Evaluation of *Support,* a self-guided online type 1 diabetes self-management education and support web application—a mixed methods study

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Abstract

Background: Type 1 diabetes requires making numerous daily decisions to maintain normoglycemia. *Support* is an evidence-based self-guided web application for type 1 diabetes diabetes self-management.

Objective: Evaluate users' satisfaction with *Support* and investigate changes in self-reported frequency of-, fear of- hypoglycemia, and diabetes-related self-efficacy.

Methods: Adults from a Quebec type 1 diabetes registry used *Support.* Data was collected through online surveys or extracted from the registry at 0, 6, and 12 months (number of episodes and fear of hypoglycemia). At 6 months, participants reported satisfaction with *Support* and diabetes-related self-efficacy. A sub-group of 16 users was interviewed about their experience. Transcripts were analyzed using inductive and deductive approaches.

Results: In total, 207 accounts were created (35% men, 96% White, mean age and diabetes duration: 49.3 ± 13.8 and 25.2 ± 14.7 years). At 6 months, the median [Q1; Q3] satisfaction was 40/49 [35; 45] with a mean decrease in hypoglycemia frequency of 0.43 episodes over 3 days (95% CI: −0.86; 0.00, $p = 0.051$) and of −1.98 score for fear (95% CI: −3.76; −0.20, $p = 0.030$). Half of the participants reported increased diabetes-related self-efficacy.

Conclusions: Participants reported a high level of satisfaction with *Support.* Its use has the potential to facilitate hypoglycemia management and increase diabetes-related self-efficacy.

Trial registration: This study is registered on ClinicalTrials.gov NCT04233138.

Keywords

Type 1 diabetes, self-management, e-health, user's experience, intervention evaluation, hypoglycemia

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Introduction

Digital health tools for health care communication and delivery can be a more accessible and flexible alternative than in-person approaches.[1] Compared to other digital health solutions (e.g., mobile applications [apps], virtual reality, web apps) have lower development costs, can be faster to develop and require fewer updates and technical support over the long-term.[2] This makes them suitable to deliver chronic disease self-management education and

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support to a larger population, especially when regular content updates are needed.[3]

People living with type 1 diabetes (PWT1D) need to make numerous daily decisions to maintain an adequate glycemic level and avoid complications.[4] Factors such as food intake, physical activity, stress, and change of routine[3,5,6] need to be considered to maintain normoglycemia. Hypoglycemia is considered one of the main barriers to optimal glycemic management.[7] Frequent episodes can lead to fear of hypoglycemia which can consequently lead to adaptative behaviours (e.g., increasing food intake, avoiding physical activity) which, in turn, potentially increase the risk of hyperglycemia and long-term complications.[7] Therefore, for PWT1D, diabetes self-management education and support (DSME/S) are essential.

DSME/S aims to facilitate long-term diabetes self-care by providing key concepts of diabetes management (e.g., factors influencing glycemic control) and by training individuals to engage in self-management behaviours (e.g., carbohydrate counting, insulin dose adjustments).[8] Compared to in-person DSME/S, online DSME/S allows people to learn at their own pace,[9] and can potentially lead to higher satisfaction.[10] In situations of limited healthcare resources, self-guided tools (i.e., absence of live involvement from healthcare professionals (HCPs)) can further decrease the DSME/S programme maintenance cost and add flexibility to the learning process.[11] Continuous evaluation is essential to understand how people are using such tools in order to an ongoing improvement on the use of the platform and its influence on clinical outcomes.[12] In addition, as behaviour change theories facilitate the understanding of behaviour mechanisms and increase the precision of interventions, their incorporation in DSME/S web apps can potentially lead to better clinical outcomes and intervention engagement.[13,14] However, there are limited self-guided DSME/S web apps for type 1 diabetes (T1D) that are informed by behaviour theories or frameworks, in particular for adults[11] and a lack of evidence on web apps' development to ensure user satisfaction.[11,12]

