







High cellphone use associated with greater risk of depression among young women aged 15–24 years in Soweto and Durban, South Africa

Janan J. Dietrich ^{a,b}, Kennedy Otwombe ^a, Tatiana E. Pakhomova^c, Keith J. Horvath^d, Stefanie Hornschuh^a, Khuthadzo Hlongwane ^a, Kalysha Closson^{c,e}, Mamakiri Mulaudzi^a, Patricia Smith^c, Mags Beksinska ^f, Glenda E. Gray^{a,g}, Mark Brockman ^c, Jenni Smit ^f and Angela Kaida^c on behalf of the AYAZAZI team

^aPerinatal HIV Research Unit (PHRU), School of Clinical Medicine, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa; ^bAfrican Social Sciences Unit of Research and Evaluation (ASSURE), School of Clinical Medicine, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa and Health Systems Research Unit, South African Medical Research Council, Cape Town, South Africa; ^cFaculty of Health Sciences, Simon Fraser University, Burnaby, Canada; ^dSan Diego State University, Department of Psychology, San Diego, California, United States; ^eSchool of Population and Public Health, University of British Columbia, Vancouver, Canada; ^fMatCH Research Unit (MRU), Department of Gynaecology and Obstetrics, Faculty of Health Sciences, University of Witwatersrand, Johannesburg, South Africa; ^gOffice of the President, South African Medical Research Council, Cape Town, South Africa

ABSTRACT

Background: The ubiquity of cellular phone (cellphone) use in young people's daily lives has emerged as a priority area of concern for youth mental health.

Objective: This study measured the prevalence of depression and its association with high cellphone use among youth in Soweto and Durban, South Africa.

Methods: We analysed cross-sectional, baseline survey data among youth aged 16–24 who participated in a dual-site cohort study, 'AYAZAZI', conducted from 2014 to 2017. The primary outcome was depression using the 10-item Center for Epidemiologic Studies Depression Scale, with a score of ≥ 10 indicating probable depression. Cellphone use was measured via self-reported average number of hours of active use, with 'high cellphone use' defined as daily usage of ≥ 8 . Multivariable logistic regression models assessed the independent relationship between high cellphone use and probable depression, adjusting for potential confounders.

Results: Of 425 participants with a median age of 19 years (IQR = 18–21), 59.5% were young women. Overall, 43.3% had probable depression, with a higher prevalence among women (49.0% vs. 34.9%, $P = .004$). Nearly all (94.6%) owned a cellphone. About one-third (29.5%) reported spending ≥ 8 hours per day using their cellphone (39.3% of women vs. 14.9% of men, $P < .001$). In the overall adjusted model, youth reporting high daily cellphone use had higher odds of probable depression (aOR: 1.83, 95% CI: 1.16–2.90). In gender-stratified models, high daily cellphone use was associated with probable depression among women (aOR: 2.51, 95% CI: 1.47–4.31), but not among men (aOR: 0.87, 95% CI: 0.35–2.16).

Conclusions: Among a cohort of South African youth, we found a high prevalence of probable depression and high cellphone use (30%). The findings indicate a need for inter-sectoral initiatives focused on meaningful mental health support for South African youth to support positive growth and development.

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Background

Globally, mental health disorders account for a significant proportion of disease burden and disability among adolescents and young adults, and depression is associated with increased morbidity and suicide [1]. While most mental disorders tend to be diagnosed later in life, initial onset often occurs between 12 and 14 years of age, making adolescents and young adults a key population for mental health interventions [2]. In South African studies, reporting of significant depressive symptoms varies from 13.6% to 48% among youth [3–5]. Young women and sexual minority youth are at

a disproportionately higher risk for mental health difficulties and psychosocial stress due to experiences of elevated discrimination and negative life events, including trauma and violence [6–9]. Among a sample of South African youth living with HIV, half had experienced eight or more adverse childhood events, including emotional abuse, physical abuse, sexual abuse, witnessing domestic violence, and witnessing community violence [10]. These multiple adverse events can be contextualised within a society that is still recovering from the effects of apartheid, with those from lower socio-economic settings most adversely

CONTACT Janan J. Dietrich  dietrichj@phru.co.za  Perinatal HIV Research Unit, New Nurses Home, Chris Hani Baragwanath Academic Hospital, Chris Hani Road, Diepkloof, Soweto, 1864, South Africa

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affected [11]. Studies of South African youth show depression as a factor in increased HIV-risk behaviours [10], including reduced condom use [4], substance abuse [12] and transactional sex [3].

