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Abstract

Background: In light of the COVID-19 pandemic, people had to adapt their daily life routines to the public health measures in place, which is likely to have resulted in a lack of social contacts in person, physical activity or sleep. Such changes can have a significant impact on mental health. Mobile sensing apps can passively record the daily life routines of people making them aware of maladaptive behavioral adjustments to the pandemic.

Objective: This study aimed to explore the views of people on mobile sensing apps passively recording behaviors and their potential to increase awareness and helpfulness for self-managing mental health during the pandemic.

Methods: We conducted an anonymous online survey including people with and without mental disorders asking them to rate the helpfulness of mobile sensing apps for the self-management of mental health during the COVID-19 pandemic. The survey took place in May, 2020.

Results: The majority of participants particularly those with a mental disorder (72%) perceived mobile sensing apps as very or extremely helpful for managing their mental health by becoming aware of maladaptive behaviors. The perceived helpfulness of mobile sensing apps was further higher among people experiencing a stronger impact of COVID-19 (??=?0.24; 95% CI, 0.16-0.33; P?<?.001), having a better understanding of technology (??=?0.17; 95% CI, 0.08-0.25; P?<?.001), and a higher education (??=?0.1; 95% CI, 0.02-0.19; P?=?.02).

Conclusions: The findings highlight the potential of mobile sensing apps to assist in mental health care during the pandemic.

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Abstract

Background: In light of the COVID-19 pandemic, people had to adapt their daily life routines to the public health measures in place, which is likely to have resulted in a lack of social contacts in person, physical activity or sleep. Such changes can have a significant impact on mental health. Mobile sensing apps can passively record the daily life routines of people making them aware of maladaptive behavioral adjustments to the pandemic.

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Conclusions: The findings highlight the potential of mobile sensing apps to assist in mental health care during the pandemic.

Keywords: Mobile sensing; COVID-19; helpfulness; mental health

Introduction

The novel coronavirus causing COVID-19 is currently affecting over 213 countries [1]. In the

absence of vaccines and antivirals, the remarkable speed and global spread of the coronavirus could currently only be reduced by rigorous implementation of traditional public health measures [2], such as quarantine and physical distancing. People had to adapt their daily life routines to the public health measures in place, which is likely to have resulted in a lack of social contacts in person, physical activity or sleep. All these factors are known to have a significant impact on mental health especially among vulnerable populations, such as patients already suffering from a mental disorder. Preliminary health reports describe adverse effects of the pandemic and its countermeasures on a range of aspects of mental health, including higher rates of anxiety, depression, abuse and self-harm [3].

The recent proliferation of mobile sensing apps offers novel opportunities to monitor people's behavior, and might thus hold great promises for the self-management of mental health during the COVID-19 pandemic. Through their passively recorded mobile sensing data people could become aware of how their behaviors changed during the pandemic. In example, from global positioning system (GPS), accelerometer and phone usage data people could infer whether they are socially isolated, sleeping poorly, physically inactive or not leaving their homes [4]. Importantly, such self-monitoring via mobile sensing has been previously shown to successfully increase people's self-awareness [5]. Self-awareness is theorized to reflect an automatic process by which people compare their current behaviors to their internalized standards and is the first step to self-regulation, i.e. the adaption of people's actual behavior to their idealized behavior [6]. Thus, during the pandemic mobile sensing apps might increase people's awareness of maladaptive behavioral changes and there by motivate them to engage in health-promoting behavior. Such self-management becomes especially important in a scenario in which a many of the health services and social infrastructures that normally bolster against mental health problems during emergencies have disappeared [7].

We hypothesize that mobile sensing apps can increase self-awareness and thereby have a potential for limiting the adverse consequences of the pandemic on mental health. To test this hypothesis, we conducted an online survey exploring, if mobile sensing apps are perceived as helpful tools by people with and without mental disorders for self-managing their mental health during the COVID-19 pandemic by increasing awareness for potential maladaptive behaviors.

