

Mobile technology use in Clinical Research: A Randomised Controlled Trial examining challenges and implications for health promotion in South Africa.

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Table of Contents

Original Manuscript.....	5
Supplementary Files.....	32
Figures	33
Figure 1.....	34
Figure 2.....	35
Figure 3.....	36



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Abstract

Background: The use of mobile technologies in fostering health promotion and healthy behaviours is becoming an increasingly common phenomenon in global health programmes. While mobile technologies have been effective in health promotion initiatives and follow-up research in higher-income countries and concerns have been raised within clinical practice and research in low-and-middle income settings, scanty literature in South Africa exists that has qualitatively explored challenges that participants experience in terms of being contactable through mobile technologies.

Objective: This study aimed to explore challenges that participants experience in terms of being contactable through mobile technologies in a trial conducted in Soweto, South Africa.

Methods: A convergent parallel mixed-methods research design was employed. In the quantitative phase, approximately 363 young women in the age cohorts 18-28 were contacted telephonically between August 2019 and January 2022 to have a session delivered to them or to be booked for a session. Call attempts initiated by the study team were restricted to only one call attempt and participants who were reached at the first call attempt were classified as contactable (n = 189) while those whom the study team failed to contact were classified as hard to reach (n = 174). Two outcomes of interest in the quantitative phase were 'contactability of the participants' and 'participants' mobile number changes' and these outcomes were analysed at a univariate and bivariate level using descriptive statistics and a two-way contingency table. In the qualitative phase, a subsample of young women (n = 20) who were part of the trial for 12 months or more participated in in-depth interviews and were recruited using a convenience sampling method. A reflexive thematic analysis approach was employed to analyse the data using MAXQDA software, version 20.

Results: Of the 363 trial participants, 47.9% (n=174) were hard to reach telephonically while approximately 52.1% (n=189) were easy to reach telephonically. Most participants (55%) who were contactable did not change their mobile number. The highest percentage of mobile number changes was observed among participants who were hard to reach, with three-quarters (75%) of the participants being reported to have changed their mobile number two or more times. Eight (8) themes were generated following analysis of the transcripts which provided an in-depth account into reasons why some participants were hard to reach. These included (1) Mobile technical issues; (2) Coverage issues; (3) Lack of ownership of personal cell phone; (4) Unregistered number, among others.

Conclusions: Remote data collection remains an important tool in public health research and could thus serve as a hugely

beneficial mechanism in connecting with participants, while actively using established relationships with participants or community-based organisations to deliver health promotion and practice.

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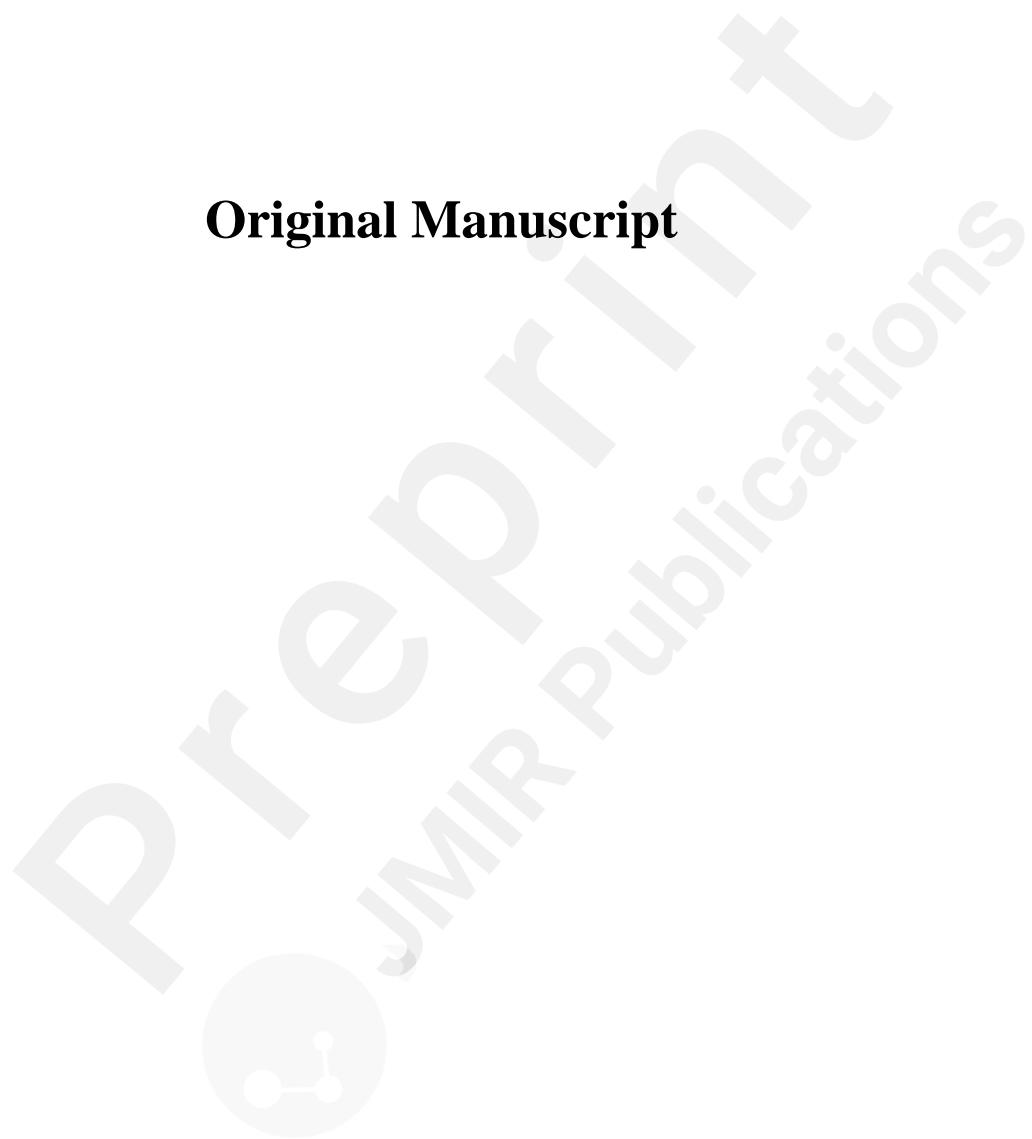
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Original Paper

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Methods: A convergent parallel mixed-methods research design was employed. In the quantitative phase, approximately 363 young women in the age cohorts 18-28 were contacted telephonically between August 2019 and January 2022 to have a session delivered to them or to be booked for a session. Call attempts initiated by the study team were restricted to only one call attempt and participants who were reached at the first call attempt were classified as contactable ($n = 189$) while those whom the study team failed to contact were classified as hard to reach ($n = 174$). Two outcomes of interest in the quantitative phase were 'contactability of the participants' and 'participants' mobile number changes' and these outcomes were analysed at a univariate and bivariate level using descriptive statistics and a two-way contingency table. In the qualitative phase, a subsample of young women ($n = 20$) who were part of the trial for 12 months or more participated in in-depth interviews and were recruited using a convenience sampling method. A reflexive thematic analysis approach was employed to analyse the data using MAXQDA software, version 20.

Results: Of the 363 trial participants, 47.9% ($n=174$) were hard to reach telephonically while approximately 52.1% ($n=189$) were easy to reach telephonically. Most participants (55%) who were contactable did not change their mobile number. The highest percentage of mobile number changes was observed among participants who were hard to reach, with three-quarters (75%) of the participants being reported to have changed their mobile number two or more times. Eight (8) themes were generated following analysis of the transcripts which provided an in-depth account into reasons why some participants were hard to reach. These included (1) Mobile technical issues; (2) Coverage issues; (3) Lack of ownership of personal cell phone; (4) Unregistered number, among others.