Globally, youth have rapidly integrated cellular phone (cellphone) use into their daily lives [13,14]. Currently, there is no universal definition for cellphone use. For the purposes of this study, cellphone use includes any measure of its use, normative or problematic, that quantifies the extent to which a person uses a phone or demonstrates dependency, irrespective of the purpose for which the phone is used [15]. In South Africa, cellphone use among young people, particularly smartphone use, has increased dramatically over the past decade and has emerged as an important area for youth health [16]. As cellphone capabilities continue to grow, allowing for constant connectivity through online communication, there has been heightened awareness of the possible connections between technology use and mental health [13,17–19]. However, cellphone use among youth in South Africa depends on their resources, including socio-economic status, cellphone ownership, and access to data or Wi-Fi [20]. Youth living in lower socio-economic settings may be more vulnerable to crime, including home and street robberies (having their phone stolen), and poorer overall access to basic needs [21,22].

Reporting of the relationship between social media use and poor mental health outcomes has been inconsistent, with no data available from South Africa. A study by Hoare et al. investigated the relationship between social media use among Australian adolescents and showed that spending ≥ 7 hours a day using the internet was associated with depression in females and psychological distress in males [18]. Although almost exclusively from Western countries and Asia, some studies have found associations between Facebook use and mental health outcomes, depression, increased stress, and lower self-esteem [23,24]. Other studies have found no associations or positive effects of Facebook use, particularly as a means of increased social connectivity, social capital growth, and increased interaction for individuals with lower self-esteem [25–28]. These data indicate that increased time using the internet is an area still requiring investigation to understand high-frequency use when compared with excessive and problematic use.

Researchers distinguish between excessive and problematic cellphone use [28–31]. Although there are at least 78 existing validated scales that measure, identify and characterise excessive or problematic smartphone use, there are currently no established standardised cut-offs to define high and/or excessive cellphone use [32]. However, factors such as age and gender play an important role in predicting excessive

cellphone use and problematic online behaviour [28]. In global studies investigating the association between technology use and mental health, results have shown that young women, who tend to engage more in social media across all age groups, have been shown to have higher rates of depression. For men, higher rates of excessive cellphone use are related to internet addiction, gaming, and accessing sexually gratifying content [29–31].

Several studies have found associations between depression, anxiety and psychological distress with time spent on the internet or cellphone ranging from one to nine or more hours per day [18,23,33–36]. A Swiss study assessing problematic cellphone use, (determined by tracking messaging volume and data traffic), found that high frequency of use associated with smartphone ownership was also linked with impaired psychological well-being, depression, and other behavioural problems [37]. A recent review of the literature on excessive smartphone use found that compulsive use of cellphones shares similarities with problematic use of other technologies, including psychological dependence, maladaptive coping, and negative mental health consequences [38]. Research on excessive and problematic cellphone use in sub-Saharan Africa and its consequences is still in its infancy, and insights into this field are limited.

To date, research on cellphone use in the South African context has focused primarily on technology uptake and cellphone-based HIV-related interventions, including their use for study recruitment, health promotion, and HIV care and prevention [39–41]. A few South African studies have investigated the use of text messages to improve adherence to mental health services [42] as well as adherence to psychotropic medication [43]. In the current global crisis of COVID-19, acquiring a better understanding of mental health and providing virtual alternatives for interventions have become crucial. Little work currently exists assessing high cellphone use and its connection to mental health outcomes among young South Africans. A 2014 study by North et al. showed some evidence of high cellphone use by South African university students and tendencies towards cellphone addiction [44]. A South African study assessing e-media use and neurocognitive outcomes was conducted among younger adolescents (9–16 years) [45]. However, more research is needed to fully understand the possible associations between cellphone use and mental health, especially among youth. There are marked disparities between existing South African studies on the relationship between cellphone use and mental health outcomes. Research conducted among youth in Soweto found differences by gender in terms of using social networking and health risks, with females reporting higher use of social networking [39,46–48]. Given these gaps, the

objective of this study was to measure the prevalence of depression and its independent association with high cellphone use among South African youth, overall and by gender.

Methods

Study design and setting

The name 'AYAZAZI' is derived from Zulu (one of South Africa's 11 official languages) – 'aya' meaning adolescents and young adults and 'zazi' meaning knowing themselves. AYAZAZI was a prospective longitudinal cohort study from November 2014 to April 2017, aimed at linking socio-behavioural, clinical and biomedical data from youth aged 16–24 years. Participants were recruited from Soweto and Durban, South Africa, and were followed for a total of 18 and 12 months, respectively, with scheduled visits every six months. Data from the baseline visit were used for the present analysis.