Method

Recruitment

We aimed to conduct a rapid online survey in a large and diverse audience exploring whether mobile sensing apps are perceived as helpful tools by people with and without mental disorders for self-managing their mental health during the COVID-19 pandemic. We chose Amazon's Mechanical Turk (AMT) as our online platform as AMT would enable us to rapidly include participants in our survey at a large scale [8]. Importantly, AMT has become an increasingly accepted way of collecting responses from diverse participants [9]. We therefore ran an anonymous online survey from 23 May, 2020 to 7 June 2020 recruiting participants via AMT. Following AMT's standard procedure, we advertised the study and the qualification criteria on the platform across the world. Interested participants clicked the link and respond to the survey accordingly. The survey was created using Dalhousie University's online survey platform Opinio. Participants received financial compensation for answering the survey's questions which required 20 minutes of their time in average. All participants provided fully informed consent online. From all the participants at 18 years age or above, those who gave incorrect responses to 5 attention check questions were excluded and incomplete responses were also discarded.

Survey

Participants rated on a 5-point Likert scale ranging from "1 = Not at all" to "5 =Extremely", how much they would agree with the following statement, a mobile phone-based tracking application for health and wellbeing will be helpful in a pandemic/crisis situation like COVID-19. Answers to this question defined our outcome of interest, the perceived helpfulness of mobile sensing apps. The concept of mobile sensing apps was introduced by multiple examples of what kind of sensors might be used in mobile sensing apps and which insights in behaviors might be gained from these sensor

data. In particular, we asked participants to rate the likeability and comfortability with different mobile sensing features (for more details see the supplementary material). Such questions have been previously shown to successfully convey a concept of mobile sensing apps [10].

Participants provided further information on predictors of perceived helpfulness such as basic demographics (age, gender, and education) and their mental health history (yes, no, prefer not to answer). We also asked participants to rate their technology knowledge on a 5-point Likert scale ranging from “1 = Poor” to “5 =Excellent”. Finally, we asked participants to rate, on a 5-point Likert scale ranging from “1 = Not at all” to “5 =Extremely”, to what extent did the COVID-19 pandemic impact their overall health and wellbeing. For an overview of all questions please see the appendix.

Setting our Type I error rate (alpha) at 0.05. Our power analysis indicated; we would require a sample size of at least 410 participants to detect a moderate effect (d=0.5) of our predictors with a power of 0.95.

Statistical Analysis

After testing for homoscedasticity (Breusch-Pagan test [11]) and multi-collinearity (Variance Inflation Factor[12]), we ran a linear model with perceived helpfulness of mobile sensing apps as the outcome of interest and age, gender, education, mental health history, health impact of the COVID-19 pandemic, and technology knowledge as independent predictors. Additionally, we explored potential mediating effects using the Sobel test [13]. SPSS, version 25 was used for all data analyses and the criterion *P* value was set at $P < .05$.

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki

Declaration of 1975, as revised in 2008. All procedures were approved by the research ethics board at Dalhousie University. The study is further General Data Protection Regulation (GDPR) compliant.

Results

Cleaning for incorrect and missing responses resulted in a survey sample of 474 participants, most participants were from the United States (237/50%) or India (175/37%). 235 of these 474 participants were aged 25 to 34 (50%), 170 of participants were female (36%), and 148 had a history of a mental disorder (31%, see Tab. 1).