Support is a self-guided web app developed with and for adults with T1D with a focus on hypoglycemia. Through a proof-of-concept study, we investigated (a) user satisfaction with *Support* and (b) changes in the self-reported frequency of hypoglycemia, in the fear of hypoglycemia, in self-efficacy in diabetes self-management (DSM) (in preventing hypoglycemia and in managing glycemia). Potential optimization of the web app to facilitate its use and training in hypoglycemia management will also be discussed. We expected that *Support* would be appreciated by users since previous digital interventions on chronic health conditions received a high satisfaction score[15] and that its use would be associated with reduced fear and frequency of hypoglycemia and with increased self-efficacy in DSM.[16]

Methods

This mixed methods concurrent triangulation study combined a registry-based quasi-experimental and a phenomenological design[17] (ClinicalTrials.gov. registration number: NCT04233138). The study was approved by the Montreal Clinical Research Institute's Research Ethics Committee and participants provided online informed consent. The results are reported based on Mobile Health Evidence Reporting and Assessment Checklist.[18]

Intervention

Participants had access to the *Support* web app (French or English)[19] for 12 months with bi-weekly e-mail newsletters during the first 6 months. Briefly, *Support* was developed by a team of patient partners, HCPs and researchers specialized in T1D (e.g., certified diabetes educator, dietitian, nurse, psychologist, endocrinologist). All content is based on the most recent literature, and peer-reviewed by patient partners and HCPs. The learning modules are divided into six categories with several courses in each. Categories have three learning levels (basic, intermediate, and advanced) and course lengths vary from 5 to 20 min. Completing the basic level unlocks the intermediate level and so forth. Four learning paths are available based on the diabetes treatment profile (Supplemental information I). Several features are included (such as videos, testimonials, downloadable PDF) to enhance user experience (Supplemental information II). The choice of features was guided by the Behaviour Change Wheel,[20] its related behaviour change techniques,[21] and evidence from previous literature.[11] At onboarding, every participant needs to complete a mandatory module on hypoglycemia.

Recruitment

Recruitment was done using a registry of PWT1D in Quebec (BETTER: BEhaviours, Therapies, Technologies, and hypoglycemic Risk in T1D[22]). Adults ($\geq$ 18 years old (y.o.)) with a self-reported diagnosis of T1D $\geq$ 1 year, and daily use of $\geq$ 4 insulin injections or an insulin pump were invited by email. Other inclusion criteria were having access to the Internet, an active e-mail address, and understanding English or French. People with ongoing pregnancy or illnesses limiting diabetes care or limiting access to educational tools (e.g., dementia and blindness) were excluded.

Data collection

At baseline, socio-demographic information and diabetes history data were extracted from the BETTER registry. Participants completed an online survey asking about their readiness to change for improving glycemic

management, their level of health literacy,[23] and the number of hypoglycemia episodes (blood glucose <4.0 mmol/L) in the last 3 days. Participants also completed the 33-item Hypoglycemia Fear Survey-II (HFS-II).[24] Questions related to hypoglycemia were repeated at 6 and 12 months. The presence of elevated fear of hypoglycemia (i.e., a score of ≥ 3 on any of the items in the HFS-II[25]) was calculated. At 6 months, participants were asked to report on changes in their confidence level in self-efficacy (in preventing hypoglycemia and in managing blood glucose).

At 6 months, the level of satisfaction with *Support* was measured using a 7-question face-validated satisfaction questionnaire (Likert scale from 1- *strongly disagree* to 7- *strongly agree*).[26,27] Two questions were purposively formulated in a negative form to ensure participants read questions properly. The score was reversed before analysis for a maximum total score of 49. Thus, data from respondents who answered all "1" or all "7" was removed from the analysis. A single question rating overall appreciation from 1 to 10 was also asked. Participants selected a maximum of three most preferred features from a list of 14 and answered two mandatory open-ended questions on what they liked most about *Support* and what should be improved. The study-specific questionnaires were administered online through Research Electronic Data Capture 11.1.0.

