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Research paper

Users of e-Health tools for mental health and suicide primary prevention: description of their characteristics, usage, and satisfaction in the case of StopBlues

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ABSTRACT

Background: Thousands of mental health (MH) applications are currently available. Suicidal behavior prevention could benefit from such tools, but few have been evaluated. StopBlues (SB) is an app- and web-based intervention for suicide primary prevention for the French general population. Our objectives were to better understand who users of e-health tools for suicide prevention are by describing SB users' characteristics and their use of the tool, engagement and satisfaction along with the factors associated with the latter two.

Methods: Age, gender, socioeconomic status (SES), and MH were collected from users who registered to SB between March 2018 and February 2020. MH was self-assessed with validated questionnaires on global MH, depression, anxiety and suicide risk. Use of SB was assessed through functionalities users interacted with (questionnaires, moodtrackers and/or safety plan). Engagement was calculated between date of registration and last interaction with those functionalities. Satisfaction was assessed through a dedicated survey between May 2019 to June 2020. Regression models studied the factors associated with satisfaction and duration of engagement.

Outcomes: 10,792 people registered to SB during the study period. Two-thirds were women, mean age was was 38·5 years old (SD = 13·8), and 53·9 % lived in municipalities from the two highest SES quintiles. 47·8 % presented a risk of moderately severe or severe depression, and 27·2 % of severe anxiety. 23 % used the app for more than a day, with a mean duration engagement of 69 days (SD = 105). 96·4 % engaged at least once with either self-assessment questionnaires/moodtrackers or the safety plan, and 21·5 % interacted with both. 413 users completed the satisfaction survey and mean satisfaction was 61·6/100 (SD = 24·7).

Interpretation: E-health tools for primary suicide prevention appear to be useful for users but close considerations to gender and age should be made when developing such tools.

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1. Introduction

Mobile-health (m-health) – a field of e-health which uses mobile and wireless information and communication technology (ICT) in support of health – is taking a more and more significant place in people's daily lives (Kiemde et al., 2022). Mental health (MH) is not left behind: over ten thousand apps for MH had been identified in 2021 (Haque and Rubya, 2022), ranging from wide-spread meditation and mindfulness apps to therapeutic tools used to care for MH disorders such as depression or schizophrenia (Haque and Rubya, 2022; Larsen et al., 2016; Simões de Almeida and Marques, 2023).

A major MH issue which could benefit from e-health and m-health in particular is suicidal behavior (Luxton et al., 2015). Indeed, studies have shown that e-health and m-health interventions could have a positive impact on suicide prevention and associated MH disorders (Bakker et al., 2016; Christensen et al., 2014). Stigma and shame associated with

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suicide make e-health tools particularly useful to people who are not yet ready to talk to a professional (Reynders et al., 2014), by giving them access to reliable information, self-assessment, and coping tools at any time, as well as the possibility to connect to social or health services when they wish to do so (Christensen et al., 2014). In October 2020, approximately 66 apps were already available in English on the main operating systems to help prevent suicide (Martinengo et al., 2019; Wilks et al., 2021).

However, despite existing recommendations to do so (Geneva: World Health Organization, 2019), few have been evaluated (Bakker et al., 2016). Moreover, when an evaluation is carried out, it is often in the context of "captive" patients included in a clinical trial, which cannot give an account of real life conditions (Fleming et al., 2018; Baumel et al., 2019), in particular in the case of users' engagement indicators such as usability, satisfaction, acceptability, and feasibility (Ng et al., 2019; Patoz et al., 2021). Other issue is the short duration of use of most m-health apps (Amagai et al., 2022), be it in a trial setting (Linardon and Fuller-Tyszkiewicz, 2020; Torous et al., 2020; Rismawan et al., 2021) or in real-life (Ng et al., 2019; Schmidt, 2022). For m-health to achieve its full potential, it is therefore necessary to better understand how to enhance engagement and sustain it among users (Connolly et al., 2021).

Borghout and al. identified three main dimensions associated with users' engagement in digital MH interventions: 1/ users' characteristics, e.g. severity of MH disorder; 2/users' experience of the e-health tool, such as perceived usefulness; and 3/the technology and implementation environment, e.g. technical issues (Borghouts et al., 2021). Studying users and their experience is therefore key to improve knowledge and solve engagement issues (Connolly et al., 2021; Chan and Honey, 2022).

In this context, we aimed to study users of an existing tool, StopBlues (SB). SB is a free e-health tool for primary prevention of suicide released in 2018 and aimed at the French general population (Gandré et al., 2020; Le Jeannic et al., 2023). It is a app- and web-based intervention available to all on the internet and in appstores without medical referral, whose main objective was to empower people by helping them manage their own MH through the provision of a reliable and evidence-based tool. It used four types of strategies: education and awareness, mental health (self-)screening, mapping of available support, and mental health coping strategies. SB users could consult information on MH disorders and existing solutions, but also register to access personalized functionalities such as MH self-assessment questionnaires and moodtrackers, a map of surrounding supports, and a safety plan. Its content and development process have been published previously (Le Jeannic et al., 2023).

The use of SB was promoted by localities and in some cases general practitioners as part of the PRINTEMPS cluster randomized trial (ClinicalTrials ID: NCT03565562), and approximately 14,000 users were registered on Google analytics during the two-year evaluation period. However, because SB use was not limited to localities participating in the trial and was not conditioned on a prior consultation with a healthcare professional, it is as close to real-life conditions as can be.

The objectives of the present paper are to better understand who the users of e-health tools designed for mental health and suicide prevention are, by describing SB users' characteristics and assessing their use of the tool, duration of engagement and satisfaction along with the factors associated with the latter two.