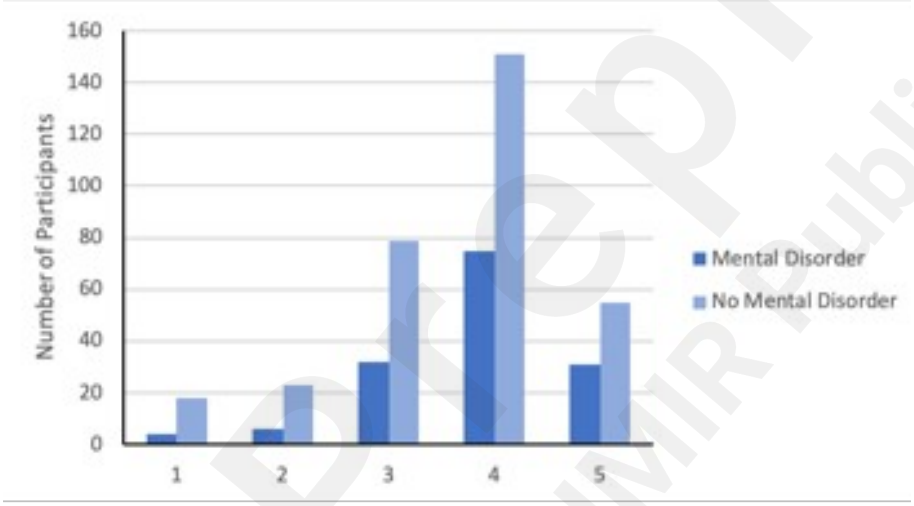
Table1. Characteristics of Participants

Age	
18-24	N=90
25-34	N=235
35-44	N=75
>45	N=74
Gender	
Female	N=170
Male	N=304
Education	
High School	N=51
Bachelor's Degree	N=336
Master's Degree	N=87
History of a Mental Disorder	
Yes	N=148
No	N=324
Health Impact of COVID-19	
Mean=4.10	SD=0.70
Technology Knowledge	
Mean=3.29	SD=1.14

SD = Standard Deviation

The majority of our participants (312 / 66%) perceived mobile sensing apps as “very” or “extremely” helpful for managing mental health during the COVID-19 pandemic. 106 out of the 148 participants with a history of a mental disorder experienced mobile sensing as “very” or “extremely” helpful (72%), whereas only 206 out of 326 participants without a history of a mental disorder (63%) did so (see Fig 1). This difference was significant controlling for age, sex, education and technology knowledge (β = 0.12; 95% CI, 0.03-0.21; *P* = .01), but fell short of statistical significance after adjusting for perceived health impact of the COVID-19 pandemic (β = 0.08; 95% CI, -0.01-0.17; *P* = .06).

Figure 1: Perceived Helpfulness Ratings of Mobile Sensing Apps during the Pandemic.



Specifically, participants with a history of a mental disorder experienced a higher health impact of the COVID-19 pandemic (β = 0.14; 95% CI, 0.05-0.23; *P* = .002), which mediated the effect of a history of a mental disorder on perceived helpfulness (Sobel test, *P* = .01). Moreover, participants who experienced a stronger health impact of the COVID-19 pandemic (β = 0.24; 95% CI, 0.16-0.33; *P* < .001), were more knowledgeable in technology (β = 0.17; 95% CI, 0.08-0.25; *P* < .001), and those who had a higher education rated mobile sensing apps as more helpful (β = 0.1; 95% CI, 0.02-0.19; *P* = .02); while there were no differences observed by age or gender (see Tab. 2).

Table 2. Linear Regression Model of Perceived Helpfulness of Mobile Sensing Apps

	β	SE	P-value
Age	-0.07	0.05	0.13
Gender	0.06	0.09	0.18
Education	0.1	0.08	0.02
Technology Knowledge	0.17	0.06	<0.001
History of a Mental Disorder	0.08	0.09	0.06
Health Impact of COVID-19	0.24	0.04	<0.001

SE = Standard Error

Discussion

Principal Results

Our findings indicate that mobile sensing apps that passively track the daily life behaviors of people are perceived as very helpful tools for the self-management of mental health during the COVID-19 pandemic. People with and without mental disorders considered mobile sensing apps as helpful for their self-management of mental health during the pandemic, although people with mental disorders experienced mobile sensing apps as slightly more helpful. Importantly, people with mental disorders were reported to have a higher risk for severe clinical outcomes of COVID-19 infections [14] and their mental health deteriorated more during the pandemic compared to people without a history of mental disorders [15, 16]. In line with these previous results, people with mental disorders reported a higher health impact of the COVID-19 pandemic in our study. Our results further indicate that this experience of a higher health impact of the COVID-19 pandemic is mediating the observed effect of history of mental disorders on perceived helpfulness of mobile sensing apps. In other words, people with mental disorder likely experience mobile sensing apps as more helpful as there are struggling more with the impact of the COVID-19 pandemic.

