The Prevalence and Perceived Utility of Mobile Health Technology Among Recently Incarcerated Homeless Adults

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Abstract

Mobile technologies can deliver physical and mental health services for recently incarcerated homeless adults (RIHAs). The purpose of this study was to examine the prevalence and perceived utility of mobile technology to support health behavior change among RIHAs. Participants ($n = 324$) from an ongoing clinical trial at a homeless shelter in Texas were included in the current descriptive cross-sectional analyses. Over one fourth (28.4%) of participants had an active cell phone. Nearly 90 percent (88.6%) of participants reported at least weekly use of the internet, 77 percent used email (77.2%), and more than half used Facebook (55.2%). Although most participants (82.8%) believed that smartphone applications (apps) could help change their behavior, only a quarter (25.1%) had used an app for this purpose. These findings highlight the potential for smartphone-based intervention technologies, and future studies should examine whether smartphone apps that address mental health and health behaviors are feasible among RIHAs.

Introduction

In 2020, an estimated 580,466 adults experienced homelessness on any given night in the USA (Sleet & Francescutti, 2021). Individuals experiencing homelessness are disproportionately represented in the criminal justice system when compared to stably housed adults (Diamond et al., 2021). Recently incarcerated homeless adults (RIHAs) are defined as individuals who were released from jail within the past 60 days and are currently homeless (Reingle Gonzalez et al., 2018). RIHAs experience a greater prevalence of mental illness and substance use disorders, and are at increased risk for re-arrest compared with recently incarcerated, stably housed adults (Greenberg & Rosenheck, 2008; Metraux & Culhane, 2004; Myrstol & Fitzpatrick, 2011). Additionally, RIHAs are less likely to access treatment services for these conditions. Thus, the development of novel methods to offer timely, consistent, and easily accessible physical and mental health services among this population is crucial (Thurman et al., 2021).

There is a dearth of research on mobile technology use among RIHA, but most individuals experiencing homelessness use mobile technologies, with estimates ranging on cell phone (i.e., without internet capabilities; 72.3–93.6%) and smartphone ownership (i.e., with internet capabilities; 32.0–58.0%), as well as the use of texting (62.9–75.5%) and internet use (23.8–51.1%) (Raven et al., 2018; Rhoades et al., 2017). For instance, our team's previous work identified that 71.9% of adults experiencing homelessness own either a cell phone or smartphone (Businelle et al., 2015; Reitzel et al., 2017). Other studies have found that adults experiencing homelessness use mobile technology for many reasons, including connecting with peers and family

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members, safety (e.g., access to emergency services), and communication with current or potential employers (Eyrich-Garg, 2010; Kim et al., 2007; Rice et al., 2011). Furthermore, adults experiencing homelessness report a willingness to use mobile technologies to stay engaged with their healthcare providers through call or text-based appointment reminders (McInnes et al., 2014).

However, less is known about mobile technology use to provide access to physical and mental health services among RIHA. While the provision of these services (i.e., mental health and substance use conditions) through telehealth has increased during COVID-19, they are still predominantly provided in person (Adams et al., 2021). As a result, it can be difficult for this underserved population to access these needed services. Therefore, the primary purpose of this study is to better understand whether it is feasible for mobile technology (i.e., smartphone-based interventions) to provide on-demand physical and mental health services for RIHA. To do so, we explore the use of mobile technology among RIHAs, including cellphone ownership, data plan access, social media use, perceptions of app use for behavioral health management, and overall internet use. The perceived utility of mobile health applications to help change or manage health behaviors among RIHAs is also examined.

Methods

Participants and Procedures

Baseline data were collected during April 2018–October 2021 from the first 324 participants enrolled in an ongoing three-armed randomized controlled trial in Dallas, Texas, and were included for the current cross-sectional study. Additional details about the parent study have been published elsewhere (Reingle Gonzalez et al., 2018). Individuals were eligible for the clinical trial if they (1) were released from Dallas County Jail within the past 60 days; (2) anticipated continued residence in the Dallas area for the 12 months following enrollment; (3) were enrolled in case management services offered at the shelter where the study takes place; (4) were willing to attend in-person baseline, randomization, and follow-up assessment visits scheduled at 1, 3, and 6 months post-randomization; (5) had an English literacy level of 6th grade or higher on the Rapid Estimate of Adult Literacy in Medicine-Short form (Davis et al., 1993); and (6) were not cognitively impaired as indicated by the Mini-Mental State Exam (Bleecker et al., 1988).