2. Methods

2.1. Study design

An observational analytical study was nested within the PRINTEMPS cluster randomized controlled trial (Gandré et al., 2020), using users' data collected online via the SB application or website.

2.2. Population

Our population consisted of SB users who registered on the app or website (i.e. created an account) between March 2018 and February 2020 and who, by doing so, consented to the use of their data. Upon registering, users could indicate whether they meant to use SB for themselves or because they were concerned for a loved one, and as such the population was divided into two groups depending on their answer to that question. Follow-up lasted until June 2020. All users were included in the analysis.

2.3. Users' characteristics

Users' characteristics consisted of gender, age, socioeconomic status (SES), and MH status at registration. Age and gender were provided by users upon registering, as was their postcode of residence, which allowed us to assess their SES using an ecological indicator. We used the French Deprivation Index (FDep) (Rey et al., 2009), which is based on four variables: the percentage of blue-collar workers in the labor force, the percentage of high school graduates in the population aged 15 and over, the unemployment rate in the labor force and the median income per household.

Users who had registered for themselves could self-assess their MH status through four validated questionnaires that provide a risk estimate for the presence of a disorder: the Global Health Questionnaire-12 items (GHQ-12), a global mental health scale (Goldberg et al., 1997); the Patient Health Questionnaire-9 items (PHQ-9) for depression (Kroenke et al., 2001); the General Anxiety Disorders-7 items (GAD-7) for anxiety (Spitzer et al., 2006); the suicide risk section of the Mini International Neuropsychiatric Interview (MINI-S). Only at-risk users (i.e. users with scores above a given threshold (Gandré et al., 2020; Le Jeannic et al., 2023)) were asked to complete the MINI-S.

Users' answers to MH questionnaires were converted into categorical variables based on their interpretation thresholds (Appendix 2). Users were further characterized into four MH profiles depending on their scores: low MH risk (GAD-7 < 10 and PHQ-9 < 10); high MH risk (GAD-7 ≥ 10 and PHQ-9 ≥ 10); high risk of anxiety only (GAD-7 ≥ 10 and PHQ-9 < 10); and high risk of depression only (GAD-7 < 10 and PHQ-9 ≥ 10).

Users who had registered for a loved one completed the Montgomery-Åsberg Depression Rating Scale (MADRS), a global mental health scale adapted for heteroevaluation (Montgomery and Asberg, 1979). Answers were also converted into categorical variables depending on their scores (Appendix 2).

2.4. Use of SB

The use of SB was assessed in two manners: 1/users' interaction with the tool, i.e. which section(s) requiring user involvement they interacted with, and 2/duration of engagement. The first looked at their use of self-assessment questionnaires, moodtrackers, and safety plan. For the safety plan, they could input both *Warning signs* indicating that they were not feeling well, and *Coping activities* that made them feel better. The frequency of use of each of these features was calculated, as was the ratio between the latter two.

Users were then categorized into one of four categories: users only looking for information (i.e. who did not provide any input on the app); those looking for information and self-evaluation (i.e. who had answered at least one self-assessment questionnaire or moodtracker but no part of the safety plan); those looking for information and self-management help (i.e. who had completed at least part of the safety plan but no self-assessment questionnaire or moodtracker); and those looking for all three.

Duration of engagement was estimated as the time between registration and last interaction with the tool (i.e. using a self-assessment questionnaire/moodtracker or modifying the safety plan). Repetitive

users were defined as users who stayed on the app for more than one day.

2.5. Satisfaction

Users' satisfaction was assessed through an ad-hoc questionnaire administered to all app users between May 2019 to June 2020. It evaluated six domains: 1/global satisfaction, 2/ whether SB had provided them with the answers they were looking for, 3/ whether they thought it had improved their knowledge, 4/likelihood that they would recommend SB to someone else, 5/whether it had helped them talk to someone when feeling down, and 6/overall grade of the tool. Each domain was assessed on a numerical scale, ranging from 0 to 100, except for the last one which ranged from 0 to 10.

Depending on their answer, patients were considered to be either very dissatisfied (<20), dissatisfied ([20-40]), neutral ([40-60]), satisfied ([60-80]), or very satisfied (≥80).

2.6. Statistical analysis

A descriptive analysis of the variables of interest was carried out using mean and standard deviation (SD) for continuous variables and number and percentage for categorical variables in the two populations. SB use was only described for the population who had registered for themselves, as the safety plan and moodtrackers were not relevant to users who had registered for a loved one.

Subgroup analyses for SB use and satisfaction were carried out based on age, gender and MH status at registration. We also studied MH status at registration in different subgroups (age and gender).

To study the association between engagement or satisfaction and users' characteristics, multivariable regression models were carried out in the population who had registered for themselves. In both cases, age, gender, SES, MH status and suicide risk categories were first introduced into univariate models as explanatory variables and then into the corresponding multivariable model if their *p*-value was <0·2. To study engagement, a two-part model was used: first we looked at the factors associated with the probability of engaging with the app for more than one day using a multivariable logistic regression model, and second we

Table 1
Characteristics of SB users who registered for themselves, overall and according to gender and age group ($N = 10{,}208$).