Fringe events such as the COVID-19 pandemic provide opportunities to examine how mental health and behaviors deviate from baseline. First mobile sensing studies during the COVID-19 pandemic indicated the mobile sensing apps can identify maladaptive behaviors such as decreased physical activity and increased screen time [17, 18]. In this regard, research has consistently shown that physical activity, particularly aerobic activity, reduces self-reported mental health symptoms [19]. Other work has shown that increased sedentary time along with increased phone usage is implicated in depression and anxiety [20]. Thus, from a health belief model [21] perspective, mobile sensing apps can help people to become aware that behavior protective for their mental health is possible

even during the pandemic in example by reducing the time of being sedentary and on screen. In addition, mobile sensing apps can be beneficial solely for self-management, but can also provide cues for clinicians to assist their patients during the pandemic in case patients agree to share their mobile sensing data with them. Importantly, while int this study we specifically explored whether mobile sensing apps could be useful to identify maladaptive changes in behavior during the pandemic; we believe mobile sensing apps will be of value for the self-management of mental health symptoms beyond the era of the pandemic. In example, people might be struggling to find their way back to their routines prior to the pandemic and by increasing self-awareness mobile sensing apps could help people to easier get back to healthy routines.

An important of caveat of mobile sensing apps is that there are some limitations to the interpretation of the recorded data. When people stay-at-home, people may not have their mobile phones with them at all times, which could lead to overestimation of sedentary time. Additionally, people may be preferentially accessing larger screens such as tablets or laptops; therefore, phone usage may underestimate the total amount of screen time. Such shortcomings will need to be considered in the design of mobile sensing apps for mental health care.

While our results indicate that gender and age seem not to impact the perceived helpfulness of mobile sensing apps for self-management of mental health during the pandemic; participants, who more knowledgeable about technology, were more likely to rate mobile sensing apps as helpful. Accordingly, increasing the knowledge of users will be a crucial step for the acceptance and usability of mobile sensing apps for mental health care. Future research should aim to better understand what additional characteristics might determine perceived helpfulness in order to enable efficient integration of mobile sensing apps in current mental health care models.

Limitations

A considerable limitation of our survey is that our sample, though well-stratified and diverse, was not random, people who have an interest in mobile sensing technologies might have been more likely to take part in this online survey. The figures might further be slightly biased by social desirability. However, we assume that such effects should only have been minimal given the anonymity of participants in the survey. Nevertheless, our data suggest that a substantial number of people perceive mobile sensing apps as helpful tools for managing their mental health during the pandemic-related lockdown.

Conclusions

Most importantly, the results indicate that the usage of mobile sensing app could have the potential to directly reduce the demand on the mental health care system during the COVID-19 pandemic by promoting better self-management. Both people with and without mental disorders experience mobile sensing apps as helpful to self-manage their mental health during the pandemic, although people with a mental disorder experience such apps as especially useful. By making users aware of maladaptive changes in their behaviors mobile sensing app can assist and motivate people to take better care of their mental health preventing novel onsets or a worsening of mental disorders. The remote empowerment of people in their mental health care has to be considered especially valuable as standard ways of delivering care have been severely comprised during the COVID-19 pandemic. Finally, the ability of mobile sensing apps to increase self-awareness might have a potential to advance current health care models beyond the era of the current pandemic.

Author Contributions

BS, RO, LW, and SM designed the study; BS and RO recruited the participants; BS, KB, and SM conducted the analyses; BS, KB and SM wrote the manuscript; AB, LW and PM assisted in the clinical presentation; and all authors critically revised the manuscript.

Author Contributions

None.