Upon release from Dallas County Jail, individuals who reported experiencing homelessness received a flyer that described the study. Interested individuals were screened by study staff at the shelter, and those who qualified for the study completed the informed consent and were asked to privately complete a series of baseline questionnaires on a tablet computer. Participants were compensated $30 for completing each baseline in-person visit. The University of Oklahoma Health Sciences Center and University of Texas Health Sciences Center Institutional Review Boards approved the study procedures.

Measures

Demographics Participants completed questionnaires during the baseline visit that assessed demographic characteristics, including sex, race/ethnicity, age, marital status, and years of completed education. Participants also answered questions regarding length of homelessness and arrest history.

Cell Phone/Smartphone Information/Ownership Participants were asked, "Do you have an active cell phone?" (Yes/No). If participants answered yes, they were then asked "Who pays for your cell phone service?" (government, family or friend, someone else, I pay for my cell phone service). Participants answered, "How many 'talk' minutes does your plan have?" (0–200, 201–400, 401–600, Unlimited, I use a 'pay as you go' or prepaid phone). Participants with active cell phones were asked, "Is your cell phone a smartphone?" (No; Yes, I have an Android smartphone; Yes, I have an Apple smartphone (iPhone); Yes, I have a Smartphone that is not Apple or Android"). Smartphone owners were asked, "Does your phone service include a data plan?" (No; Yes, but my data plan is limited; Yes, my plan includes unlimited data). For participants with or without active cellphones, they were also asked, "How many times has your phone number changed in the past year?" (0, 1, 2, 3, 4, 5, or more).

Social Media/Internet Use All participants were asked, "Which of the following forms of media do you use?" (Email, Facebook, Google Plus, Twitter, Blogs, Instagram, Snapchat, LinkedIn, None of the above). Participants were asked about internet usage, "How often do you access the internet?" (Never, About once a month, About once per week, 2 or 3 times per week, 4 to 6 times per week, About once per day, About twice per day, Every few hours or more). Participants were also asked "Do you have an active Facebook page?" (Yes/No). If the participant answered "Yes," they were then asked, "How often do you check or post on Facebook?" (Never, About once a month, About once per week, 2 or 3 times per week, 4 to 6 times per week, About once per day, About twice per day, Every few hours or more). These follow-up questions were only asked about Facebook use.

Perceptions of Smartphone Apps for Health Behavior Change Participants were asked questions to assess their past experiences with and perceptions of smartphone

Table 1 Characteristics of participants who completed the Link2Care baseline assessments ($n = 324$) by phone ownership