Web app usage and engagement

Google Analytics was used to track the usage of the web app (number of page views, number of sessions, and average session duration) and of specific embedded features (calculator use, downloaded PDF documents, and submitted quizzes). The number of page views included only pages with specific uniformed resource locator (URL; i.e., learning content, dashboard, media library, frequently asked questions, discussion forum, and news blogs) and included pages seen multiple times. They were reported per period of 6 months and used to describe engagement with the web app. When a user logged in to *Support* and remained active, a session was tracked.[28] Usage of the calculator was defined as the number of times a result was displayed, PDF documents referred to the number of downloaded documents, and a quiz was considered when the user clicked on "submit." The number of posts on the discussion forum was analyzed from the front end of *Support*. Mailchimp tracked the number of opened and clicked newsletters (out of 13 sent).[29]

Natural evolution of hypoglycemia within the BETTER registry's participants

Using the BETTER registry, we contrasted the change in the frequency and fear of hypoglycemia observed among the *Support* participants from baseline to 6 months to the natural evolution observed in the registry over a similar 6-month period. The data included in this description are from participants in the registry not part of the actual study but who met the inclusion and exclusion criteria.

Quantitative data analysis

Descriptive analyses are presented (median and interquartile range or mean and standard deviation). Cronbach's alpha was used to measure the reliability of the satisfaction questionnaire. Pearson correlation, paired *t*-tests, and independent *t*-tests were performed. Analyses were conducted using SPSS Statistics version 28.

Semi-structured interviews

At 6 months, semi-structured individual interviews based on a phenomenological design were conducted to deepen the understanding of the participants' experience using *Support* (content and format). Of those who completed the satisfaction questionnaire, 16 users were included. To decrease recall bias, four participants were randomly selected, using R Studio, for every 25 participants who completed their first 6 months. To ensure an equal number of men or women, purposive sampling was employed with the last group of 25 participants. Participants were excluded if they explicitly expressed never using *Support*.

The interviews lasted about 60 min and were conducted in French on Microsoft Teams. A doctoral student (LFX), trained in qualitative data collection and unknown to the participants, conducted all interviews. The interview guide was developed following work from Arnold et al.[30] with guidance from HCPs (dietitians, nurses, and an endocrinologist) and patient partners. It consisted of five sections with a total of 24 questions, including 20 open- and four closed-ended questions. Participants were invited to share their general experience using the healthcare system and then to focus on their experience with Support. Factors influencing their use of Support, feedback on the contents and the features, and the consolidation of knowledge learned from Support into their DSM were explored. Following the interview, participants received a summary of their interview's key points by email and were asked to comment within 2 weeks. Each participant was sent an electronic gift card (40 CAD) for their participation.

Open-ended questions from satisfaction questionnaires were qualitatively analyzed along with the semi-structured interview transcripts using NVivo (QSR International, Melbourne, Australia). Two researchers (LFX and AH) performed the initial inductive coding independently on two transcripts randomly selected. Then, all the interviews were analyzed with the created coding book in an iterative approach. Codes were refined as needed (e.g., through

rewording). After independently coding all transcripts, 100% agreement was achieved through discussion. Codes were grouped into themes using a combination of inductive (i.e., using concept mapping) and deductive methods (i.e., guided by the interview questions).[31] Analyses were performed in French and were translated into English using a forward-backward translation process for publication.

Results

Satisfaction and change in hypoglycemia

From October 28th, 2019, to September 30th, 2021, 207 participants consented and created a *Support* account and

Table 1. Baseline characteristics of support users.