Soweto and Durban are densely populated South African cities in which most youth have access to cellphones [39,46], but experience high rates of unemployment and poor socio-economic status, including high food insecurity [21,49]. Previous work in Soweto indicates a high incidence of depression [4,5,7,50]. The Soweto cohort was based at the Perinatal HIV Research Unit (PHRU) located at Chris Hani Baragwanath Hospital. The Durban cohort was based at the Commercial City research site led by the MatCH Research Unit (MRU). Study inclusion criteria were 16–24 years of age, residing in Soweto or Durban, self-reporting an HIV-negative or unknown HIV status, and being willing and able to provide voluntary written informed consent for study procedures. Exclusion criteria included current participation in another clinical or observational HIV prevention study, lack of parental consent for candidates below 18 years, and an inability to provide informed consent. At both sites, a community outreach strategy was used to recruit participants, by using posters, pamphlets and word-of-mouth. In Soweto, participants were also recruited through the PHRU's HIV Counselling and Testing Clinic and in Durban, participants were also approached through a nearby public sector reproductive health clinic. Additional details about the study have been published elsewhere [51].

Measures

Questionnaire

Trained youth interviewers administered a structured online questionnaire (supported by DataFAX™ software) at baseline. Questionnaires were delivered in

English, isiZulu, or Sesotho in Soweto and in English or isiZulu in Durban, according to each participant's preference. Questionnaires were designed in English with input from the adolescent community advisory boards. Thereafter, questionnaires were translated into isiZulu and Sesotho by a local translation company and reviewed by the adolescent community advisory boards. Questionnaires took approximately 60 minutes to complete.

Main outcome

Depression was assessed using the 10-item Center for Epidemiologic Studies Short Depression Scale (CES-D-10) [52], a depression screening tool validated in South Africa [53], and demonstrated an acceptable Cronbach's alpha score ($\alpha = 0.71$) in our study sample [54]. Each item assesses a dimension of mood over the past seven days with a four-point Likert response scale (less than a day, 1–2 days, 3–4 days, 5–7 days). Probable depression is defined as a cut-off score of ≥ 10 [53].

Main exposure

The exposure of interest was high cellphone usage. We asked participants whether they owned a cellphone (yes vs. no) and, if they answered yes, what activities they used it for. Participants could select from the multiple options: general communication (including sending and receiving SMSes); making phone calls and e-mail; mobile entertainment (including listening to music/radio, playing games, and accessing the internet and YouTube; Mxit, Facebook, Twitter, WhatsApp, BBM, We Chat, Instagram, 2Go); for emergencies only; cellphone banking, and an 'other' option. We then asked participants, 'How much time in a day do you spend actively using a cellphone? This includes listening to music/radio, SMS, making phone calls, playing games and accessing the internet.' Response options were: 0–1 hours, 2–4 hours, 5–7 hours and ≥ 8 hours per day. 'High cellphone use' was based on these categories already used in the survey and defined as active daily usage ≥ 8 hours in comparison with < 8 hours. Participants were asked additional questions about their cellphone use, including: 'How do you get airtime? (prepaid and contract)'; and 'Who pays for the prepaid/contract airtime?'

Internet access and usage were assessed through the following questions, which were analysed separately: 'In the past 6 months, have you had access to the internet?' and 'When you are on the internet, what do you do or search for?' For the latter question, participants selected all options given: downloading music and videos, research for school projects, looking up health information, looking up information about sex, apps, dating sites, getting

directions to places (GPS – global positioning system) and looking at maps, finding out about parties/DJ events, internet banking, using social media sites, software, e-mail, selling and buying sites, and other.

These variables were: selected based on known relationships with depression and cellphone use [9,39,46,49]. study site (Soweto or Durban); self-identified gender (man, woman or other); sexual orientation (heterosexual, lesbian, gay, bisexual, transgender, queer or questioning); housing (formal [brick house, townhouse, flat/apartment] vs, reconstruction development program (RDP) house, shack [informal settlement], or shack [backyard]); female-headed household (yes vs. no); median quartile 1–quartile 3 (Q1–Q3) number of adults in the home; median Q1–Q3 number of children in the home; income in the past 3 months (1–400 ZAR, 401–800 ZAR, 801–1 600 ZAR, 1 601–3 200 ZAR, $\geq 3 201$ ZAR); number of people financially dependent on participant (none vs. ≥ 1); currently enrolled in any school (no vs. yes), and had ever had consensual sexual intercourse, which included oral, vaginal and/or anal sex; consensual sex was defined as both partners having agreed to have sexual intercourse.