	Total	Gender		Age group			
		Women	Men	< 25	[25 – 40]	[41–55]	> 55
	n = 10,208	*n* = 6520	*n* = 3688	*n* = 1506	*n* = 2950	*n* = 2287	*n* = 1042
	Missing						
Gender, n (%)							
Female	6520 (63·9)	–	–	1134 (75·3)	1790 (61·0)	1290 (56·4)	583 (56·0)
Male	3688 (36·1)	–	–	372 (24·7)	1145 (39·0)	997 (43·6)	459 (44·0)
Total	10,208 (100·0)	6520 (100·0)	3688 (100·0)	1506 (100·0)	2935 (100·0)	2287 (100·0)	1042 (100·0)
Mean age, in years (SD)	2423 38·5 (13·8)	37·1 (13·8)	40·6 (13·5)	–	–	–	–
Socioeconomic status	2799						
Mean FDep (SD)	2·5 (1·3)	2·56 (1·29)	2·5 (1·3)	2·6 (1·24)	2·5 (1·3)	2·48 (1·32)	2·45 (1·3)
Q1 (highest SES), n (%)	2123 (28·7)	1193 (26·1)	808 (21·9)	322 (22·8)	808 (27·4)	684 (29·9)	307 (29·5)
Q2, n (%)	1866 (25·2)	1194 (26·1)	733 (19·9)	390 (27·6)	733 (24·9)	508 (22·2)	235 (22·6)
Q3, n (%)	1673 (22·6)	1060 (23·1)	578 (15·7)	373 (26·4)	578 (19·6)	489 (21·4)	233 (22·4)
Q4, n (%)	1039 (14·0)	669 (14·6)	430 (11·7)	191 (13·5)	430 (14·6)	298 (13·0)	120 (11·5)
Q5 (lowest SES), n (%)	708 (9·5)	464 (10·1)	261 (7·1)	137 (9·7)	261 (8·9)	216 (9·4)	93 (8·9)
Total	7409 (100·0)	3520 (100·0)	2810 (100·0)	1276 (100·0)	2810 (100·0)	2195 (100·0)	988 (100·0)
GHQ-12 (global MH)	2903						
Mean score (SD)	7·4 (3·5)	7·6 (3·5)	7·1 (3·6)	8·3 (3·1)	7·4 (3·5)	7·1 (3·6)	6·5 (3·7)
No mental health troubles, n (%)	628 (8·6)	386 (8·1)	242 (9·5)	41 (3·7)	179 (8·2)	178 (10·6)	92 (12·8)
Possible mental health troubles, n (%)	6677 (91·4)	4365 (91·9)	2312 (90·5)	1058 (96·3)	2004 (91·8)	1496 (89·4)	626 (87·2)
Total	7305 (100·0)	4751 (100·0)	2554 (100·0)	1099 (100·0)	2183 (100·0)	1674 (100·0)	718 (100·0)
PHQ-9 (risk of depression)	2981						
Mean score (SD)	13·4 (6·5)	13·7 (6·5)	12·84 (6·5)	15·4 (6·4)	13·14 (5·5)	12·62 (6·4)	12·26 (6·2)
No depression, n (%)	591 (8·2)	335 (7·1)	256 (10·1)	53 (4·9)	171 (7·9)	162 (9·8)	71 (10·1)
Mild depression, n (%)	1723 (23·8)	1081 (23·0)	642 (25·4)	167 (15·4)	550 (25·5)	440 (26·7)	197 (27·9)
Moderate depression, n (%)	1775 (24·6)	1170 (24·9)	605 (23·9)	250 (23·0)	540 (25·1)	425 (25·8)	180 (25·5)
Moderately severe depression, n (%)	1679 (23·2)	1106 (23·5)	573 (22·7)	302 (27·8)	496 (23·0)	344 (20·9)	163 (23·1)
Severe depression, n (%)	1459 (20·2)	1008 (21·5)	451 (17·9)	316 (29·0)	398 (18·5)	276 (16·8)	95 (13·5)
Total	7227 (100·0)	4700 (100·0)	2527 (100·0)	1088 (100·0)	2155 (100·0)	1647 (100·0)	706 (100·0)
GAD-7 (risk of anxiety)	2984						
Mean score (SD)	10·7 (5·5)	11·02 (5·4)	10 (5·5)	12·24 (5·29)	10·57 (5·52)	9·93 (5·36)	9·27 (5·17)
No anxiety, n (%)	1091 (15·1)	616 (13·1)	475 (18·8)	100 (9·2)	354 (16·4)	280 (17·0)	134 (19·0)
Mild anxiety, n (%)	2077 (28·8)	1323 (28·2)	754 (29·9)	245 (22·6)	607 (28·2)	540 (32·8)	245 (34·8)
Moderate anxiety, n (%)	2045 (28·3)	1369 (29·1)	676 (26·7)	328 (30·2)	599 (27·8)	459 (27·9)	187 (26·5)
Severe anxiety, n (%)	2011 (27·8)	1390 (29·6)	621 (24·6)	413 (38·0)	594 (27·6)	369 (22·4)	139 (19·7)
Total	7224 (100·0)	4698 (100·0)	2526 (100·0)	1086 (100·0)	2154 (100·0)	1648 (100·0)	705 (100·0)
MINI-S (suicide risk), n (%)	636						
Low risk	3742 (59·5)	2504 (60·3)	1238 (58·1)	472 (46·8)	1140 (61·0)	907 (65·1)	377 (64·4)
High risk	2545 (40·5)	1652 (39·7)	893 (41·9)	537 (53·2)	728 (39·0)	486 (34·9)	208 (35·6)
Total	6287 (100·0)	4156 (100·0)	2131 (100·0)	1009 (100·0)	1868 (100·0)	1393 (100·0)	585 (100·0)
MH profile, n (%)							
Low MH risk	1855 (25·7)	1111 (33·3)	744 (40·0)	395 (36·4)	1108 (51·4)	929 (56·4)	425 (60·3)
High MH risk	3600 (49·8)	1093 (32·8)	479 (25·7)	691 (63·6)	1046 (48·6)	717 (43·6)	280 (39·7)
High risk of anxiety only	456 (6·3)	303 (9·1)	153 (8·2)	50 (4·6)	147 (6·8)	111 (6·7)	46 (6·5)
High risk of depression only	1312 (18·2)	827 (24·8)	485 (26·1)	175 (16·1)	388 (18)	328 (19·9)	158 (22·4)
Total	7223 (100)	3334 (100)	1861 (100)	1311 (100)	2689 (100)	2085 (100)	909 (100)