Variables, n (%) unless specified	$n = 207$
Gender (self-identified)	
Men	73 (35%)
Women	135 (65%)
Age in years, mean $\pm$ SD	49.3 $\pm$ 13.8
Duration of type 1 diabetes in years, mean $\pm$ SD	25.2 $\pm$ 14.7
Ethnicity	
White	196 (96%)
Others	9 (4%)
Level of education	
College or lower	87 (43%)
Bachelor's degree or higher	117 (57%)
Employment status	
Full-time	105 (51%)
Retired	58 (28%)
Others	43 (21%)
HbA1c in the last 3 months	
7% or less	81 (41%)
7.1%–8%	82 (42%)
8.1 or more	34 (17%)
Number of hypoglycemia in the last 3 days, mean $\pm$ SD	2.38 $\pm$ 2.37
Fear of hypoglycemia total score, mean $\pm$ SD	33.8 $\pm$ 16.5
Readiness of making changes to improve glycemic management (/10), median [quartile 1; quartile 3]	9 [8;10]
Level of health literacy (/5), [quartile 1; quartile 3]	5 [4;5]

HbA1c: Hemoglobin A1c

were included in the analysis (Supplemental information III). The baseline characteristics are summarized in Table 1.

At 6 months, 169 participants answered the satisfaction questionnaire (Cronbach's alpha of 0.88). The median [quartile 1; quartile 3] score was 40/49 [35; 45], which is similar to the overall rating of *Support* on a 10-point scale (8 [8;9]) ($n = 166$) (Supplemental information IV). During the first 6 months, the self-reported frequency of hypoglycemia over 3 days decreased by −0.43 episodes (95% confidence interval [95% CI]: −0.86, 0.001; $n = 166$) from 2.47 episodes to 2.04 episodes. Self-reported hypoglycemia from 6 to 12 months showed an average additional decrease of −0.51 (95% CI: −1.13 to 0.12; $n = 89$) (Table 2). In contrast, in the BETTER registry, a sub-group of 244 participants, reported on average no change in the number of hypoglycemic episodes (0.01 episodes per 3 days, 95% CI: −0.22, 0.25) during the same 6-month period.

A decrease in HFS-II total score (out of 132) was observed during the first 6 months (−1.98; 95% CI: −3.76 to −0.20; $n = 170$) and by −10.20 (95% CI: −13.84, −6.56; $n = 100$) during the following 6 months (Table 2). The percentage of users having elevated fear of hypoglycemia at baseline, 6-month, and 12-month were 82% ($n = 166/203$), 53% ($n = 78/146$), and 48% ($n = 53/111$), respectively. In the BETTER registry, there was no change in their fear of hypoglycemia during the same period (mean 0.94 95% CI: −0.64; 2.52; $n = 248$). The changes in the frequency of hypoglycemia and in fear of hypoglycemia were not associated with satisfaction scores with the web app (respectively $r = -0.064$; $p = .442$, and $r = 0.021$; $p = 0.786$) during the first 6 months. At 6 months, about half of the users reported an increase in their confidence in managing blood glucose levels (47%, $n = 79$) and in their confidence in preventing hypoglycemia (51%, $n = 85$) (Supplemental information V).

Support usage

The use of *Support* is described in Table 3. No web app usage was tracked by Google Analytics for 25 users due to their privacy parameters and four users did not receive newsletters due to a human error (their email address was not added to the newsletter list).

The median number of page views during the first 6 months was 54 [24;147] and decreased to 0 [0;10] in the following 6 months. Based on a stratification analysis with the median split of the number of page views in the first 6 months ($n = 90$ for lower engagement vs $n = 92$ for higher engagement), all baseline characteristics were similar except that people with a higher engagement reported a slightly higher readiness for glycemic management's change at baseline (9.0 $\pm$ 1.0 vs 8.8 $\pm$ 1.1; $p = 0.047$). The number of page views was not associated with changes in hypoglycemia frequency ($r = -0.008$; $p = 0.917$) nor fear ($r = 0.004$; $p = 0.961$) during the first 6 months

Table 2. Changes in hypoglycemia frequency and fear.