Characteristic	Overall ($n = 324$)	No mobile phone ($n = 232$)	Mobile phone ($n = 92$)
Age, mean (sd)	39.8 (10.9)	39.9 (11.2)	39.3 (10.0)
Gender, n (%)			
Male	275 (84.9)	198 (85.3)	77 (83.7)
Female	44 (13.6)	29 (12.5)	15 (16.3)
Other	5 (1.5)	5 (2.2)	0 (0.0)
Race/ethnicity, n (%)			
White, non-Hispanic	54 (16.7)	44 (19.0)	10 (10.9)
Black, non-Hispanic	194 (59.9)	140 (60.3)	54 (58.7)
Hispanic, any race	42 (13.0)	25 (10.8)	17 (18.5)
Other race, non-Hispanic	34 (10.5)	23 (9.9)	11 (12.0)
High school grad or GED, n (%)			
No	101 (31.2)	77 (33.2)	24 (26.1)
Characteristic	**Overall ($n = 324$)**	**No Mobile mobile phone ($n = 232$)**	**Mobile phone ($n = 92$)**
Yes	223 (68.8)	155 (66.8)	68 (73.9)
Employment status, n (%)			
Employed	27 (8.3)	14 (6.0)	13 (14.1)
Unemployed, looking for work	176 (54.3)	135 (58.2)	41 (44.6)
Unemployed, not looking for work	47 (14.5)	34 (14.7)	13 (14.1)
Unable to work or disabled	59 (18.2)	40 (17.2)	19 (20.7)
Other	15 (4.6)	9 (3.9)	6 (6.5)
Lifetime months homeless, median (IQR)	30.0 (53.6)	29.5 (53.2)	31.5 (53.5)
Lifetime years in jail, median (IQR)	3.5 (6.7)	4.0 (7.0)	3.0 (5.4)
General health, n (%)			
Excellent	57 (17.6)	39 (16.8)	18 (19.6)
Very good	70 (21.6)	52 (22.4)	18 (19.6)
Good	103 (31.8)	69 (29.7)	34 (37.0)
Fair	70 (21.6)	54 (23.3)	16 (17.4)
Poor	24 (7.4)	18 (7.8)	6 (6.5)
N days out of past 30 physical health not good, mean (sd)	7.2 (9.9)	7.5 (9.9)	6.4 (10.0)
N days out of past 30 mental health not good, mean (sd)	11.7 (11.1)	12.0 (11.2)	11.1 (10.9)
Characteristic	**Overall ($n = 324$)**	**No Mobile mobile hone ($n = 232$)**	**Mobile phone ($n = 92$)**
Mental health treatment, n (%)			
No	136 (42.0)	97 (41.8)	39 (42.4)
Yes	188 (58.0)	135 (58.2)	53 (57.6)

applications to support behavior change. Specifically, participants were asked: "Do you believe that a smartphone app can help you to change your actions or behaviors?" (Yes/No) and "Have you ever used a smartphone app to manage one or more health-related issues?" (Yes/No). Those who answered "Yes" to the latter question were asked, "What type of health-related issues [did you use an app to help manage]?" Response options included food/calorie tracking, medication reminders, mood manager, physical activity, sleep tracking, smoking cessation, stress reduction, and weight loss or tracking.

Statistical Analyses

Standard descriptive statistics (i.e., mean, median, standard deviation, interquartile range, and percentages) were calculated for each of the variables described above. Similarly, we calculated the number and percentage of participants who believed that a smartphone app could help them change their actions and behaviors, and the number and percentage of participants who had previously used an app for this purpose. Statistical analyses were conducted using R version

Table 2 Characteristics of participants who completed the Link2Care baseline assessments (*n* = 324) by phone ownership

Characteristic	Overall (*n* = 324)	No mobile phone (*n* = 232)	Mobile phone (*n* = 92)
Is mobile phone a smart phone, *n* (%)			
No	14 (15.2)	0 (0)	14 (15.2)
Yes — I have an android phone	74 (80.4)	0 (0)	74 (80.4)
Yes — I have an Apple smartphone (iPhone)	3 (3.3)	0 (0)	3 (3.3)
Yes — I have a Smartphone that is not Apple or Android based	1 (1.1)	0 (0)	1 (1.1)
Talk minutes in mobile plan, *n* (%)			
0–200	3 (3.3)	0 (0)	3 (3.3)
201–400	4 (4.3)	0 (0)	4 (4.3)
401–600	1 (1.1)	0 (0)	1 (1.1)
Unlimited	80 (87.0)	0 (0)	80 (87.0)
I use "pay as you go" or prepaid phone	4 (4.3)	0 (0)	4 (4.3)
Mobile phone bill payer, *n* (%)			
Government	10 (10.9)	0 (0)	10 (10.9)
Family or friend	29 (31.5)	0 (0)	29 (31.5)
Someone else	4 (4.3)	0 (0)	4 (4.3)
I pay for my cell phone service	49 (53.3)	0 (0)	49 (53.3)
Have data plan, *n* (%)[a]			
No	4 (5.1)	0 (0)	4 (5.1)
Yes, but my data plan is limited	22 (28.2)	0 (0)	22 (28.2)
Yes, my plan includes unlimited data	52 (66.7)	0 (0)	52 (66.7)
N times mobile number has changed, *n* (%)			
0	66 (24.4)	39 (21.8)	27 (29.3)
1	62 (22.9)	47 (26.3)	15 (16.3)
2	65 (24.0)	45 (25.1)	20 (21.7)
3	29 (10.7)	16 (8.9)	13 (14.1)
4	18 (6.6)	11 (6.1)	7 (7.6)
5 or more	31 (11.4)	21 (11.7)	10 (10.9)

[a]Have data plan was only asked of participants who reported having a mobile phone

4.1.0 in RStudio version 1.4.1717 with the following packages: tidyverse, freqtables, and meantables.