Statistical analyses

We first used descriptive statistics to summarise the sample. Continuous measures were summarised descriptively using the medians, Q1–Q3 already defined. Frequencies and percentages were determined for categorical variables. Next, we assessed the associations between depressive symptoms and socio-demographics and cellphone use, stratified by gender. Both continuous and categorical variables were stratified by gender and symptoms of probable depression (yes vs. no). To test for statistical significance for categorical measures stratified by gender and probable depression, Pearson's chi-square analysis or Fisher's exact test was used. The medians and interquartile range (IQR) were compared between groups using the Kruskal-Wallis test.

We dichotomised the exposure variable into high (≥ 8 hours) and low (< 8 hours). Using crude and adjusted logistic regression analyses overall and by gender, we assessed the independent association between high cellphone use and depressive symptoms, controlling for potential confounding. Variables with a p -value ≤ 0.2 at univariate level thought to be explanatory variables based on

Table 1. Baseline characteristics among male and female participants of AYAZAZI in South Africa.

Variables	Overall (n = 425)	Young women (n = 253)	Young men (n = 172)	P-value
Site				
Durban (%)	220 (51.8)	132 (52.2)	88 (51.2)	0.84
Soweto (%)	205 (48.2)	121 (47.8)	84 (48.8)	
Age group (in years)				
16–20 (%)	315 (74.1)	189 (74.7)	126 (73.3)	0.74
21–24 (%)	110 (25.9)	64 (25.3)	46 (26.7)	
Median age [IQR]	19.0 [18.0–21]	19.0 [17.0–21]	19.0 [18.0–21]	0.77
Sexual orientation^a				
Heterosexual (%)	395 (93.2)	235 (92.9)	160 (93.6)	0.79
LGBTQI (%)	29 (6.8)	18 (7.1)	11 (6.4)	
Main home language				
IsiZulu (%)	310 (72.9)	181 (71.5)	129 (75.0)	0.43
Other (%)	115 (27.1)	72 (28.5)	43 (25.0)	
Type of housing				
Formal housing (%)	301 (70.8)	165 (65.2)	136 (79.1)	0.002
Other (%)	124 (29.2)	88 (34.8)	36 (20.9)	
Head of household^b				
Female (%)	259 (60.9)	164 (64.8)	95 (55.2)	0.047
Other (%)	166 (39.1)	89 (35.2)	77 (44.8)	
Monthly personal income (ZAR)				
None–1600 (%)	328 (77.2)	204 (80.6)	124 (72.1)	0.04
1601–More (%)	97 (22.8)	49 (19.4)	48 (27.9)	
Median number of adults in the household (IQR)	3.0 (2.0–4.0)	3.0 (2.0–4.0)	3.0 (2.0–4.0)	0.49
Median number of children in the household (IQR)	2.0 (0–3.0)	2.0 (1.0–3.0)	1.0 (0.0–2.0)	0.003
Currently a student?				
No (%)	121 (28.5)	71 (28.2)	50 (29.1)	0.84
Yes (%)	303 (71.5)	181 (71.8)	122 (70.9)	
Number of persons financially depending on participant				
0 (%)	303 (71.3)	174 (68.8)	129 (75.0)	0.16
≥ 1 (%)	122 (28.7)	79 (31.2)	43 (25.0)	
Ever had consensual sex				
No (%)	63 (14.9)	46 (18.2)	17 (9.9)	0.02
Yes (%)	361 (85.1)	207 (81.8)	154 (90.1)	

P-values that are italicized are statistically significant at the 0.05 level.

^aLGBTQ: Lesbian, gay, bisexual, transgender, queer or questioning

^bOther is defined as Male adult, Male child, Male child < 18 years, more than 1 person, Me (participant), and don't know

Table 2. Cellphone usage among young male and female participants of AYAZAZI.