Conclusion: Remote data collection remains an important tool in public health research and could thus serve as a hugely beneficial mechanism in connecting with participants, while actively using established relationships with participants or community-based organisations to deliver health promotion and practice.

Keywords: Mobile technologies, health promotion; mixed-methods, clinical practice

Introduction

Background

The use of mobile technologies in engaging people and communities to choose healthy behaviours and to improve their health is becoming an increasingly common phenomenon in global health

programmes [1-4]. Mobile technologies have increasingly become a common mode of delivering telemedicine in sub-Saharan Africa and other low- and middle-income countries (LMICs) given improvements in coverage [5], with the prospects of improving access to information pertaining to healthcare services in areas where healthcare systems lag behind in meeting minimum health standards [6, 7]. Mobile phone technology use in clinical studies is a potential avenue for both follow-up of participants in research [8-10], and providing targeted and tailored messaging, to facilitate behaviour change support. For instance, patients now progressively receive reminders regarding clinic appointments [11], medication uptake [12], health promotion [13, 14], medical treatment or diagnosis [15], and obtaining information on disease outbreaks and other health-related data [16] through short message service (SMS) systems and telephone calls; which have all contributed to better health [1, 17]. These digital interventions are reinforced by the high level of mobile phone penetration in many LMICs.

Generally, mobile technologies typically exist in the form of internet-enabled devices such as smartphones, tablets, and watches [18]. Mobile phones constitute the most commonly used mobile technologies for cellular communication in LMICs [19-20] and are used as a cellular communication system for making and receiving phone calls, video calls, text and instant messaging, surfing the internet, GPS navigation and for playing games [21]. For the purposes of this study, the focus was particularly restricted to mobile phones, with the form of cellular communication being restricted only to phone calls.

Research conducted in the sub-Saharan African region has shown that individuals who participate in research studies are intermittently reached through the phone, which is the most commonly used method in the region [22]. South Africa is the third country in Africa that has the highest number of people in the population who are active mobile phone users, providing a robust platform for telemedicine prospects [22]. For example, 97% of households in South Africa have access to a mobile phone [23]. According to the Independent Communications Authority of South Africa's (ICASA) 2019 report on the state of Information Communication Technology (ICT), an estimated 82% of the country's total population have a smartphone [24], with 88% of the population reported to have prepaid mobile cellular subscriptions and 12% of the population reported to have contract subscriptions [24]. Although mobile technologies have shown some success in their effectiveness in health promotion initiatives and improving health knowledge, the use of mobile phones in delivering these interventions within clinical practice and research comes with concerns [25]. For example, although a large proportion of people own mobile phones, there are low retention rates in clinical research, and this has been largely attributed to challenges of participant reachability and accessibility by phone [22]. For instance, in a clinical trial conducted in Togo, out of an approximate proportion of 13,726 respondents who had provided their mobile number, 80% could not be reached on that number [26].

Additionally, research conducted in Cote d'Ivoire among patients who were taking antiretroviral treatment showed that out of the 7000 patients who were traced telephonically after initially actively participating in the research but became lost at the point of follow-up in the study, only 40% of the patients could be reached on the telephone number which was provided [27]. A randomised

controlled trial conducted in South Africa amongst 400 HIV positive patients found that only 60.3% of the patients were reached telephonically after receiving at most 3 phone calls on different days and different times, for every phone number that the participant had provided [22]. In addition, another South African study indicated that reachability by phone is a common challenge in the country, for instance through theft and loss of phones, which results in connectivity loss with respondents and loss to follow up [28]. Although several scholars have investigated how effective mobile phones are in follow-up studies [1, 6-8, 13, 24, 27-29], there is a dearth of literature in South Africa that has qualitatively explored challenges that participants experience in terms of being contactable through mobile technologies. Gaining insight into these challenges will help in developing targeted strategies to facilitate ways for research staff and researchers to remain in contact with participants over time and for follow-up research. Results could also potentially inform the use of mobile technologies for reaching patients in a clinical setting.

The trial is being conducted in Soweto, South Africa. It is the *Bukhali* preconception health trial, which is nested in the Healthy Life Trajectories Initiative (HeLTI) [30]. It is aimed at optimising the physical and mental health of young women for the young women to develop and build positive dynamic changes related to their health for themselves and, where applicable, future cohorts. In this trial, young women receive intervention materials and resources which are delivered by Community Health Workers, referred to as 'Health Helpers'. These materials include receipt of health literacy materials, multi-micronutrient supplements, health screening and referral conducted in person, nutritional risk and support and monthly sessions which help with modifying or transforming health behaviours. The monthly sessions are conducted telephonically by the Health Helpers with onsite visits scheduled for every 6 months [30-32]. However, there have been challenges in contacting participants for booking and delivering monthly trial sessions, due to participants being unreachable on the contact numbers registered for the study. Therefore, this study aimed to explore challenges that participants experience with regards to being contactable through mobile technologies, using both quantitative and qualitative data.

Methods

Study Design

A convergent parallel mixed-methods research design was applied. It is a research design which involves the collection and analysis of quantitative and qualitative data separately, which are then compared simultaneously to best understand the phenomenon under study [33]. The research design's main presumption is that both quantitative and qualitative data offer varying information, with the qualitative data providing narrative accounts of the participants and the quantitative data providing scores on selected variables [33]. This design provides broader insight into the issue being studied by comparing the findings and results to discern if they confirm or disconfirm each other.

Combining both qualitative and quantitative methods as complementary methods has the potential to contribute to broader applicability of the findings in other settings or with other wider population [33-36]. This method is applicable in this study given that the quantitative data provided insight into data on many *Bukhali* participants while the qualitative data provided an in-depth narrative account of the mobile phone challenges faced by participants and other reasons for being hard to reach.

Participants and Recruitment

The study population were young women aged 18-28 years who participate in the trial within the precinct of the Chris Hani Baragwanath Academic Hospital, located in Soweto, Johannesburg, South Africa, and recruited into the intervention arm of the *Bukhali* trial [30]. Soweto is a largely overpopulated and multi-lingual area that lies in the outskirts of the greater Johannesburg city. It is characterised by several socioeconomic issues, namely joblessness, gender-based violence, and food insecurity, as well as factors hindering healthy behaviours [37], which have the potential to influence young women's mobile phone usage patterns.

Overall, the study team contacts participants telephonically to (i) deliver participant monthly sessions, (ii) book subsequent participant monthly sessions, (iii) arrange to have supplements delivered to the participants' homes or (iv) to follow up on participants who have experienced an adverse event. The mobile phone information of participants is captured by the study team to enable the team to reach the participants. For the quantitative component of this study, we included all young women who were contacted telephonically between August 2019 and January 2022. These women were contacted to either have a session delivered to them or to be booked for a session ($n = 363$), out of the wider group of HeLTI participants. This was done for the purpose of identifying young women who were reachable and young women who were unreachable. Participants who had (i) in-person contact with the study team (either off-site to deliver supplements OR on-site to deliver a session); (ii) were contacted via text messaging or (iii) through other means of communication (e.g., home visits or instant messaging), were excluded from this study in order to focus on the extent to which participants could be contacted by phone.