	Paired *t*-test		
Number of hypoglycemia/3 days	Mean ± SD	Mean difference (95% CI)	*p*-value
6-month to baseline (*n* = 166)		−0.43 (−0.86; 0.001)	0.051
Baseline	2.47 ± 2.38		
6-month	2.04 ± 2.10		
12-month to 6-month (*n* = 89)		−0.51 (−1.13; 0.12)	0.109
6-month	2.38 ± 2.47		
12-month	1.88 ± 1.83		
Fear of hypoglycemia total score (/132)			
6-month to baseline (*n* = 170)		−1.98 (−3.76; −0.20)	0.030
Baseline	33.8 ± 16.1		
6-month	31.8 ± 15.5		
12-month to 6-month (*n* = 100)		−10.20 (−13.84; −6.56)	< 0.001
6-month	33.8 ± 16.4		
12-month	23.6 ± 11.3		

Among the 14 listed features, the most preferred features were downloadable PDF documents, blog news, newsletters and videos with an equal number of votes, and quizzes. Discussion forums, certificates for course completion, virtual rewards, and glossary definitions were the least frequently selected features.

User's experience with Support

The interviews were held between February 2 to June 30, 2021. Thirty-one invitations were sent. Three participants declined, 11 didn't respond, and 17 accepted. One participant admitted not using *Support* despite creating an account and was therefore not interviewed. The mean age of the 16 participants (50% women, 100% White) was 53.8 ± 16.1 years (ranging from 27 to 79) with a mean diabetes duration of 26.5 ± 14.7 years. Among those participants, the median number of page views on *Support* was 130 [30; 323]. Based on descriptive analyses, the change in the self-reported frequency of hypoglycemia during the last 3 days was −0.4 ± 2.8 episodes and total fear of hypoglycemia was −1.98 ± 11.75 during the first 6 months. Only one participant provided comments after receiving the interviewee's summary (i.e., by highly suggesting the use of a mobile app instead of a web-based one).

Interview code saturation (i.e., information was repetitive and no new code occurred[32] was reached after 14 transcripts. Feedback and suggested modifications are summarized in Supplemental information VI. Participants reported on the factors that could impact their experience with *Support* and these factors were further divided in relation to the content and the format (Figure 1). Examples of quotes can be found in Supplemental information VII.

Experience with the content

The majority of the participants expressed the importance of having content that is accessible, personalized, and credible. They suggested unblocking all modules to increase accessibility and flexibility in navigating the content. Having information that was concise and easy to understand (e.g., using PDF documents to summarize the information or delivering information with videos) was reported among the main strengths of *Support*. A few participants stated that the length of the content impacted its accessibility. They appreciated that a written module could be completed within 10–15 min and a video between 2 and 4 min, as lengthy content can decrease their motivation in accessing the information.

Many participants elaborated on the need for having personalized information, that should be level- and need-adapted, and allow them to integrate the new skills into their daily life. A participant suggested having "a knowledge validation questionnaire" *(woman, 37 y.o.)* at the beginning to guide users to the appropriate level of content. As suggested by our users, diabetes duration can be a potential factor influencing their level of understanding. The feature "Case studies with the six characters" was positively viewed by some participants as it can

Table 3. Web app usage during the first 6 months of intervention.

Web app usage[a]	Median [quartile 1, quartile 3]
Number of page views[b]	54 [24;147]
Number of sessions	7 [3;12]
Average session's duration, in minutes	12 [7;23]
Calculator	
Number of people who used at least once, *n* (%)	30 (16%)
Discussion forum	
Number of users who posted at least once, *n* (%)	33 (16%)
Total number of posts[c], *n*	89
Newsletters	
Number of people who opened at least once, *n* (%)	198 (98%)
Number of opened newsletters (out of the 13)	11 [7;13]
Number of people who clicked the link from newsletters at least once, *n* (%)	170 (84%)
Number of newsletters with the embedded link clicked at least once (out of 13)	3 [1;6]
PDF documents	
Number of people who downloaded at least once, *n* (%)	101 (54%)
Number of downloaded PDF documents	1 [0;6]
Quizzes	
Number of people who submitted at least once, *n* (%)	126 (67%)
Number of submitted quizzes	3 [0;14]

[a]*n* = 202 for newsletters, *n* = 207 for the discussion forum, and *n* = 182 for others.
[b]A same page, PDF documents, and quiz view/usage can be tracked more than once. Pages related to administrative purposes were excluded.
[c]Total number of posts based on the respective 6-month of each participant.

potentially help users save time by identifying the scenario corresponding to their needs, going beyond the basics, and making direct applications.