GHQ-12 = Global Health Questionnaire-12 items. GAD-7 = General Anxiety Disorders-7 items. PHQ-9 = Patient Health Questionnaire - 9 items. Q1-5 = quintiles. MH = Mental Health. SD = Standard Deviation. SES = Socioeconomic Status.

looked at the duration of engagement among repetitive users using a multivariable generalized linear regression model. To study the association between satisfaction scores and users' characteristics, multivariable generalized linear regression models were carried out. Analyses were carried out using R version 4·4·1, RStudio 2023·12·0 and SAS version 9·4.

3. Results

3.1. Users' characteristics

Between March 2018 and February 2020, 10,792 people registered to SB and were included in our analyses. The vast majority (94·6 %) registered for themselves and mean age was 38·5 years old (SD = 13·8). Two-thirds were female, but the proportion of men grew with age. Half of the users (53·9 %) lived in municipalities from the two highest SES quintiles (Table 1).

Over 9/10 users presented a MH risk according to the GHQ-12 (91·4 %), with some form of depression being present in 91·8 % and anxiety in 84·9 %. In particular, 47·8 % presented a risk of moderately severe or severe depression, and 27·2 % of severe anxiety. 24·9 % of all users who had registered for themselves were considered at high risk of suicide.

Women seemed to be at slightly higher risk of moderate and severe depression or anxiety but men were at higher risk of suicide (Table 1). All three self-assessment questionnaires showed mean scores decreasing with age, as did the percentage of users at risk of severe disorders, except in the case of users with a high risk of depression only, whose scores increased with age (Table 1).

Users present in the app for a loved one counted more women (68·0 % vs. 63·9 %) and were older (42·8 years old vs. 38·5). MADRS scores were similar to the PHQ-9: <10 % of loved ones had no depression risk, 18·4 % had a mild depression risk, 50·6 % had a moderate risk, and 22·3 % had a severe risk.

3.2. Use of StopBlues

The vast majority of users (96·4 %) who had registered for themselves engaged with one of SB's features (self-assessment or self-management) at least once and 21·5 % interacted with both at least once (Table 2).

Approximately half of users answered all three self-assessment questionnaires once, and 14·1 % thrice or more. Almost all users used the moodtracker features (95·2 %), but the majority only used them once (74·3 %), while 11·4 % used them thrice or more.

Regarding users who used the safety plan (22·3 %), respectively 54·0 % and 88·3 % filled out at least one *Warning signs* and one *Coping activity* (Table 2).

Women were more likely to fill out the features of the safety plan than men (24·5 % vs. 18·6 %) (Table 2). Users under 25 also tended to use both of the tool's features more frequently than other age groups. While they were fewer to use moodtrackers, those who did seemed more likely to use it twice or more (25·6 % vs. 19·1-21·4 % in other age groups) (Table 2).

When looking at SB use according to MH status, we found that users with a high MH risk profile at registration were more likely to fill a *Safety plan* than those with a low MH risk profile (33·2 % vs. 21·4 %), but there was no difference in how many times they used it. They were also more likely to fill out *Warning signs*, with a ratio of *Warning signs* to *Coping*

Table 2
Users' interactions with StopBlues among users who had registered for themselves, overall and according to gender and age group (N = 10,208).