The standard process that the intervention team uses to facilitate the intervention involves making several call attempts to reach the participants. All call attempts and contact statuses of the participants are captured on a contact log. At most, three call attempts are made and if participants are still not reached following this number of call attempts, the study team generates tracing lists which prompt them to trace these participants through conducting further fieldwork to update the contact details of the participants. For the purposes of this study, we restricted the call attempts to only one call attempt given that the study only aimed to provide a cross-sectional picture and not analysis that focuses on more longitudinal repeated attempts, which was beyond the scope of this study. Thus, participants who were reached at the first call attempt were classified as 'reachable'. Participants whom the study team failed to make contact with at the first call attempt were classified as 'hard to reach' or 'failed to make contact'. In the same period, some participants changed their

mobile number once, others several times and others did not change their number. A flow chart indicating stages of participant recruitment is shown on figure 1.

Figure 1: Flow Diagram of trial participants contacted telephonically between August 2019 to January 2022

For the qualitative component, a subsample of participants ($n = 20$) who were part of the *Bukhali* trial for 12 months or more were recruited telephonically for those who were easily contactable, and recruitment was done by a fieldwork team for those who were hard to reach. This sample of participants was purposively selected using a convenience sampling technique. The group of 20 participants was selected by drawing them from the same group of young women who participated in the trial between August 2019 and January 2022. The overall group of women who participated in the trial would be booked to receive a monthly session either in person, telephonically or though text messaging or to have supplements delivered to them. We then first restricted this group to only young women whom we failed to make contact with, those who had a session delivered to them and those who were booked for a session. Furthermore, participants who had repeated call attempts were excluded and we then further restricted the sample to those who only had one call attempt. This resulted in a group of those who were contactable and those who were hard to reach and this group was included in the quantitative analysis. Thereafter, the 20 young women who were included in the qualitative analysis were then chosen from the 363 young women who were included in the quantitative analysis. This was done by selecting the record IDs of young women by extracting their IDs from the Research Electronic Data Capture which is a secure database that stores data for research studies [38]. Qualitative data was collected only for this group of young women given that the trial aims to deliver an intervention that fosters behaviour change. Thus, the lack of contactability or loss to follow up of this group of participants poses a significant threat on the effective delivery of the intervention and could potentially have adverse biases on the conclusiveness of the results of the trial, which could have significant effects on the credibility and reliability of the trial.

Data collection

Quantitative data collection

Quantitative data collection was conducted, thereafter the data was recorded, and stored on REDCap (Research Electronic Data Capture) [38]. The data involved a set of interview-led administered questionnaires that collected baseline data on the demographic characteristics of participants. The variables that were used in this study to show a descriptive profile of the sociodemographic characteristics of the participants who were contactable and those who were hard to reach included: i) age; ii) family size; iii) highest level of education; iv) vocational activity; v) type of dwelling unit;

vi) times in past 12 months when family went hungry; vii) phone ownership; viii) contract type; and viii) type of cell phone.

In this component of the study, the first outcome of interest was the ‘contactability’ of participants. Two groups of young women were of interest in this phase of analysis. These were (i) young women who were contactable; and (ii) young women who were hard to reach at the first call attempt. The second outcome was mobile number changes of participants which were captured on REDCAP. These number changes were tracked from randomisation into the trial. The number changes were categorised as (i) no number change; (ii) one number change and (iii) two or more number changes.

Qualitative data collection

20 participants were interviewed individually using an in-depth interview guide by two female interviewers who were fluent in both English and other South African vernacular languages. The interview schedule was developed by the study team to capture the participants’ reasons for changing their mobile numbers and to discern why staying in contact with participants is challenging. Interview questions focused on young women’s demographic characteristics, questions around ownership of a mobile phone(s), mobile phone use behaviour and patterns, and receipt of health information. The interviews were conducted face-to-face with the participants within the precinct of the Chris Hani Baragwanath Academic Hospital, in February and March 2022. Interviews lasted between 30 to 40 minutes and were audio recorded. Interview notes were captured during each scheduled interview session to record the participants’ main accounts and non-verbal cues. Before analysis was conducted, recordings were transcribed to their original form and translated into English where necessary.

Data analysis

Quantitative data analysis

To statistically analyse the differences between the two groups of participants (failed to make contact and contactable), the data was analysed descriptively at a univariate and bivariate level. At a univariate level, to visually illustrate the differences between contact status of participants by mobile number change, a graph was generated to compare the proportion / rate of mobile number change of each group in relation to another. Similarly, another graph was generated to identify the most cited and least cited outcomes of the attempted call for participants we failed to make contact with. At a bivariate level, a contingency table was generated to depict the differences in the results of the tabulation of observations at each level of a variable for both groups i.e., cross-tabulation of the two groups to show the relationship / differences in the proportions and frequencies of the sociodemographic characteristics of the two groups. This table included the Pearson’s chi-square test of association to statistically identify the independence or association between the two groups /

categorical variables and accompanying sociodemographic co-variates. These were all analysed with the aid of STATA version 17 [39].

Qualitative data analysis

A reflexive thematic analysis approach was employed for analysis using MAXQDA software, version 20 [36] which helped in the recording, coding and interpretation of the transcripts. Reflexive thematic analysis is an interpretive method which enables researchers to establish the outcome of the work rather than following a specific theory [35]. Six steps were employed in the analysis. In the first step, data familiarisation was conducted by checking the quality of the transcripts against the recordings to understand the data thoroughly which would make it possible to search for patterns and meanings. This involved reading and re-reading transcripts and taking notes. In the second step, initial codes were generated by labelling and organizing participants' narratives to form a complete meaning.

In the third phase, initial themes were then generated by sorting initial codes that had been generated into themes and identifying meanings and relationships between the initial codes. In the fourth phase, the themes were reviewed by identifying coherent patterns and ensuring that generation of themes was supported by sufficient data. This also included collapsing overlapping themes and re-generating and improving codes and themes. This was done as a collective effort between KM, LS, and CD. In the fifth phase, themes were defined and named by linking each narrative to the appropriate theme. Lastly, in the sixth phase, the narratives of the participants were presented under each generated theme in a concise manner.

Ethical Statement

Ethical approval was granted by the Human Research Ethics Committee (Medical) which is located at the University of the Witwatersrand (M190449). Participants provided written informed consent to participate consented to have the interviews audio recorded.

Although the information provided by the participants was captured on an audio recorder, the data was protected by securely storing it in a password-protected computer in a secure locked cabinet. The identities of the participants were protected through de-identification of all their personal information and characteristics. Secondly, transcripts contained ID numbers that represented each participant's responses.

Results

Quantitative results

The participants' (n = 363) sociodemographic characteristics are provided in Table 1. Of these participants, 47.9% (n=174) were hard to reach telephonically while approximately 52.1% (n=189) were easy to reach telephonically. Most participants (55%) who were contactable did not change their mobile number. The highest percentage of mobile number changes was observed among participants who were hard to reach, with three-quarters (75%) of the participants being reported to have changed their mobile number two or more times (Figure 2). While 58% of the participants could not be reached as the attempted call went to voicemail, 29% of the participants were reported to not have taken the call when the attempted call was placed and only 2% of the participants took the call but ended it (Figure 3).

Figure 2: Contact status of trial participants by mobile number change

Figure 3. Outcome of attempted call for participants who were unreachable.