Results

Participants (*n* = 324) were predominantly male (84.9%), Black or African American (59.9%), and 39.8 years old (*sd* = 10.9) on average. Three quarters of participants completed high school (68.8%) and a small minority reported being currently employed (8.3%). Nearly one third of participants (29.0%) indicated that their general health was "less than good," averaging more than 1 week of poor physical health (*M* = 7.2, *sd* = 9.9) in the past month and nearly 12 poor mental health days (*M* = 11.7, *sd* = 11.1) in the past month. The median number of months experiencing lifetime homelessness exceeded 2 years (*Mdn* = 30.0, *IQR* = 53.6), and the median time experiencing incarceration was 3.5 years ((*IQR* = 6.7); see Table 1).

Prevalence of Mobile Technology Use Among RIHAs Over one fourth (28.4%; 92/324) of participants owned a mobile phone at the time of the survey, but the vast majority (83.6%) of participants reported having owned a phone in the past year. Participants with a mobile phone were proportionally more educated (73.9% vs. 66.8%), identified as Hispanic (18.5% vs. 10.8%), employed (14.1% vs. 6.0%), and had spent more lifetime months homeless (31.5 vs. 29.5) but less years in jail (3.0 vs. 4.0). Among those who owned a phone in the past year, three quarters (75.6%) reported that their number was changed at least once during that time. Among those that currently owned a mobile phone, nearly 90 percent (87.0%) had an unlimited talk plan; of those, more than half (53.3%) paid for their own mobile service. Eighty-five percent of participants who owned a mobile phone had a smartphone (versus a device that does not have "smart" capabilities), and most of these phones used the Android operating system (80.4%). Two thirds of participants (66.6%) who owned a smartphone had an unlimited data plan (see Table 2).

Table 3 Characteristics of participants who completed the Link2Care baseline assessments ($n = 324$) by phone ownership

Characteristic	Overall ($n = 324$)	No mobile phone ($n = 232$)	Mobile phone ($n = 92$)
Types of media used, n (%)[a]			
Email	250 (77.2)	171 (73.7)	79 (85.9)
Facebook	227 (70.1)	159 (68.5)	68 (73.9)
Google Plus	127 (39.2)	97 (41.8)	30 (32.6)
Twitter	29 (9.0)	21 (9.1)	8 (8.7)
Blogs	9 (2.8)	7 (3.0)	2 (2.2)
Instagram	86 (26.5)	55 (23.7)	31 (33.7)
Snapchat	42 (13.0)	31 (13.4)	11 (12.0)
LinkedIn	25 (7.7)	16 (6.9)	9 (9.8)
None	28 (8.6)	24 (10.3)	4 (4.3)
Characteristic	**Overall ($n = 324$)**	**No mobile phone ($n = 232$)**	**Mobile phone ($n = 92$)**
Frequency of internet access, n (%)			
Never	25 (7.7)	24 (10.3)	1 (1.1)
About once a month	12 (3.7)	10 (4.3)	2 (2.2)
About once per week	16 (4.9)	15 (6.5)	1 (1.1)
2–3 times per week	31 (9.6)	24 (10.3)	7 (7.6)
4 to 6 times per week	18 (5.6)	14 (6.0)	4 (4.3)
About once per day	31 (9.6)	25 (10.8)	6 (6.5)
About twice per day	42 (13.0)	26 (11.2)	16 (17.4)
Every few hours or more	149 (46.0)	94 (40.5)	55 (59.8)
Frequency of Facebook use, n (%)			
Never	22 (10.0)	20 (13.2)	2 (2.9)
About once a month	19 (8.6)	12 (7.9)	7 (10.1)
About once per week	13 (5.9)	11 (7.3)	2 (2.9)
2–3 times per week	29 (13.2)	17 (11.3)	12 (17.4)
4 to 6 times per week	14 (6.4)	10 (6.6)	4 (5.8)
About once per day	32 (14.5)	20 (13.2)	12 (17.4)
About twice per day	31 (14.1)	22 (14.6)	9 (13.0)
Characteristic	**Overall ($n = 324$)**	**No mobile phone ($n = 232$)**	**Mobile phone ($n = 92$)**
Every few hours or more	60 (27.3)	39 (25.8)	21 (30.4)