	Total	Gender		Age group			
		Women	Men	< 25	[25 – 40]	[41–55]	> 55
	n = 10,208	n = 6520	n = 3688	n = 1506	n = 2950	n = 2287	n = 1042
Type of users							
Information only	366 (3·6)	207 (3·2)	159 (4·3)	61 (4·1)	79 (2·7)	67 (2·9)	31 (3)
Information and self-evaluation	7758 (74·0)	4715 (72·3)	2843 (77·1)	1050 (69·7)	2266 (76·8)	1782 (77·9)	789 (75·7)
Information and self-management	3 (0·0)	2 (0·0)	1 (0·0)	0 (0)	0 (0)	0 (0)	2 (0,2)
Information, self-evaluation and self-management	2281 (22·3)	1596 (24·5)	685 (18·6)	395 (26·2)	605 (20·5)	438 (19·2)	220 (21·1)
Self-assessment	7758 (76·0)	6311 (96·8)	3528 (95·7)	1445 (95·9)	2871 (97·3)	2220 (97·1)	1009 (96·8)
Questionnaire use (any)	7222 (93·1)	4751 (72·9)	2554 (69·3)	1099 (73·0)	2183 (77·4)	1674 (73·2)	718 (68·9)
GHQ-12	7305 (71·6)	4751 (100·0)	2554 (100·0)	1099 (73·0)	2183 (77·4)	1674 (73·2)	718 (68·9)
Once	6256 (85·6)	4084 (86·0)	2172 (85·0)	938 (85·4)	1868 (85·6)	1397 (83·5)	606 (84·4)
Twice	852 (11·7)	542 (11·4)	310 (12·1)	126 (11·5)	259 (11·9)	227 (13·6)	102 (14·2)
Thrice or more	197 (2·7)	125 (2·6)	72 (2·8)	35 (3·2)	56 (2·6)	50 (3·0)	10 (1·4)
PHQ-9	7227 (70·8)	4700 (98·9)	2527 (98·9)	1088 (72·2)	2155 (73·1)	1647 (72·0)	706 (67·8)
Once	6245 (86·4)	4076 (86·7)	2169 (85·8)	930 (85·5)	1849 (85·8)	1393 (84·6)	611 (86·5)
Twice	798 (11·0)	509 (10·8)	289 (11·4)	129 (11·9)	251 (11·6)	208 (12·6)	87 (12·3)
Thrice or more	184 (2·6)	115 (2·4)	69 (2·7)	29 (2·7)	55 (2·6)	46 (2·8)	8 (1·1)
GAD-7	7224 (70·8)	4698 (98·9)	2526 (98·9)	1086 (72·1)	2154 (73·0)	1648 (72·1)	705 (67·7)
Once	6256 (86·6)	4072 (86·7)	2184 (86·5)	929 (85·5)	1841 (85·5)	1391 (84·4)	632 (89·6)
Twice	785 (10·9)	508 (10·8)	277 (11·0)	128 (11·8)	261 (12·1)	211 (12·8)	66 (9·4)
Thrice or more	183 (2·5)	118 (2·5)	65 (2·6)	29 (2·7)	52 (2·4)	46 (2·8)	7 (1·0)
Moodtrackers use	9713 (95·2)	6246 (95·8)	3467 (94·0)	1415 (94·0)	2820 (95·6)	2198 (96·1)	1004 (96·4)
Once	7222 (74·3)	4565 (73·1)	2657 (76·6)	1030 (68,4)	2189 (74,2)	1712 (74,9)	805 (77,3)
Twice	1385 (14·3)	918 (14·7)	467 (13·5)	212 (14·1)	371 (12·6)	283 (12·4)	114 (10·9)
Thrice or more	1106 (11·4)	763 (12·2)	343 (9·9)	173 (11·5)	260 (8·8)	203 (8·9)	85 (8·2)
Self-management							
Safety plan	2284 (22·4)	1598 (24·5)	686 (18·6)	395 (26·2)	414 (14·0)	441 (19·3)	222 (21·3)
Warning signs	1231 (54·0)	880 (55·1)	351 (51·2)	190 (48·1)	245 (59·2)	248 (56·2)	121 (54·5)
One	1165 (94·6)	831 (94·4)	334 (95·2)	184 (96·8)	234 (95·5)	229 (92·3)	112 (92·6)
Two or more	66 (5·4)	49 (5·6)	17 (4·8)	6 (3·2)	9 (4·5)	19 (7·7)	9 (7·4)
Coping activities	2016 (88·3)	1423 (89·1)	593 (86·4)	354 (98·6)	355 (85·8)	390 (88·4)	183 (82·4)
One	1884 (93·5)	1320 (92·8)	564 (95·1)	333 (94·1)	335 (94·4)	359 (92·1)	170 (92·9)
Two or more	132 (6·5)	103 (7·2)	29 (4·9)	21 (5·9)	20 (5·6)	31 (7·9)	13 (7·1)
Warning signs AND Coping activities	963 (42·2)	705 (44·1)	258 (37·6)	149 (37·7)	184 (44·4)	197 (44·7)	82 (36·9)
Ratio Signs/Activities	0·6	0·6	0·6	0·5	0·7	0·6	0·7

Data are n (%) unless otherwise specified. GHQ-12 = Global Health Questionnaire-12 items. GAD-7 = General Anxiety Disorders-7 items. PHQ-9 = Patient Health Questionnaire - 9 items.

activities of 1·0 vs. 0·5–0·7 for others (Table 3).

3.3. Duration of engagement

Mean engagement was 16 days (SD = 58). 22·7 % were repeat users and their mean engagement was 69 days (SD = 105), with half using the tool for more than a month.

In the multivariable regression models, we found no association between engagement, gender and MH at registration. However, users with a suicide risk at registration had a higher probability than others to be repetitive users (OR = 1·50, 95%CI = 1·31 to 1·72), and among repeat users duration of engagement significantly increased with age (+0·39 day/year of age, 95%CI = 0·06 to 0·72) (Table 4).

3.4. Users' satisfaction

413 users (3·8 %) answered the satisfaction survey. Their characteristics were similar to the overall population, except that they were more men (39·7 % vs. 35·9 %), fewer people using SB for a loved one (1·2 % vs. 5·4 %), and more people showing a high risk of suicide (49·4 % vs. 40·5 %) (Supplementary table 1).

Mean overall satisfaction was 61·6 (SD = 24·7) and mean overall grade was 6·3 (SD = 2·3) (Supplementary table 2). 53·0 % were either satisfied or very satisfied overall and 28·3 % were very satisfied. Likewise, 61·5 % gave a grade of 6 or more, and 34·4 % of 8 or more. 42·5 % were satisfied or very satisfied with SB providing them with the answers they were looking for, and 48·9 % were satisfied or very satisfied with SB improving their knowledge. 25·7 % were satisfied or very satisfied with SB helping them talk to someone when feeling down. Finally, 59·1 % of users were likely or very likely to recommend SB (Fig. 1).

Table 4
Association between users' characteristics and engagement with the StopBlues tool.