Table 1. Socio-demographic characteristics of trial participants

	Failed to make contact	Contactable	Total	P-value	
	% (n)	% (n)	% (n)		
Age					
18-20 years	40.2 (70)	31.2 (59)	35.5 (129)		
21-23 years	27.6 (48)	33.9 (64)	30.8 (112)		
24-26 years	21.8 (38)	27.0 (51)	24.5 (89)		
27-28 years	10.3 (18)	7.9 (15)	9.1 (33)		
Total	100.0 (174)	100.0 (189)	100.0 (363)		
Family size					
1	4.6 (8)	6.9 (13)	5.8 (21)	0.781	
2	7.5 (13)	9.0 (17)	8.3 (30)		
3	14.4 (25)	12.2 (23)	13.2 (48)		
4-7	54.6 (95)	55.6 (105)	55.1 (200)		
>7	19.0 (33)	16.4 (31)	17.6 (64)		
Total	100.0 (174)	100.0 (189)	100.0 (363)		
Education and Socioeconomic characteristics					
Highest level of education					
Primary	32.8 (57)	22.3 (42)	27.3 (99)	0.082	
Secondary	52.3 (91)	62.8 (118)	57.7 (209)		
Tertiary	4.6 (8)	6.9 (13)	5.8 (21)		

Other	10.3 (18)	8.0 (15)	9.1 (33)	
<i>Missing</i>	0	1	1	
Total	100.0 (174)	100.0 (189)	100.0 (363)	
Vocational activity				0.065
Currently enrolled in higher education institution, employed, or currently looking for a job	5.2 (9)	10.0 (19)	7.7 (28)	
Not enrolled in higher education institution, not employed, or not currently looking for a job	94.8 (165)	89.9 (170)	92.3 (335)	
Total	100.0 (174)	100.0 (189)	100.0 (363)	
Type of dwelling unit				0.431
House of brick/concrete block structure on a separate stand or yard or on a farm	70.1 (122)	67.7 (128)	68.9 (250)	
House/flat/room on your homestead	13.8 (24)	18.5 (35)	16.2 (59)	
Informal dwelling/ shack in backyard	8.6 (15)	7.4 (14)	8.0 (29)	
Informal dwelling/shack not in backyard	4.0 (7)	1.6 (3)	2.7 (10)	
Other	3.4 (6)	4.8 (9)	4.1 (15)	
Total	100.0 (174)	100.0 (189)	100.0 (363)	
<i>Were there times in past 12 months when members of your family went hungry because there was not enough food in the house to eat</i>				0.117
Yes	39.1 (68)	31.2 (59)	35.0 (127)	
No	60.9 (106)	68.8 (130)	65.0 (236)	
Total	100.0 (174)	100.0 (189)	100.0 (363)	

Table 2 shows mobile phone information of both hard-to-reach participants and contactable participants. There was a significant difference in mobile phone ownership among participants who were hard to reach and those who were contactable as 97% of those who were contactable owned a personal cell phone compared to 91% of those who were hard to reach. Most of the young women (both contactable and hard to reach) had a smartphone (more than 80% each) and did not have a phone contract (more than 90% each). Results indicated no statistically significant differences in these variables among participants who were hard to reach and participants who were contactable.

Table 2. Mobile phone information of trial participants

	Failed to make contact. % (n)	Contactable % (n)	Total % (n)	P-value
<i>Do you have a personal cell phone</i>				0.026
Yes	91.4 (159)	96.8 (183)	94.2 (342)	
No	8.6 (25)	3.2 (6)	5.8 (21)	
Total	100.0 (174)	100.0 (189)	100.0 (363)	
<i>If yes, is it on contract</i>				0.201

Yes	6.9 (11)	3.8 (7)	5.3 (18)	
No	93.1 (148)	96.2 (176)	94.7 (324)	
Total	100.0 (159)	100.0 (183)	100.0 (342)	
Is it a smartphone				0.323
Yes	84.9 (135)	88.5 (162)	86.8 (297)	
No	15.1 (24)	11.5 (21)	13.2 (45)	
Total	100.0 (159)	100.0 (183)	100.0 (342)	

Qualitative results

Table 3 shows the sociodemographic profile of the interview participants. The overall mean age of the participants who were interviewed was 22. In addition, 10 participants had a secondary school qualification, 8 had not completed secondary education and only 2 had a tertiary qualification, at the time of assessment. Almost all the participants lived with a parent or relative, while only one participant lived with her partner and 13 participants were not in a relationship at the time of assessment.

Table 3: Sociodemographic profile of interview participants

Participant number	Current age	Highest level of education attained	Lives with	Relationship status
Participant 1	25	Secondary school qualification	Siblings and child	Single
Participant 2	22	Tertiary qualification	Parent	Single
Participant 3	21	Secondary school qualification	Parents, child, and sibling	Single
Participant 4	22	Grade 11	Parent, siblings, and child	Single
Participant 5	28	Grade 11	Parent, sibling, children, and relatives	Single
Participant 6	20	Grade 11	Parent and siblings	In a relationship
Participant 7	21	Secondary school qualification	Parent	Single
Participant 8	26	Grade 11	Partner	In a relationship
Participant 9	20	Secondary school qualification	Parent, siblings, and relatives	Single
Participant 10	24	Grade 10	Grandparent, siblings, and children	In a relationship
Participant 11	22	Grade 11	Grandparent and relatives	Single
Participant 12	24	Grade 11	Parent, siblings and relative	In a relationship
Participant 13	20	Secondary school qualification	Parent, sibling, and child	Single
Participant 14	21	Currently doing matric	Sibling, parent, and child	In a relationship
Participant 15	25	Secondary school qualification	Relatives	Single
Participant 16	20	Secondary school qualification	Parent, siblings, and child	In a relationship
Participant 17	20	Secondary school qualification	Siblings	Single
Participant 18	22	Secondary school qualification	Parents	Single
Participant 19	22	Tertiary qualification	Grandparents and relatives	Single

Participant 20	24	Secondary school qualification	Sibling, relatives, and child	In a relationship
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An overview of the superordinate themes and sub-themes generated from the qualitative analysis is shown in Table 4. As indicated by Table 4, this section is sorted into the narrative findings, with illustrative quotations provided for each superordinate theme and sub-theme.

Table 4. Themes focusing on young women's reasons for being hard to reach.

Superordinate theme	Sub-themes
1. Mobile phone technical issues	
2. Coverage issues	2.1. Electricity unreliability 2.2. Network connectivity issues
3. Lack of ownership of personal cell phone	
4. Unregistered number	
5. Usage patterns	5.1 Cell phone theft in community 5.2. Stalking behaviour
6. Inconsistent sim use	
7. Availability of data and airtime	
8. Lack of interest in possessing mobile phone	

1. Mobile phone technical issues

Technical barriers were reported by most of the participants as a major challenge that affected the efficiency, functioning, and usability of their mobile phones. Key challenges that were reported by participants which resulted in inherent limitations in operating their mobile phones included poor battery life, faulty charging system, mobile phone and application crashes and touch screen of the phone no longer in good working condition. Such challenges resulted in the participants not being easily contactable or contactable at all. Some participants resorted to changing their mobile phones or using alternative communication methods such as using the phones of individuals within their social networks.

“I've experienced battery challenges and the charging system, ja that's the only thing that's been wrong with my phone. I had to charge my phone a certain way and I couldn't even use it until I finished charging and the battery will finish fast sometimes when I'm trying to do something” (Participant 2, 25 years old, single).

“The phone I was using, it lived on life support. I had to use it while it was in a charger at home. The charger also was faulty so sometimes I would think it's on and it's off” (Participant 9, 20 years old, single).

“It sometimes jams. The battery finishes quickly while you are chatting. So those are the challenges that I face with my phone” (Participant 16, 20 years old, in a relationship).

“My phone has problems. Like it just switches off, because it fell once, and now every time when it hits hard or something, it just switches off, and it is going to take time for it to switch on, so I wait for it to switch on” (Participant 1, 25 years old, single).

“The touch screen doesn’t work properly now because it fell sometime last year. I don’t know if it’s a space issue or just the phone itself because sometimes when I get incoming calls the phone rings but then I can’t touch it for me to be able to pick up the call because of the touch screen problems with the phone” (Participant 13, 20 years old, single).

