing to the success of this project. Special thanks are also due to Ninorta Morad for her crucial role in translating the survey from English to Arabic. Her meticulous efforts in ensuring the accuracy and cultural relevance of the translation. Her contribution has been a key factor in the smooth execution and overall success of this study. Also, the authors would like to extend special appreciation to Xia Li for her valuable assistance in handling the statistical aspects of this project. Lastly, the authors acknowledge the assistance of AI platforms such as Grammarly and ChatGPT in rephrasing sentences. This support proved particularly valuable as the authors' first language is not English, helping to enhance the clarity and effectiveness of communication.

Conflicts of Interest: The authors declare no conflict of interest.

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