The credibility of the information was associated with scientifically up-to-date information and the involvement of HCPs in creating the content and monitoring the forum (e.g., have HCPs involved and supervised the discussion forum).

Experience with the format

Some participants explained that they would need active exposure to the web app's information such as through email newsletters, social media, or reminders from HCPs. Although categorization of the information was mentioned to facilitate information searching, some participants shared difficulties in navigating *Support*, especially not understanding how each section or feature was connected. To increase accessibility, some participants suggested transferring to a mobile application because "it's easier to log on the phone than on a computer." *(woman, 37 y.o.)*

The web app format should be personalized through flexibility in the learning process and the ability to track self-progress. Many participants appreciated that *Support* is completely online and self-guided allowing them to "stop at any moment and resume where [they] were" *(woman, 27 y.o.)*. Compared to in-person classes where participants might only "retain 25% of what they heard in 4 days" *(woman, 67 y.o.)*, being able to repeat the modules on *Support* allowed them to revisit information. The dashboard was mentioned as a feature that facilitated self-tracking and personalized the learning progress based on user needs.

Some interactive features received mixed feedback. On the one hand, participants found that the interaction between peers in the discussion forum allowed them to "know that [they are] not alone in [their] situation" *(woman, 60 y.o.)*. On the other hand, some participants expressed that questions asked in the forum by others were not relevant to them and did not feel the need for referring to the forum. Similarly, concerning gamification, some mentioned it might facilitate the learning process (e.g., with the quizzes) and maintain motivation (e.g., through the trophies), though others expressed it had no impact on their use of the web app. Participants appreciated interactive features that align with their expectation or objective of using *Support*, such as quizzes that helped "confirm whether [they] understood the content". *(man, 75 y.o.)*

The aesthetic aspects were also mentioned during the discussion. One participant reported that "I like the visuals because it's attractive and simple. It's nothing too childish nor adultlike or serious." *(woman, 32 y.o.)* and another suggested having a greater contrast to facilitate the reading. In addition, a participant suggested the integration of an in-person component to the intervention, as "[an online intervention] is a computer and can't be compared with a human. It is cold and has no [human] contact". *(man, 42 y.o.)* As a future direction, a participant also proposed to expand the web app for family and friends of people with T1D to increase their "medical literacy". *(man, 79 y.o.)*