	Probability to engage for more than one day	Duration of engagement among users who stayed more than one day
	OR (95%CI)	Estimate (95%CI)
Age	0·995 (0·990 to 1·000)	0·39 (0·06 to 0·72)
Women (ref: men)	1·116 (0·973 to 1·280)	-7·01 (-16·35 to 2·32)
Mental health status at registration (ref: low MH risk)		
High risk of anxiety only	0·918 (0·684 to 1·233)	
High risk of depression only	0·816 (0·653 to 1·020)	
High MH risk	0·840 (0·689 to 1·024)	
Suicide risk at registration (ref: no risk)	1·499 (1·305 to 1·720)	

While users under 25 had higher overall satisfaction than other, they often were less satisfied in other items, with users between 25 and 40 y. o. reporting higher scores for finding answers, improving knowledge, and recommending SB to someone else. Finally, users aged 40 to 55 were the most satisfied when it came to SB helping them talk to someone (Supplementary table 2).

When looking at MH status and satisfaction, satisfaction was systematically higher among users with a high risk of anxiety only and in users with a low MH risk profile and low suicide risk (Supplementary table 3).

In the multivariable regression models, women had a significantly higher score than men to the question of SB helping them talk to

Table 3
Users' interactions with StopBlues among users who had registered for themselves, depending on their mental health risk at registration.

	Low mental health risk	High mental health risk	High risk of anxiety only	High risk of depression only	Low suicide risk	High suicide risk
	n = 1855	*n* = 3600	*n* = 456	*n* = 1312	*n* = 3742	*n* = 2545
Type of users						
Information and self-evaluation	1458 (14·3)	2442 (23·9)	326 (3·2)	909 (8·9)	2713 (26·6)	1662 (16·3)
Information, self-evaluation and self-management	397 (3·9)	1158 (11·3)	130 (1·3)	402 (3·9)	1029 (10·1)	883 (8·7)
Self-assessment						
Questionnaire use (any)	1855 (100·0)	3600 (100·0)	456 (100·0)	1312 (100·0)	3742 (100·0)	2545 (100·0)
GHQ-12	1855 (100·0)	3600 (100·0)	456 (100·0)	1312 (100·0)	3742 (100·0)	2545 (100·0)
Once	1591 (85·8)	3076 (85·4)	383 (84·0)	1125 (85·7)	3217 (86·0)	2132 (83·8)
Twice	216 (11·6)	419 (11·6)	60 (13·2)	156 (11·9)	429 (11·5)	325 (12·8)
Thrice or more	48 (2·6)	105 (2·9)	13 (2·9)	31 (2·4)	96 (2·6)	88 (3·5)
PHQ-9	1855 (100·0)	3600 (100·0)	456 (100·0)	1312 (100·0)	3742 (100·0)	2545 (100·0)
Once	1615 (87·1)	3097 (86·0)	386 (84·6)	1142 (87·0)	3249 (86·8)	2154 (84·6)
Twice	192 (10·4)	407 (11·3)	57 (12·5)	142 (10·8)	399 (10·7)	312 (12·3)
Thrice or more	48 (2·6)	96 (2·7)	13 (2·9)	28 (2·1)	94 (2·5)	79 (3·1)
GAD-7	1855 (100·0)	3600 (100·0)	456 (100·0)	1312 (100·0)	3742 (100·0)	2545 (100·0)
Once	1611 (86·8)	3116 (86·6)	389 (85·3)	1138 (86·7)	3255 (87·0)	2167 (85·1)
Twice	198 (10·7)	387 (10·8)	57 (12·5)	143 (10·9)	398 (10·6)	298 (11·7)
Thrice or more	46 (2·5)	97 (2·7)	10 (2·2)	31 (2·4)	89 (2·4)	80 (3·1)
Moodtrackers use	1815 (97·8)	3549 (98·6)	443 (97·1)	1289 (98·2)	3680 (98·8)	2513 (98·9)
Once	1336 (73·6)	2424 (68·3)	312 (70·4)	901 (69·9)	2669 (72·5)	1590 (63·3)
Twice	254 (14·0)	578 (16·3)	65 (14·7)	204 (15·8)	535 (14·5)	452 (18·0)
Thrice or more	225 (12·4)	547 (15·4)	66 (14·9)	184 (14·3)	476 (12·9)	471 (18·7)
Self-management						
Safety plan	397 (21·4)	1158 (33·2)	130 (28·5)	402 (30·6)	1029 (27·5)	627 (24·6)
Warning signs	173 (43·6)	1003 (86·6)	76 (58·5)	241 (60·0)	579 (56·3)	394 (62·8)
One	162 (93·6)	663 (94·3)	74 (97·4)	230 (95·4)	550 (95·0)	373 (94·7)
Two or more	11 (6·4)	40 (5·7)	2 (2·6)	11 (4·6)	29 (5·0)	21 (5·3)
Coping activities	376 (94·7)	989 (85·6)	117 (90·0)	349 (86·8)	912 (88·6)	542 (86·4)
One	349 (92·8)	911 (92·1)	106 (90·6)	338 (96·9)	839 (92·0)	506 (93·4)
Two or more	27 (7·2)	78 (7·9)	11 (9·4)	11 (3·1)	73 (8·0)	36 (6·6)
Warning signs AND Coping activities	152 (38·3)	534 (46·1)	63 (48·5)	188 (46·8)	462 (44·9)	309 (49·3)
Ratio Signs/Activities	0·5	1·0	0·6	0·7	0·6	0·7

Data are n (%) unless otherwise specified. GHQ-12 = Global Health Questionnaire-12 items. GAD-7 = General Anxiety Disorders-7 items. PHQ-9 = Patient Health Questionnaire - 9 items.