“It has a tendency to freeze if it fell, maybe if I’m receiving a call, I can’t answer it because the phone is frozen, you know” (Participant 15, 25 years old, single).

2. Coverage issues

Coverage issues such as network and electricity made it difficult for some participants to be contactable. Participants indicated that they could not receive calls or messages or had to change their mobile sims due to challenges concerning the connectivity, reliability, and quality of the mobile network. This included signal weakness and network availability issues with some mobile service providers being cited as having general network unreliability or the network being offline in some instances. Participants reported experiencing electricity unreliability due to frequent power cuts. This greatly affected their ability to utilise their mobile phones, thus being unable to be in touch with people.

“My network becomes very slow, sometimes I don’t even get calls I just get messages that I have a missed call but then it didn’t even ring if you don’t have electricity. It’s been hectic hey, we didn’t have electricity on Sunday” (Participant 2, 22 years old, single).

“It has been a while since we have been without electricity but right now, we don’t have it because they said that the substation was on fire” (Participant 7, 21 years old, single).

“I first bought the Telkom sim card but then I don’t know what happened with the coverage in Orlando, but it was giving me problems, so I couldn’t get network, so I used my MTN sim card. I think I got it like two years ago. I was not using it as frequently as the Telkom number, so I had to use the MTN number” (Participant 9, 20 years old, single).

“Telkom network is problematic, sometimes you want to make a call, it will tell you that there is no service, things like that. Sometimes the sim card does not connect. I will find myself taking it out and putting it back on but still, so I decided to change MTN, then, MTN gave me a problem of taking my airtime every time when I recharged” (Participant 1, 25 years old, single).

3. Lack of ownership of personal cell phone

Some participants indicated that they were not easily contactable because they do not currently own their own personal cell phone or previously did not own one. Reasons attributed to the lack of ownership ranged from the phone being reported to be broken, stolen, lost, or not having one at all. Despite this circumstance, participants used other alternative communication means to try and be contactable. Participants reported using their social networks to try and solve the problem of not having a mobile phone through sharing a phone with siblings, peers, or partners. However, sharing a phone limited their ability to stay connected with others and to be reachable because their time with the device was limited. In some cases, this was exacerbated by the participants not living near to the people they shared the phone with. In other instances, participants' social networks would not relay the message back to them. These narratives are reflected in the excerpts below:

“I didn’t have a phone for two months, so I spent quite a while without a phone. I used parents’ phones. It was for when people couldn’t get hold of me, they would call my parents for emergencies. (Participant 18, 22 years old, single).

“I didn’t have a phone for four months. I was not reachable. I used my boyfriend’s phone. The first number that I applied with is my grandmothers, that was the first one. I did not have a phone at that time, and so I applied with her phone, and they tried to call her, but it did not get through to her. Because her phone, she is a person that does business, it would switch off and she would not find the charger, and then it would be charged after a while, and then I gave them the number of my partner, and then they said that they can’t get me with that one as well” (Participant 10, 24 years old, in a relationship).

“I stayed for a long time without a phone. I think it had been two years without having a phone. I used to borrow my friend’s phone if for instance there is someone who had asked for my number, then I would give them my friend’s number, and my friend would tell me that so and so had phoned, they called me because you don’t have a phone. So, when people wanted my number, I would give them my friend’s number. It was not easy for them to get hold of me because sometimes I am at my home, and she is at her home” (Participant 1, 25 years old, single).

“I didn’t have a phone for two months, so I spent quite a while without a phone. I used parents’ phones. It was for when people couldn’t get hold of me, they would call my parents for emergencies. (Participant 18, 22 years old, single).

Other participants further highlighted that they were not contactable because their mobile phone was stolen or had gone missing.

“I lost my phone and then I took time to do the sim swap and by the time I decided to do it, they had already given the number to someone else” (Participant 9, 20 years old, single).

“I started by using said provider, yes I was using said provider first, and now I am on

another provider because my phones got lost" (Participant 11, 22 years old, single).

"I had a phone, it was last year, I had another phone and they mugged me in March" (Participant 20, 24 years old, in a relationship).

One participant lost her mobile phone due to theft, but her mobile sim was still in her possession. As an alternative means of communication, she would insert her sim card in other people's phones and reach out to people given that she does not have the financial means to buy a new phone.

***"I was going to the mall and then I was mugged but then I have a sim card which I did a sim swap, yes so every time I need a phone, I can contact people I wasn't able to contact"* (Participant 12, 24 years old, in a relationship).**

4. Unregistered number

Another factor that has resulted in participants being hard to reach is due to their mobile number being unregistered. Some participants reported that they had lost their phones together with their mobile sim card. Two participants reported that they bought new phones and sim cards and went to a mobile store to get a sim swap, but the mobile store could not perform the sim swap. One reason for this is because their previous mobile numbers were no longer registered under the participants' names and had been reassigned to new owners. Another reason was not being able to remember the last five number called on the sim, which is a requirement for performing a sim swap. Consequently, participants had to purchase new sim cards with new mobile numbers, different to the one recorded by the trial.

"I had to go this year January to Telkom to do a sim swap because I had applied for jobs with that number. Then when I got to Telkom, they told me that that number was not registered under my name, you see these sim cards that you get on the streets. So, I had to start another sim and so I started afresh with that number" (Participant 17, 20 years old, single).

"They took my number in January and then I got this one in February" (Participant 11, 22 years old, single).

"I lost the phone and then when I went to do the sim swap, they told me I couldn't do it because the numbers were wrong, and that I wanted the last five numbers that I last called, and so I was not able to continue with the sim swap" (Participant 7, 21 years old, single).

5. Usage patterns

Although the participants owned a personal cell phone, an inconsistent pattern of mobile phone use was observed in the narratives of the participants and impacted the ability to contact them. Some participants reported that they do not carry their mobile phones when they are outdoors and only use

the device when they are at home. Reasons for this behaviour were, however, not reported by the participants.

“I don’t use it when I am on the road, even when I am going to town or to the mall, I usually leave it behind” (Participant 3, 21 years, single).

“When I go outside, I don’t take it with me, I leave it at home. I use it when I know that I am not going anywhere” (Participant 11, 22 years old, single).

“Sometimes I’m at school, and sometimes I’m busy and I left it at home and went to the shops, ja I’m not on my phone every time, I just use my phone only when I do important things, ja” (Participant 14, 21 years old, in a relationship).

“I couldn’t go out with it, like I had to use it at home. When I go out, I leave it at home so I had to tell the person that I am meeting that we are meeting at a specific time and place, and I just had to hope they will be there” (Participant 9, 20 years old, single).

Conversely, some participants reported that their communities are not safe and there is a high rate of mobile phone theft in their area. This thus prompted them not to use their mobile phones in public. This has contributed to participants not being easily contactable given that they use their mobile phones inconsistently.

“I don’t carry my phone in the streets. It’s not safe because most of the time there’s people taking other people’s phones, most of the time, like maybe in a week we’ll hear about 2 people, 3, ja so it’s not safe” (Participant 2, 22 years old, single).

“I use when I am at home alone, outside there are a lot of thieves, when you are outside and you are using your phone, they take it from you” (Participant 10, 24 years old, in a relationship).

Conversely, another participant indicated that she was no longer comfortable using her phone or taking calls as she had experienced continuous threatening harassment over the phone from an unknown individual. This thus resulted in other people finding it difficult to reach her.

“There were people stalking me, and I didn’t know where they were getting my number from. They would tell me where I was, meanwhile, I don’t know them and I didn’t see them, then I decided to change my number.” (Participant 3, 21 years old, single).