Discussion

Users reported an overall high satisfaction after 6 months of use and our results show the potential of *Support* in decreasing the self-reported frequency and fear of hypoglycemia. There was also an increased self-efficacy for preventing
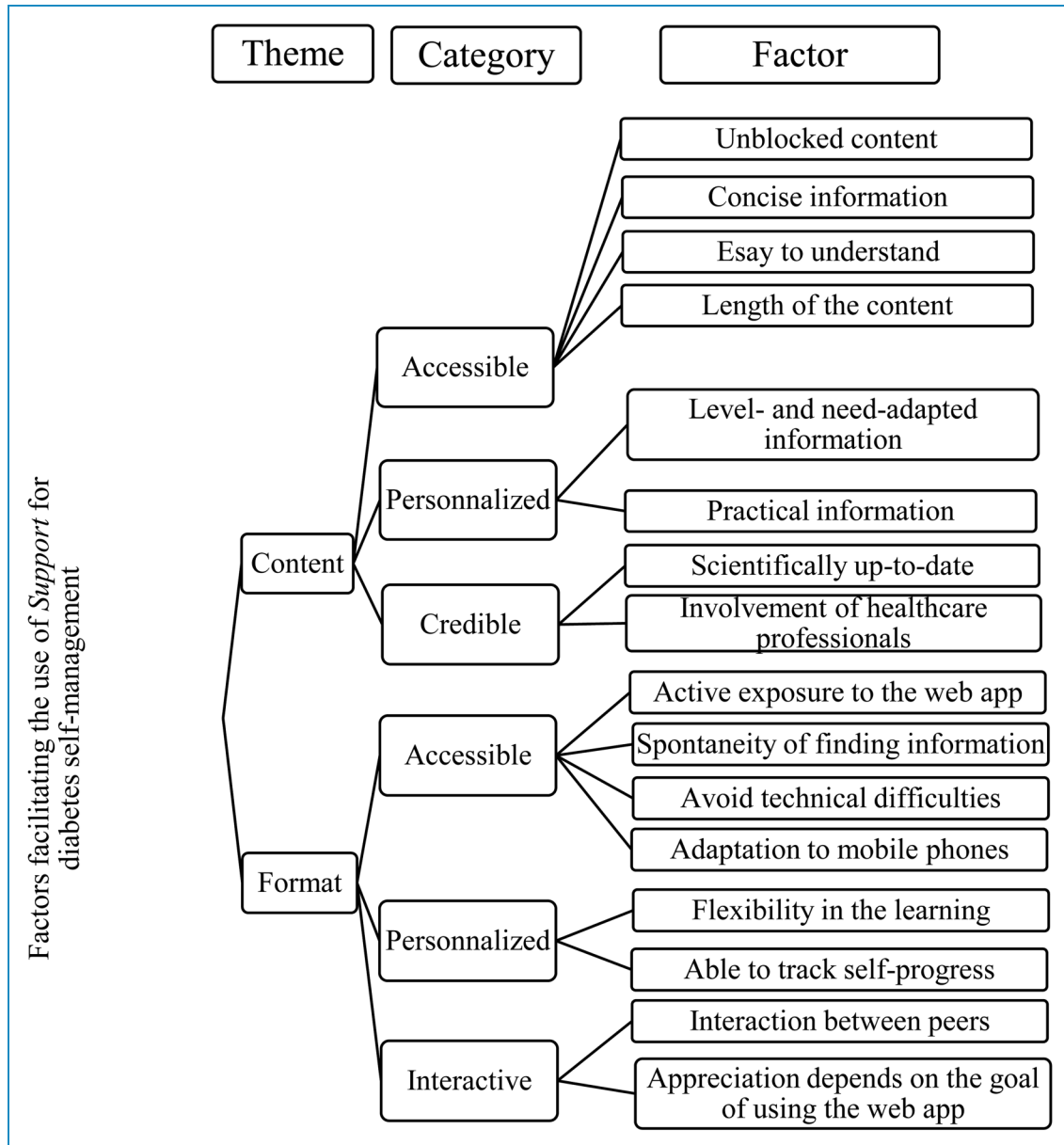
Figure 1. Factors facilitating the use of support for diabetes self-management.

hypoglycemia and for managing blood glucose levels after having accessed *Support*. Engagement in *Support* was greater during the first 6 months than in the subsequent ones and the engagement was similar across people from different socio-demographic backgrounds (e.g., age, gender, number of years of T1D duration). Features supporting information viewing, such as case studies and news blogs, were the most appreciated. When users expected to receive peer-to-peer interaction, they tended to appreciate social support-related features such as testimonial videos and the discussion forum.