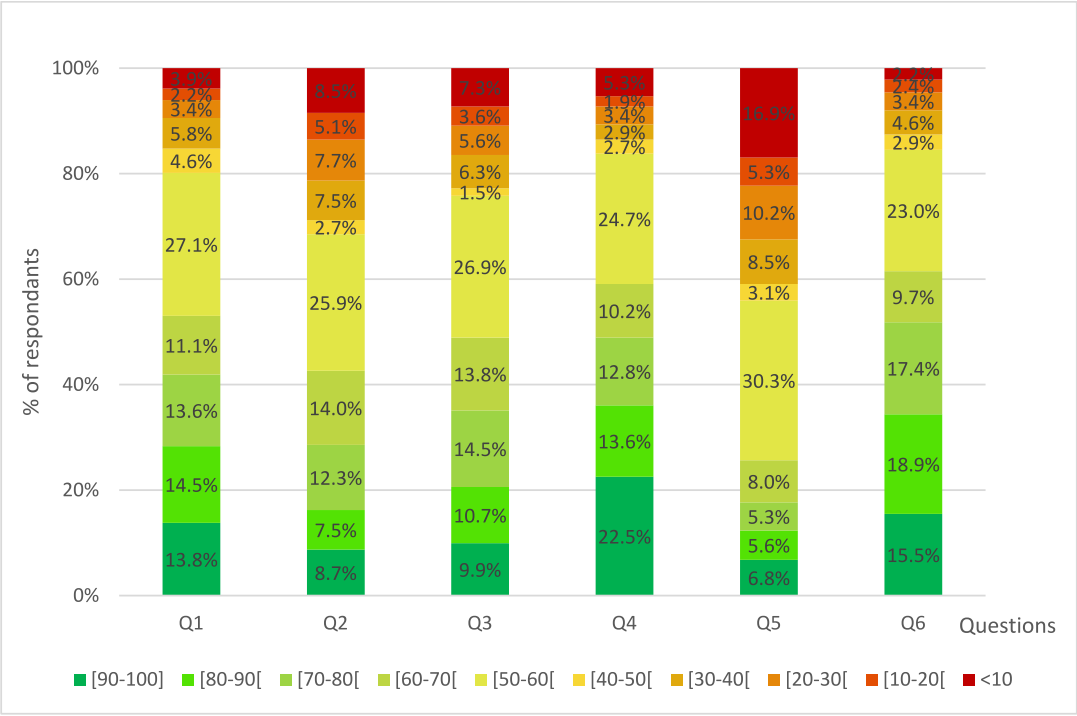

Fig. 1. Satisfaction with StopBlues. How to read the figure: each bar represents a question, with users' grades divided into deciles, from green (satisfaction score between 90 and 100) to red (satisfaction score between zero and 10). Questions: Q1 = Global satisfaction; Q2 = Provided the answers they were looking for; Q3 = Improved their knowledge; Q4 = Would recommend StopBlues to someone else; Q5 = Helped to talk to someone when feeling down; Q6 = Overall grade. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

someone (+7·59, 95%CI = 1·46 to 13·73), and users with a high risk of anxiety at registration had a significantly higher score when asked whether SB had improved their knowledge (+15·59, 95 % CI = 2·00 to 29·17). Finally, SES was also associated with satisfaction, with significant increases found in the second highest and/or lowest SES quintile compared to the highest for four of the six satisfaction items (Supplementary table 4).

4. Discussion

Over a two-year period, 10,792 people registered to the SB tool. Approximately 9 out of 10 users showed signs of depression and anxiety at registration, and at least a quarter were at high risk of suicide. Users under 25 y.o. had more severe MH scores than other users. Mean engagement was 16 days, but increased to two months for users interacting with the tool for more than a day. The vast majority of users who answered the satisfaction questionnaire appeared to be satisfied with the tool, but less so for users under 25.

Regarding the MH status of SB users, 43·4 % were at risk of major depressive disorder (MDE) (PHQ-9 score $\geq$ 15), and 56·1 % of moderate or severe general anxiety disorder (GAD) (GAD-7 score $\geq$ 10). This is much higher than the prevalence reported in the French population (between 4 % and 10 % for MDE in studies carried out in 2017 and 2019 (Bagein et al., 2022; Léon et al., 2017a), and 12·8 % for GAD in an earlier study between 1999 and 2003) (Leray et al., 2011). This supports the idea that a large part of people with significant MH issues finds e-health tools relevant to them, even when it is a primary prevention tool not designed with their needs and specificities in mind. While one would hope that they were already receiving care and found SB to be a helpful add-on, some may not have any solution to turn to, either because they were afraid of stigma or did not have access to support (Bakker et al., 2016; Reynders et al., 2014).

Users under 25 y.o. were the group the most at risk of suicide or severe MH disorder. This likely reflects the deterioration of MH in youth observed over the past decades in many countries (Léon et al., 2024; Frajerman et al., 2023), and underlines the need to pay special attention to this population. Indeed, even before the Covid-19 pandemic, 15-19 y.o. already represented the highest proportion of suicide attempters in France (Léon et al., 2017b). Yet the majority age group in our sample was 25-40 y.o., who are not necessarily the most at risk, as in addition to young people, 55-64 y.o. women and 35-54 y.o. men are most at risk of suicidal thoughts (Léon et al., 2017b), and 45-64 y.o of deaths by suicide (Ha and Chan-Chee, 2019). It may be that this age group was easier to reach that younger/older groups and that specific actions are needed to increase others' awareness of the tool.