Abbreviations

GPS Global Positioning System

GDPR General Data Protection Regulation

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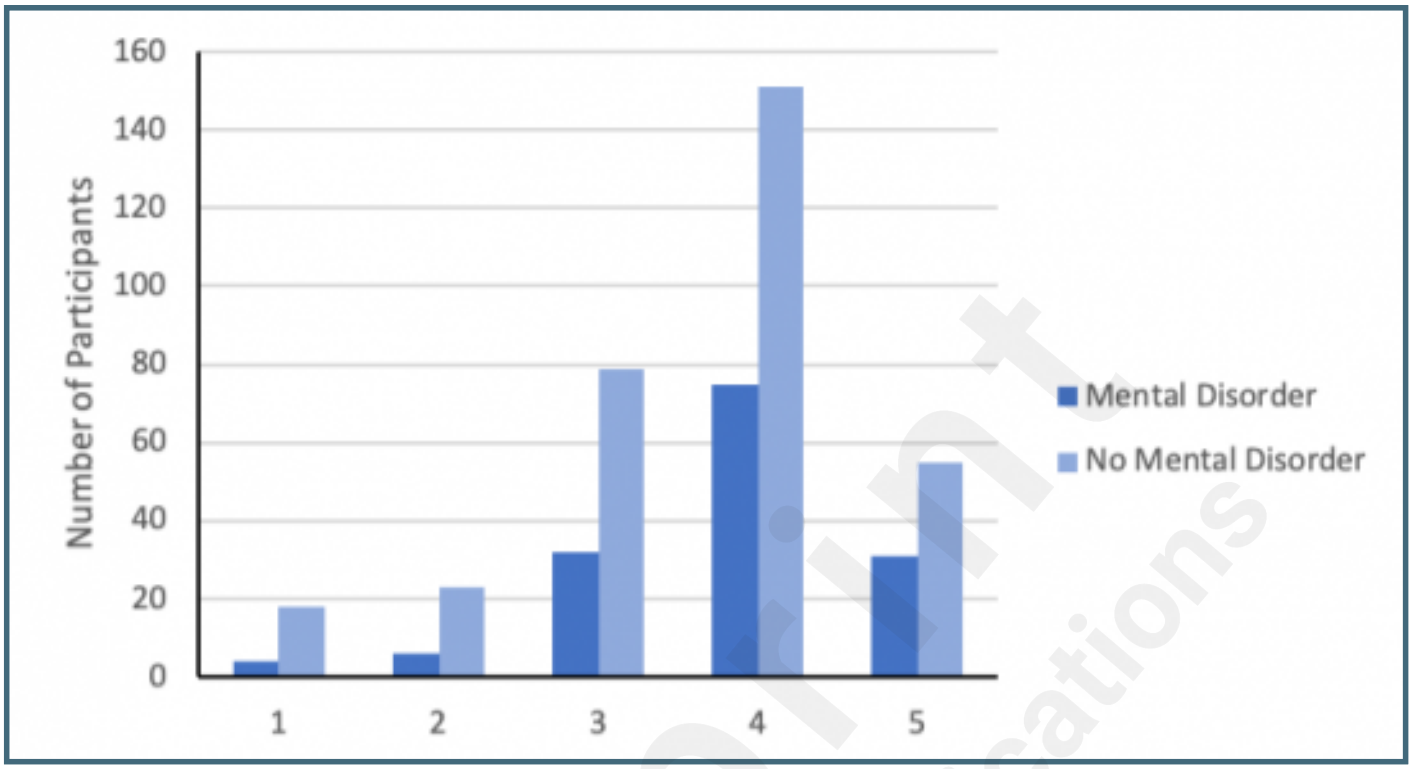
Supplementary Files

Figures

Perceived Helpfulness Ratings of Mobile Sensing Apps during the Pandemic.



Multimedia Appendixes

Survey Questions.
URL: http://asset.jmir.pub/assets/554bf469d8969789c0ecdce7feaebb99.docx