6. Inconsistent sim use

For other participants, their inconsistent mobile phone behaviour was largely because of the participants owning dual sim cards. Participants reported that they often use one mobile number more than the other while another participant indicated that she had to change her sim cards frequently given some technical issues she was experiencing with the card. Similarly, another participant reported changing her sim cards frequently because she would lose one sim because of

repeatedly changing mobile devices and thereafter must replace it with another sim card. Another participant's inconsistent use of her mobile phone was largely because of her younger sibling who does not own his own personal cell phone. Given this circumstance, she shared her phone with her younger sibling as he frequently took out the participant's sim card and put his own for a certain period. This greatly affected the participant's ability to receive calls or messages thus making her seemingly unreachable. Other participants indicated that systems for performing a sim swap are often offline every time the participants went to do one. This has led into the participants' losing interest in doing a sim swap and has prompted them to change their mobile number. All these factors have thus contributed greatly to the participants being unreachable.

*“The sim card used to get lost because I kept changing the phones. I was using the other network’s * number. The 060. So now I am using another network. I don’t know the other network’s number, but this one”* (Participant 10, 24 years old, in a relationship).

“My younger brother likes using it a lot because he likes logging in on Facebook and chat with his friends and then bring it back. He takes out my starter pack and puts in his own. Maybe they call me, and it goes to voicemail, that is because my sim card is out” (Participant 1, 25 years old, single).

“I have two numbers and there is one that I always use and the other one that I use sometimes, because I have two sim cards, and both are in the phone. So sometimes I give people the number that I don’t use every day” (Participant 16, 20 years old, in a relationship).

“I used to use two starter packs because I wanted to use Telkom and MTN, and at the time I was using Cell C as well. I had a lot of starter packs, and I changed the numbers a lot. Telkom was giving me problems, and then MTN used to take airtime every time when I recharged. I didn’t know where my airtime was going every time when I recharged the number, so yeah, I used to change the number a lot” (Participant 1, 25 years old, in a relationship).

“Because when I do a sim swap, they ask a lot of questions, so I sometimes find that it is better if I change the number. Yes because this time I had to do a sim swap, and they said I should go to Shoprite with my ID and my proof of address, when I got to Shoprite, they said that their machines were offline, and then that is where I gave up, and then I said it is better that I change my numbers, because the numbers of most of the people that I know, I have them, I have written them in my book” (Participant 11, 22 years old, single).

“You know what, I was tired of changing number so I decided that you know what, let me stick to this number because a lot of people have this number, and they call me on it, when I give out my CVs, this is the number that I use, so I don’t take it out, this is the one that I am using” (Participant 17, 20 years old, single).

Interestingly, one contrary finding from one participant's narrative showed that the participant had the same number for more than 10 years and decided not to change her number to ensure that she remained contactable.

“I’ve had this number for more than 10 years I think, the reason why it was more it made sense to do a sim swap instead of changing numbers it was for convenience and with this phone number I had registered it on a lot of platforms, you know when you apply online when they ask you to leave your details you leave your number, so the first thing that came to mind is that for people to be able to get hold of me it’d better to have the same number and also because had lost contacts as well for me to get back my contacts I had to have the number I was using” (Participant 15, 25 years old, single).

7. Availability of data and airtime

Other participants reported that a major challenge that they face which has resulted in them not being able to stay in contact with people or being difficult to reach is that airtime and data costs are very steep, and they lack the financial ability to afford data and airtime and thus cannot purchase it regularly. As a result, there are times when they do not have any airtime or data in their phone and thus cannot make or return any calls or messages received.

“When I don’t have money where I am, or I don’t have money at that time”. “It depends on whether I have data at the time. If in a week my data finishes on Wednesday, then I will buy it on Sunday. There are days when I don’t have data. Maybe for a short while, for maybe two or one week” (Participant 16, 20 years old, in a relationship).

“I was supposed to attend the interview today and I was unable to go, because I did not have data and I saw the message on a Friday” (Participant 3, 21 years old, single).

“Before I bought a new phone, I used Vodacom, but I just didn’t like it because their data and airtime are expensive. So, the other phone came with an MTN sim, and I carried on with that one” (Participant 18, 22 years old, single).

8. Lack of interest in possessing mobile phone

Some participants reported to have no interest in possessing a mobile device to stay in contact with their social networks or being contactable on the phone. One of the common reasons for this was that participants are often near their social networks and can communicate in person as opposed to communicating via mobile phone. Others mentioned that they don’t have friends with whom to communicate while others hardly use their phones and often misplace it given the lack of importance, they give to owning a phone.

“Not that important, it’s not that important in fact. Because I don’t spend a lot of time on the phone, so I wouldn’t say that it is important. Eh, they can contact me during the say but sometimes I don’t answer the phone. I think I don’t like it that much to have it all the time, I feel like I can stay without a phone” (Participant 16, 20 years old, in a relationship).

“It’s not that important. It’s just to keep boredom off. I don’t care much about the phone”

(Participant 10, 24 years old, in a relationship).

“I don’t spend a lot of time on the phone, so I wouldn’t say that it is important. I think I don’t like it that much to have it all the time, I feel like I can stay without a phone”
(Participant 16, 20 years old, in a relationship).

“I am very reckless with my phone. I don’t use my phone often so I just leave it on the table or the cupboard or wherever and then I leave the house and people will call me and not reach me until I started to realise that okay, I need to send my CV somewhere and a phone is necessary to have on you” (Participant 5, 28 years old, single).

One participant indicated that she had previously lost her phone before purchasing a new one months later. The amount of time she spent without a phone resulted in her losing interest in possessing a phone as she had grown accustomed to being a non-mobile user.

“I didn’t see the importance of having a phone. I stayed a long time, like I didn’t care about the phone. I stayed for a long time without it, and I didn’t feel like I didn’t have a phone. So, I didn’t see the importance of having a phone, even though I saw other people with phones, but for me, I never had that feeling of not having a phone. I had already gotten used to not having a phone” (Participant 12, 24 years old, in a relationship).

In contrast to these findings, other participants indicated that possessing a mobile phone was important to them and helped them to stay in touch with their social networks, to keep abreast of any job opportunities that may arise, to apply to university or college as well as for accessing their emails and the internet. Participants indicated using their phones all the time thus suggested that they were easily contactable and reachable. These findings are reflected in the excerpts below:

“It’s very important because they need to find me every time I’m needed and most things I do on the phone, so I view it most times. I use my cell phone a lot, like every day”
(Participant 2, 22 years old, single).

“I use my phone all the time like 10 hours. When I wake up, before I go to bed, and I always provide the alternative number in case my phone is maybe low, or I have lost it. I always put in an alternative number” (Participant 9, 20 years old, single).

“It’s important because even the study get hold of me on that phone. When people are looking for me, they get hold of me on that phone. Even now the study helped me because if I didn’t have a phone, I would not be reachable because it has been a while since I have been here” (Participant 19, 22 years old, single).

Discussion

Principal Findings

The aim of this study was to explore challenges that participants experience in terms of being

contactable through mobile phones in a trial conducted in Soweto, South Africa. This study highlighted that although most participants who are difficult to contact do own a personal cell phone, which is a smartphone, most of them face a myriad of interrelated mobile phone challenges particularly technical and coverage issues, mobile theft in their communities and high costs of data and airtime. Consequently, these challenges contribute to participants' need to change their mobile numbers which subsequently has the potential to affect their reachability. The novelty of the study was the use of a mixed-methods research design. It was important to conduct a study of this nature within the context of Soweto, a resource constrained setting, characterised by a short supply of free public Wi-Fi, unequal mobile coverage, and comparably high data costs [40], among other factors.