The majority of SB users were women, who also were at higher MH risk (32·8 % at high-risk vs. 25·7 % of men). Depression and anxiety are more prevalent among women in the general population (Angst et al., 2002; Parker and Brotchie, 2010; Monnin et al., 2012), corroborating SB numbers. This also likely reflects the gender paradox, i.e. men being more numerous to die from suicide, and women representing a larger part of suicide attempts (Barrigon and Cegla-Schvartzman, 2020). In addition, women were more likely to report that SB had helped them talk to someone when feeling down. This is consistent with the literature which reports that women are more comfortable seeking help from MH professionals (Bosco et al., 2020), but also highlights the fact that SB may not have taken gender's specificities enough into account.

Despite our initial goal to conceive a tool for all, the fact that the majority of SB users lived in high SES areas shows that it remains difficult to reach all parts of the population. As stated by Yates et al. (Yates et al., 2015), population without internet access are, among others, the elderly, the unemployed, those higher on indices of deprivation, and those disabled or with long-term health issues, which are also more at risk of depressive symptoms and suicidal behavior (Bagein et al., 2022). Unlike trials set in a clinical setting which may offer smartphones with internet access to included patients, SB was implemented in real life. Reaching harder-to-reach populations is still something to work on, even if Agachi et al. recently concluded to a

diminishing health disparities through "*the increasing use of mobile phones among disadvantaged population groups*" (Agachi et al., *2022*). If the issue is no longer technological, accessibility in terms of outreach and content may then become of major importance. Data collected by SB unfortunately does not allow for a detailed analysis of the barriers faced by potential SB users with low SES but a previous research found that disadvantaged localities participating in the trial had more difficulties promoting SB, which may in part explain why uptake was less in those areas (Turmaine et al., 2021). In addition, while we cannot conclude on the effects of SB on social health inequalities, the fact that satisfaction was significantly higher in the lowest SES group in terms of overall grade and recommending SB to someone else would seem to indicate that the contents of the tool itself were relatively accessible. It is therefore necessary to develop strategies to reach underprivileged populations and fight mental health stigma in those populations to ensure that MH apps do not increase inequalities. The literature shows that a high health literacy is associated with an increased perceived usefulness of m-health (Dembele et al., 2023) as well as a better comprehension of resources tools like SB. Finding innovative ways to improve health literacy hand-in-hand with all stakeholders should thus be a priority.

Regarding the functionalities of the tool, the safety plan was more often used by high MH risk users, who most need it. Overall, *Coping activities* were filled out twice as much as *Warning signs*, possibly because they are easier to answer, the latter requiring an introspective view of oneself which is not easy to aquire and may need an external assistance (Buus et al., 2018). Users with high MH risk profile, depression and suicide risks seemed to find it easier, possibly because they had had previous experiences. This highlights an issue of online safety plans, as it may work best in the context of a therapeutic alliance (Bloch-Elkouby and Barzilay, 2022).

Regarding engagement, among the 14,000 initial users, 12·1 % continued to use SB functionalities for a month or more. This is higher than the average retention rate of 3·3 % (IQR 6·2 %) at one month found by Baumel et al. (Baumel et al., 2019) among 93 MH apps. Age and suicide risk had an impact on duration of engagement, similarly to what was reported in a review focused on schizophrenia (Simões de Almeida and Marques, 2023), which concluded that user engagement may be influenced by age and illness severity, and to a lesser extent gender, education level and SES. Regarding age, in the case of SB, it is likely due to the fact that the tool was not specifically designed for a younger audience in terms of contents. The specific issues faced by young adults make it necessary to develop a dedicated tool for this age group.

The satisfaction level with SB was good. While it is difficult to compare this to other evaluations because of the different themes and methods used, this appears similar to the findings by Monney and al (Monney et al., 2015), in which 82 % of participants considered the app under evaluation had helped them to stop or reduce cannabis consumption. While other apps have reported higher satisfactions, it was often for short programs with few patients (Tsirmpas et al., 2023). *E*-health tools therefore seem to meet the expectations of the population.

Our work has some limitations. First, engagement could only be determined through registered users' interactions with one of the three interactive functionalities of SB and any other use of SB (e.g. simply looking at the information) was not recorded. As such, it is possible that mean engagement was underestimated. Likewise, we could not study the engagement or characteristics of unregistered users, who still had access to the tool but not its interactive part.

Another limit is that self-assessment questionnaires only estimate a likelihood of a disorder, and are in no way a diagnosis. As such, we cannot conclude with certainty as to the true prevalence of disorders among users, but only at a risk level. The questionnaires were only to be used as self-assessment to help users become aware of their risk.

Finally, because the satisfaction survey was optional and sent out after one year of intervention, participation rate was low and it is likely there may have been a selection bias among users (Elston, 2021). Because of the small sample sizes in some subgroups, we likely lacked the power to detect significant associations between satisfaction and some users' characteristics in the regression models.

5. Conclusion

E-health tools developed in the field of MH to prevent suicide ideation and the worsening of depression and anxiety disorders appear to be useful, with users being satisfied with the tool and giving it a good overall grade. However, the latter varied with age and gender, pointing out a need to carefully consider those characteristics when developing such tools. Finally, the true impact of such tools on users' MH and its evolution now must to be assessed in the short and long term so as to conclude on its effectiveness.

CRediT authorship contribution statement

Anaïs Le Jeannic: Writing – review & editing, Writing – original draft, Validation, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Morgane Michel:** Writing – review & editing, Visualization, Validation, Supervision, Methodology. **Claude El Hayek:** Writing – original draft, Formal analysis, Data curation. **Karine Chevreul:** Writing – review & editing, Supervision, Project administration, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2025.04.110.

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