[a]Percentages sum to > 100% because participants could select more than one response option

Internet use was common in this sample. Overall, nearly 90 percent (88.6%) reported accessing the internet on at least a weekly basis, and almost half (46.0%) reported accessing the internet every few hours. We explored whether internet use differed by ownership of a mobile phone. We found a greater percentage of participants with access to a mobile phone were more likely to use the internet at least weekly than those without access to a mobile phone (98.2% vs. 89.7%), which differed even more for those accessing every few hours (59.8% vs. 40.5). Most participants used email (77.2%) and Facebook (70.1%), but use for both was greater among mobile phone owners for email (85.9% vs. 73.7%) and Facebook (73.9% vs. 68.5%). Among participants who had an active Facebook account, most reported posting or checking their Facebook page at least weekly (81.4%) with 46.8% indicating that they check their page at least daily. More than one fourth of participants (27.3%) indicated that they check Facebook every few hours or more frequently. Participants without a mobile phone were more likely to never use Facebook (13.2% vs. 2.9%). Relatively few participants used platforms like Twitter, blogs, Snapchat, or LinkedIn (Table 3).

	Characteristic	Overall (*n* = 324)	No mobile phone (*n* = 232)	Mobile phone (*n* = 92)
Table 4 Characteristics of participants who completed the Link2Care baseline assessments (*n*=324) by phone ownership	Believe smartphone app can help change actions or behaviors, *n* (%)			
	No	55 (17.2)	31 (13.5)	24 (26.4)
	Yes	265 (82.8)	198 (86.5)	67 (73.6)
	Used smartphone app to manage health-related issues, *n* (%)			
	No	242 (74.9)	172 (74.5)	70 (76.1)
	Yes	81 (25.1)	59 (25.5)	22 (23.9)
	Type of issue managed with smartphone app, *n* (%)[a]			
	Food or calorie tracking	41 (50.0)	30 (50.0)	11 (50.0)
	Medication reminders	40 (48.8)	28 (46.7)	12 (54.5)
	Mood manager	20 (24.4)	15 (25.0)	5 (22.7)
	Physical activity	42 (51.2)	33 (55.0)	9 (40.9)
	Sleep tracker	25 (30.5)	17 (28.3)	8 (36.4)
	Smoking cessation	14 (17.1)	9 (15.0)	5 (22.7)
	Stress reduction	31 (37.8)	19 (31.7)	12 (54.5)
	Weight loss tracking	23 (28.0)	16 (26.7)	7 (31.8)
	Other	19 (23.2)	13 (21.7)	6 (27.3)
	Number of issues managed with smartphone app, *n* (%)[b]			
	1	11 (13.6)	9 (15.3)	2 (9.1)
	2	28 (34.6)	21 (35.6)	7 (31.8)
	3	16 (19.8)	9 (15.3)	7 (31.8)
	4	11 (13.6)	9 (15.3)	2 (9.1)
	5	4 (4.9)	4 (6.8)	0 (0.0)
	6	5 (6.2)	4 (6.8)	1 (4.5)
	7	3 (3.7)	3 (5.1)	0 (0.0)
	8	3 (3.7)	0 (0.0)	3 (13.6)
	9	0 (0.0)	0 (0.0)	0 (0.0)
	Number of issues managed with smartphone app, *n* (%)			
	0	242 (74.9)	172 (74.5)	70 (76.1)
	1	11 (3.4)	9 (3.9)	2 (2.2)
	2	28 (8.7)	21 (9.1)	7 (7.6)
	3	16 (5.0)	9 (3.9)	7 (7.6)
	4	11 (3.4)	9 (3.9)	2 (2.2)
	5	4 (1.2)	4 (1.7)	0 (0.0)
	6	5 (1.5)	4 (1.7)	1 (1.1)
	7	3 (0.9)	3 (1.3)	0 (0.0)
	8	3 (0.9)	0 (0.0)	3 (3.3)
	9	0 (0.0)	0 (0.0)	0 (0.0)