The current study was descriptive in nature. Therefore, caution should be practiced when interpreting the results of this study since no significant associations were found in the quantitative analysis. The quantitative results in this study showed that a large proportion of individuals owned a mobile phone. This is a result that is in line with previous literature which has shown that mobile connectivity in South Africa has grown rapidly with a mobile penetration rate of over 95%, with 91% of all phones being smartphones [1, 17, 24]. Although this was also corroborated by the qualitative findings, a key finding was that some participants are mobile phone sharers whereas others have no phones at all and thus rely on their social networks who have phones and often depend on using these phones for a short while to be in touch with other individuals. Previous literature has shown that the use of mobile phones is an inherent part of people's lives which exists in socioeconomic practices and realities [15]. Although South Africa has seen an exponential increase in mobile phone ownership and access, the high cost of mobile phones still represents a formidable barrier that constraints mobile phone use [40]. In fact, a lack of income has been reported as the primary factor in a lack of phone ownership in many LMICs [41, 42]. This largely surpasses other probable barriers such as perceived importance of using a mobile phone and technical literacy [41, 42].

Given that this study aimed to explore the challenges that participants experience in terms of being contactable through mobile phone, overall, the quantitative and qualitative findings in this study suggest that the socioeconomic context of the participants is a major factor that has contributed to participants' mobile usage behaviour and difficulty in reaching them. Thus, the findings of this study uniquely contribute to the existing body of knowledge in various ways. Firstly, although phone ownership has increased rapidly in South Africa, there are some important usage gaps that remain pronounced, and these are evident in a LMIC such as Soweto. To illustrate this, although phone ownership may be predominantly high among both groups who were included in this study, their socioeconomic backgrounds are complex and create different realities which subsequently leads to variability in mobile phone usage and usability. Thus, daily realities such as unemployment, poverty and infrastructural barriers have the potential to prevent them from fully utilizing their devices in a sustainable manner. In addition, the challenges that were explored in this study in terms of participants being contactable through the mobile phone show that the experiences of youth are vastly different and complexities around socioeconomic backgrounds and environmental settings create different realities pertaining to phone possession and use. Although the participants may reside in one central area, the circumstances of young people (phone sharers, phone owners and non-phone owners) differ quite substantially, not only depending on their age, level of education or vocational activity but also on factors such as socio-economic circumstances, family structure, household

resources and livelihood patterns. This aligns with evidence from the World Bank which has shown that 50% of South African inhabitants who reside in urban settings, live in low-income settings that account for close to 40% of individuals who constitute the working population, and caters close to 60% of non-working citizens who live in cramped family settings [29].

These previous findings align with the quantitative results of this study which demonstrated that most participants were individuals who were still in early young adulthood (18-25), with more than 90% of them not in education, employment, or training (NEET) and only 5% having a mobile phone contract. Previous literature has also indicated a digital divide along gender lines [43]. The study indicated that women are more at risk of poor mobile use compared to men and attributed poor mobile phone use to economic inequality, namely women's lower educational attainment and poor income levels [43]. These findings illuminate the way mobile phone use is interwoven with the daily realities and experiences of the participants, which has the potential to prevent the participants from fully utilizing their devices in a sustainable manner.

Existing research has further shown that individuals who earn a low income have limited connectivity which is inhibited by disparities in wealth, resources and other opportunities which presents a challenge in terms of use mobile technologies [44]. This finding is strongly congruent to the qualitative findings which revealed that participants face a myriad of mobile phone, leading to them being hard to reach which is in line to what the study aimed to explore (challenges experienced in terms of being contactable over the mobile phone). Such structural inequalities that make it hard for participants to be hard to reach include coverage issues, high costs of data and airtime and safety in their communities. Furthermore, the quantitative results of this study showed that in addition to the fact that most participants only have a secondary school qualification and are NEET, nearly one-third of these participants have been reported to live in households that are food insecure. Household constraints serve as important factors that people's access to mobile technology [45]. Another study has shown that ownership of a mobile phone necessitates the need to have a phone that is in good working condition (available data and airtime, functional battery and network signal) and the financial freedom to sustain this without giving up other necessities [46]. All these factors are unevenly distributed, with those living in resource-constrained settings being most disadvantaged [46]. These findings thus suggest that the mobile phone challenges experienced by the participants are interwoven with their socioeconomic backgrounds thus making it difficult to maintain mobile technology use.

This study further found that the proportion of those who own phones is higher decreases with each successive age category for both participants who are hard to reach and those who are contactable. These findings are supported by previous literature which showed that age has been identified as a social determinant of digital inequality [22]. A curvilinear relationship has been found between age and digital use in low-and middle-income countries [22]. For instance, one study conducted in India showed that phone ownership is above 66% for 15- to 24-year-olds but only 55% for those aged 25 to 44 years-old [41]. In addition, a study conducted in Tanzania found that women aged 30 and under were 17% less likely to remain phone owners [47].

Mobile technologies have the potential to improve health behaviours among individuals participating

in clinical research [38]. For instance, the COVID-19 pandemic has led to an increased need to use mobile technologies for health promotion due to measures of social distancing and nationwide lockdowns [48]. This reliance on mobile technologies means that challenges in reaching these participants could cause disruption in continuity of health promotion, for both research and clinical practice. Participants could, for example, seek health advice outside of their healthcare system or not attend their regular health sessions [39] due to unresolved concerns via telephone. This may thus lead into clinical interventions being highly inefficient. Thus, using mobile phones in any clinical study can inform how these devices could be used in future interventional research. Although this study found that the mobile challenges that participants face are mostly influenced by structural inequalities, it is pivotal to note that addressing and alleviating these structural inequalities is beyond the scope of this current study.

However, several possible solutions exist for the problems that were encountered in this study that could be feasible. To maximise engagement in mobile health studies, health promotion initiatives can be delivered via in-person consultations or sessions with the participants. These in-person consultations would afford participants the opportunity to get increased personal contact with the study team and to obtain study support and personalised study feedback. This is a strategy that has proved to be successful in a previous clinical trial where personalised care including allowing participants to share their personal problems and enabling participants increased contact with the study team or investigators, helped in maximising engagement [49]. This could include fieldwork to complement the use of mobile technologies and thus ensure participant retention. Secondly, advisory groups could be created by bringing together the participants and giving them an opportunity to engage in discussions around crafting possible solutions to mobile technology barriers that were identified in this study. Thirdly, automated health promotion messages could be relayed to the participants' phones particularly in instances where calls do go through but are not answered by participants.

Study Strengths and Limitations

The strength of this study was the use of a convergent-parallel mixed-methods approach which assisted in exploring the quantitative findings by relating the findings obtained from the qualitative and quantitative analysis. The use of this method thus helped in providing comprehensive insight on the mobile phone behaviours of young women and the factors that have contributed to this behaviour. A limitation of this study was that the quantitative analysis was only restricted to the first instance (i.e., first call attempt in which some young women were hard to reach, and some were easily contactable). Thus, repeat instances / call attempts for other subsequent monthly sessions were excluded. These could have provided a broader longitudinal picture of the time from randomisation up to infancy of all call attempts and whether there were any demographic characteristics that were associated with these changes. However, this was beyond the scope of this study as the focus was only on providing a descriptive profile of women who were hard to reach, while comparing their demographic profile to those who were easily contactable.

Conclusion

Despite the availability of mobile technology and network accessibility, there are substantial economic barriers that prevent young adults from fully benefitting from technology. These barriers consequently affect health promotion and behavioural change. For individuals to stay digitally connected, multiple strategies should be employed. For research, remote data collection remains an important tool in public health research and could thus serve as a hugely beneficial mechanism in connecting with participants, while actively using established relationships with participants or community-based organisations to deliver health promotion and practice. With increasing phone ownership in LMICs including South Africa, greater accessibility to less expensive or free data networks or digital platforms is needed universally across South Africa to ensure more equitable access to such technologies.