The high level of user satisfaction can be related to the development and delivery method of *Support* compared to other in-person DSME/S interventions.[19] To our knowledge, *Support* is the first self-guided web app for PWT1D built using a behaviour change framework. The material is evidence-based and peer-reviewed. These characteristics bridge gaps in the development of digital healthcare tools, namely the user's distrust in the information[33] and the lack of an evidence-based design.[34] Its development by a multidisciplinary team includes PWT1D participating in every step of the development can contribute to increased acceptability by the end-users given their shared experiences and needs.[12,35] The decrease in self-reported frequency and fear of hypoglycemia after 6 and 12 months of accessing *Support* is comparable to results reported by

other DSM programmes for PWT1D. For instance, in a 6-week in-person intervention, 23 participants were taught about hypoglycemia symptoms, causes, and consequences of impaired awareness of hypoglycemia. The intervention was delivered over three weekly full-day group sessions, homework using home glucose monitoring for two weeks, and one final full-day group session in week 6. Participants reported significant improvement in hypoglycemia awareness after 12 months and a decreased median range rate of severe hypoglycemia.[36] In another in-person programme, 81 PWT1D were gathered in 12 group lessons of 90 min each for a total of 6 weeks. The programme focused on intensive insulin therapy, detection and treatment of acute complications, and prevention and early identification of late complications. An improvement in hypoglycemia awareness and decreased incidence of severe hypoglycemia were reported after 6 months of the programme. The self-guided online delivery format is an alternative to in-person programmes.[36,37] It provides the opportunity to reach a greater population that may not have physical access to those programmes and allow users to learn at their pace.[38]

Similar to previous online interventions,[39] our results show a decrease in engagement with time and low usage of downloadable PDF documents, calculators, and newsletters in general. This low feature usage can be explained by the method used for measuring it. For example, downloadable PDF documents can be viewed in a browser without being downloaded, whereas only actual downloaded documents were tracked by Google Analytics. The absence of newsletters in the second 6 months may partially explain the lower engagement because our results show that the newsletters were mainly used to obtain information rather than promote engagement with *Support*. Some participants explained that when receiving sufficient information from the newsletters, they did not perceive the necessity to log in online or click the links; while others only connected to the web app when they received a reminder as an external stimulus. The decreased engagement can also be explained by the fact that users perceived *Support* as a source of information and once they finished viewing the content relevant to them, they might only refer to it based on their needs. Therefore, a decreased engagement (measured by the number of page views) is to be expected.

Limitations

Our study has some limitations including the absence of Anglophone users for the interview and the lack of ethnic diversity. Our interviewed participants also had a higher engagement than other users, indicating a greater preference for using digital tools for DSM or higher digital literacy. These participants were also included in the second 6 months' engagement analysis, their interview invitation might have encouraged them to use the web app during this period. Recruitment within diverse cultural communities could improve the sample's diversity and enhance the findings' generalisability. When responding to the satisfaction survey, some participants might not have explored all the components of Support. This reflects one of the challenges in delivering digital interventions, as it is often difficult to evaluate if the users received the intervention content in the intended way.[40] During the intervention, we noticed that some participants were not receiving the newsletters due to human errors. This lack of fidelity in the intervention delivery highlights the need for having utility and feasibility studies before larger pivotal studies to advocate adjustments needed in future intervention deliveries. We also encountered challenges in tracking the usage data, as 25 (12%) of the users had no usage data from Google Analytics due to privacy settings. The selection bias can also be present due to the timing and method of recruitment. This study occurred during the coronavirus pandemic when people's lifestyles, including the use of digital tools, were affected.[41,42] Participants were recruited through the BETTER registry. However, the recruitment for the registry was also slowed down at the beginning of the pandemic having to move from primarily in-person clinic-based recruitment to mainly online. These aspects might restrict the recruitment of people having a greater interest in digital health and research and of those with more time availability. Therefore, future evaluation projects in a non-pandemic situation would be suggested.

Conclusions

In conclusion, our study showed that *Support* is highly appreciated by PWT1D. This online education and support web app has the potential to decrease the self-reported frequency and fear of hypoglycemia and increase self-efficacy in DSM among adults living with diabetes. Such a web app could be used as an adjuvant tool to DSME/S in clinical settings. Future steps include adjusting the web app based on the suggestions provided by the participants and investigating its clinical implementation and effectiveness for scalability.

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