[a]Percentages sum to > 100% because participants could select more than one response option

[b]Among participants who reported managing any issues with smartphone app

Perceptions of Smartphone Apps for Health Behavior Change Among RIHAs The majority of participants believed that smartphone apps could be used to change health-related actions or behaviors (82.8%); however, only a quarter of participants had used an app for this purpose (25.1%). Among those who had used an app to manage a health behavior (Table 4), most reported app use for multiple health behaviors (86.4%). The most commonly identified types of apps used for health behavior management included physical activity (51.2%), food/calorie tracking (50.0%), and medication reminders (48.8%). See Figs. 1 and 2 to visualize app use.

1. Only asked of participants who reported managing *any* issues with a smartphone app (*n*=81).
2. Percentages sum to > 100% because participants could select more than one response option.

Fig. 1 Percentage of participants who reported using a smartphone app to manage each of the following types of issues
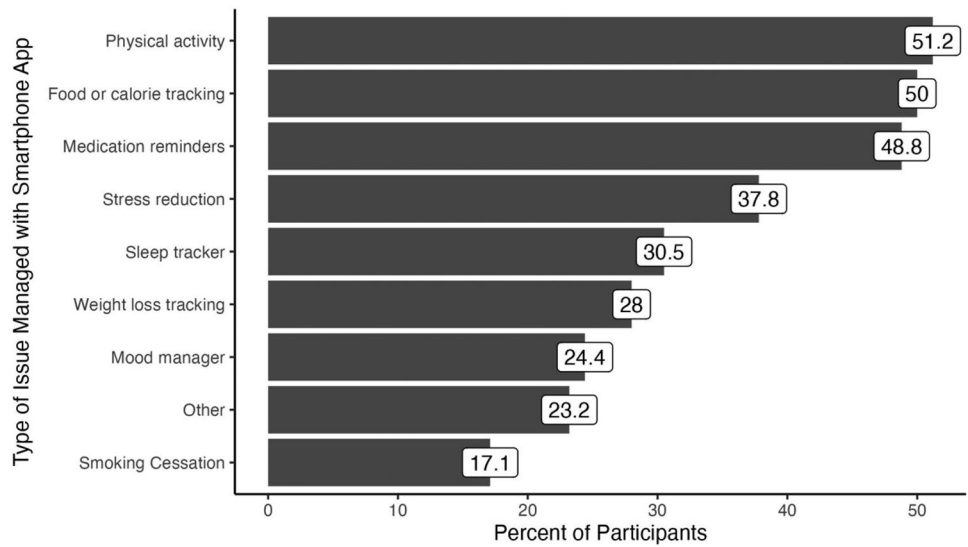

Discussion

Findings from this descriptive study indicated that RIHAs regularly use technologies (e.g., email, internet), with many reporting regular use of social media (e.g., Facebook). The majority of RIHAs believed that smartphone apps could help them to change their health-related actions or behaviors; however, most reported that they had never used apps for this purpose. Taken together, these findings suggest a potential gap in the development and delivery health-related behavioral interventions to RIHAs.

Results indicated that most RIHAs (i.e., 83.6%) had owned a mobile phone in the past year. This is slightly lower than the rate of past year mobile phone ownership among adults experiencing homelessness who were not recently incarcerated (e.g., 93.6%). RIHAs may have lower current smartphone ownership rates (24.1%) than other adults experiencing homelessness because their property may have been confiscated when they

were arrested, and they have not yet reestablished wireless service. Upon release from incarceration, distribution of low-cost smartphones may increase access to needed physical and mental health services, which has previously been demonstrated to be crucial among high-risk groups (Ozga et al., 2022).