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Data Availability

The data sets generated during and/or analysed during this study are not publicly available due to the reason that the trial is still ongoing thus the data is not yet readily available for public use but are available from the corresponding author on reasonable request.

Conflicts of interest

None declared.

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Abbreviations

HELTI - Healthy Life Trajectories Initiative.

ICASA - Independent Communications Authority of South Africa.

ICT – Information Communication Technology.

LMICs - Low- and Middle-Income Countries.

NEET - Not in Education, Employment, or Training.

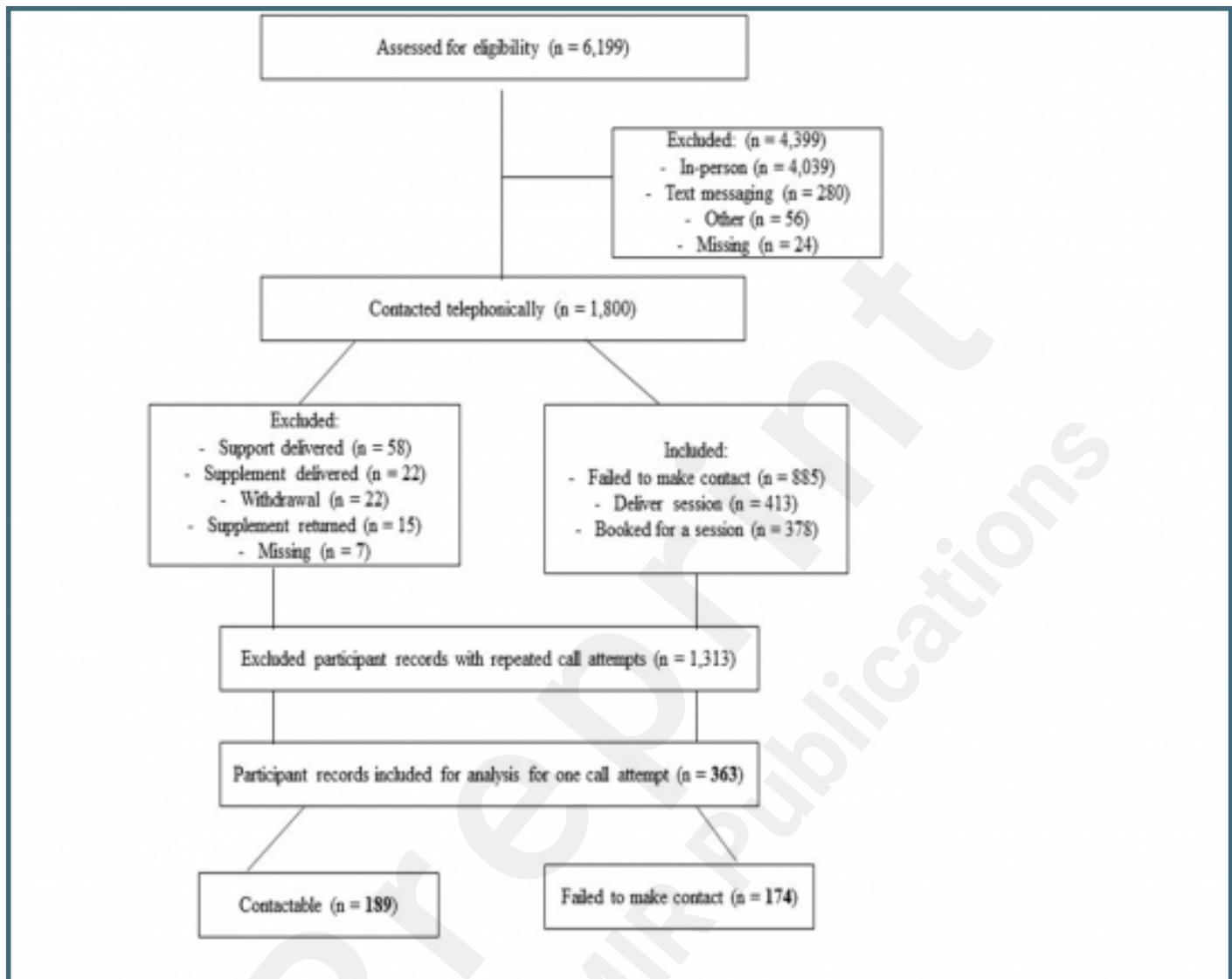
REDCap - Research Electronic Data Capture.

SMS – Short Message Service.

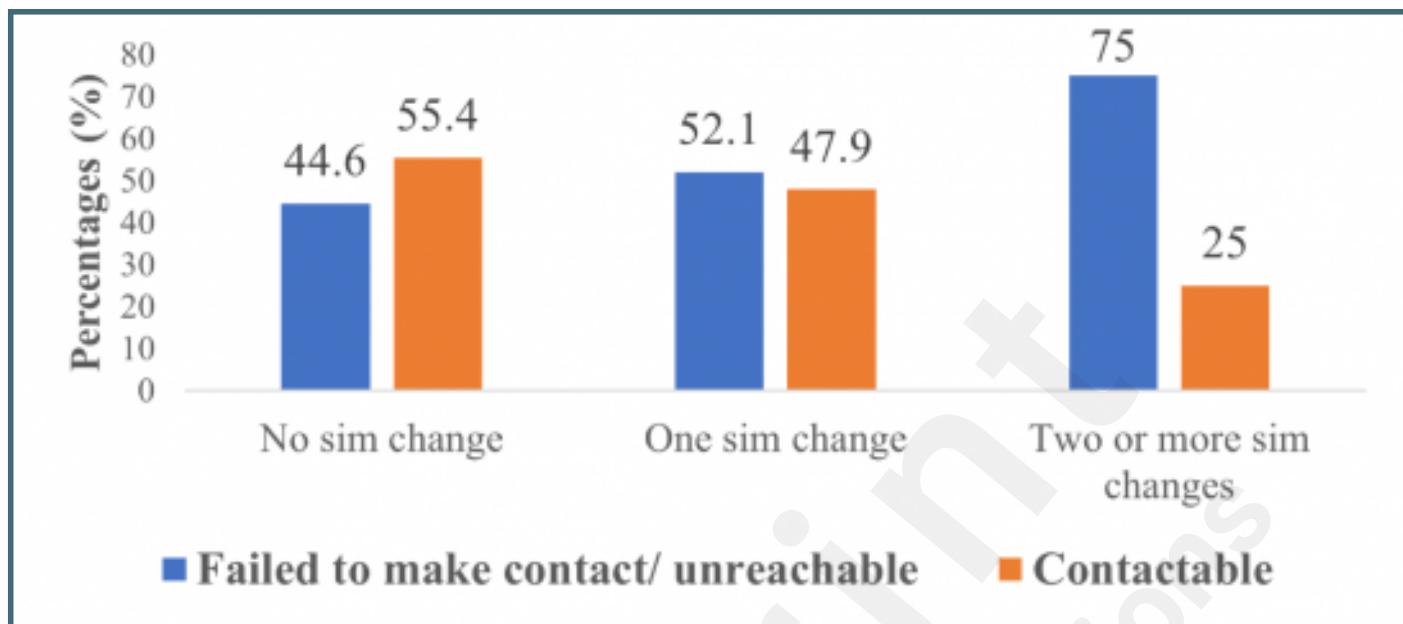
Supplementary Files

Figures

Flow Diagram of trial participants contacted telephonically between August 2019 to January 2022.



Contact status of trial participants by mobile number change.



Outcome of attempted call for participants who were unreachable.