While there are a number of strengths of this study (e.g., a large sample of a difficult-to-reach population), there are also limitations. First, this study was descriptive. While the analyses allowed us to identify the frequency of use of multiple types of technology, a descriptive longitudinal analysis would help to identify opportunities for how and when these technologies could be used to support physical and mental health service delivery. Second, the study included a convenience sample of RIHAs at one homeless shelter in Dallas, Texas, which may limit the generalizability of study findings to other areas or to homeless adults who avoid or do not obtain services at homeless shelters. Third, follow-up questions were not asked to further

Fig. 2 The total number of issues managed using a smartphone app by participants — among the 9 options supplied
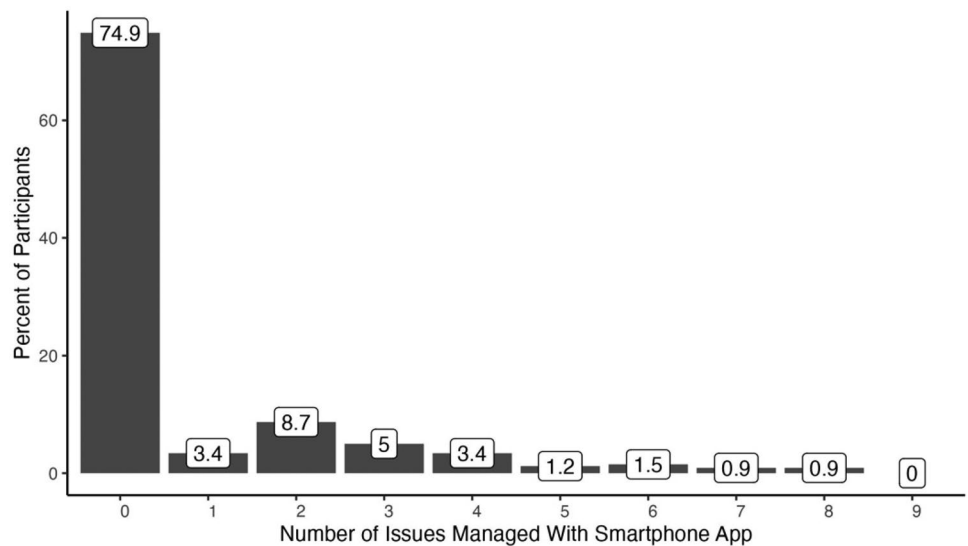
explore reasons why participants did not have an active cell phone and/or had changed their number. This was a missed opportunity to further explore potential barriers to consistent and reliable access to technology-delivered physical and mental health services among this difficult-to-reach group. Finally, data for the current study was collected from participants who voluntarily enrolled in a clinical trial that aimed to evaluate a smartphone app to increase case management and treatment service utilization. Therefore, participants who elected to enroll in the trial may have had greater access to and comfort with using mobile technologies than participants who declined enrollment.

There are some important implications and future directions that can be derived from the current study's findings. Primarily, while overall mobile phone use was high among participants in the past year (83.6%), three quarters (75.6%) of participants had their number changed at least once and over one tenth (11.4%) had it changed over five times in the past year. This highlights that interventions that rely solely on an active and consistent mobile phone number to maintain engagement with RIHA (e.g., via SMS text interventions) are at high risk of losing connection with this population. As such, alternative modalities are needed to maintain connection and engagement. Among participants with and without current access to a mobile phone, email and Facebook use was high. Past studies of hard-to-reach, at-risk groups have found Facebook as a viable channel to maintain connection with rural drug-using women (Dickson et al., 2017). However, few interventions utilizing these technologies are currently available, and even fewer have been empirically tested for clinical utility among RIHA — a hard-to-reach population of underserved and understudied adults. Mobile interventions that utilize email, social media (e.g., Facebook), phone calls, texts, and/or smartphone applications should be developed and tested as a multimodal way to engage RIHAs in mental health and health behavior change interventions.

Declarations

Informed Consent This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committees of The University of Oklahoma Health Sciences Center and University of Texas Health Sciences Center Institutional Review Boards approved the study procedures. IRB approval number is HSC-SPH-15–0632 and was last approved 2/18/2022.

Conflict of Interest The authors declare no competing interests.

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