Variables	Overall (n = 425)	Young women (n = 253)	Young men (n = 172)	P-value
Do you have your own cellphone?				
No (%)	23 (5.4)	9 (3.6)	14 (8.1)	<i>0.04</i>
Yes (%)	402 (94.6)	244 (96.4)	158 (91.9)	
What do you use the cellphone for?				
General communication (%)	410 (97.2)	248 (98.4)	162 (95.3)	0.06
Mobile entertainment (%)	388 (91.9)	235 (93.3)	153 (90.0)	0.22
Facebook (%)	300 (71.1)	184 (73.0)	116 (68.2)	0.29
Twitter (%)	79 (18.7)	37 (14.7)	42 (24.7)	0.01
WhatsApp (%)	327 (77.5)	200 (79.4)	127 (74.7)	0.26
Instagram (%)	58 (13.7)	26 (10.3)	32 (18.8)	0.01
Amount of time in a day spent actively using a cellphone				
< 8 Hours (%)	296 (70.5)	153 (60.7)	143 (85.1)	<0.001
≥ 8 Hours (%)	124 (29.5)	99 (39.3)	25 (14.9)	
How do you get airtime?				
Contract (%)	10 (2.4)	5 (2.0)	5 (2.9)	0.53
Prepaid (%)	412 (97.6)	247 (98.0)	165 (97.1)	
Who pays for the prepaid?				
Participant (%)	292 (71.2)	158 (64.0)	134 (82.2)	<0.001
Other (%)	118 (28.8)	89 (36.0)	29 (17.8)	
Do you have access to the internet?				
No (%)	45 (10.6)	28 (11.1)	17 (9.9)	0.76
Yes (%)	380 (89.4)	225 (88.9)	155 (90.1)	
When you are on the internet what do you do or search for?				
Download music and videos (%)	214 (50.7)	93 (36.9)	121 (71.2)	<0.001
Research for school projects (%)	247 (58.5)	141 (56.0)	106 (62.4)	0.19
Look up information about health (%)	97 (23.0)	51 (20.2)	46 (27.1)	0.10
Search for information about sex (%)	51 (12.1)	21 (8.3)	30 (17.7)	0.004
Apps (%)	226 (53.6)	157 (62.3)	69 (40.6)	<0.001

P-values that are italicized are statistically significant at the 0.05 level.

a priori knowledge were included in the full multivariable model. Thereafter, a backward selection procedure was used to determine the final model with the lowest Akaike information criterion (AIC). The Hosmer-Lemeshow statistic was used to measure model diagnostics/fit in the final multivariate model. Regression results are presented as Odds Ratio (OR) in the univariate and adjusted OR (aOR) in the final multivariate model. All statistical analysis was conducted in SAS Enterprise Guide 7.1 (SAS Institute, Cary, NC) using SAS/STAT procedures PROC FREQ, PROC NPARIWAY and PROC LOGISTIC.

Ethical considerations

The AYAZAZI study was approved by the University of the Witwatersrand, Johannesburg, South Africa, and Simon Fraser University, Burnaby, Canada. Written informed consent was obtained for participants 18 years and older. Written assent was obtained from minors younger than 18 years, together with written informed consent from a parent or legal guardian. Participants received a 150 ZAR (~\$12 USD) reimbursement per scheduled visit to compensate for transportation and time.

Results

Demographic characteristics by gender

Of the 425 participants included in this analysis, 59.3% (n = 253) were women (Table 1). Most

participants were 16–20 years old (74.1%, n = 315/425), heterosexual (93.2%, n = 395/424), living in formal housing (70.8%, n = 301/425), receiving an average income of less than 1600ZAR (77.2%, n = 328/425), currently students (71.5%, n = 303/424). Most had no dependents (71.3%, n = 303/425) and the majority had had sex in their lifetime (85.1%, n = 361/424).

Relative to men, women were more likely to receive an average income of ≤1600ZAR (80.6% vs. 72.1%; *P* = .04). Conversely, men were more likely than women to live in formal housing (79.1% vs. 65.2%; *P* = .002) and have had consensual (oral, vaginal or anal) sex (90.1% vs. 81.8%; *P* = .02).

Cellphone use

Of the 425 participants, 94.6% (n = 402) owned a cellphone. Those with access used cellphones for general communication (97.2%, n = 410/422), mobile entertainment (91.9%, n = 388/422), WhatsApp (77.5%, n = 327/422), Facebook (71.1%, n = 300/422), Twitter (18.7%, n = 79/422) and Instagram (13.7%, n = 58/422). Most received airtime on prepaid (97.6%, n = 412/422) and paid for their own airtime (71.2%, n = 292/410). A significantly higher proportion of women than men owned a cellphone (96.4% vs. 91.9%; *P* = .04) and spent ≥8 hours using their cellphone daily (39.3% vs. 14.9%; *P* < .001). In the preceding six months all participants had used

their cellphones primarily to search for apps on the internet (62.3% vs. 40.6%; $P < .001$) (Table 2). Relative to women, men were more likely to use Twitter (24.7% vs. 14.7%; $P = .01$), Instagram (18.8% vs. 10.3%; $P = .01$), to pay for their own prepaid airtime (82.2% vs. 64.0%; $P < .001$), download music and videos (71.2% vs. 36.9%; $P < .001$) and search for information about sex using their phones (17.7% vs. 8.3%; $P = .004$).

Depression by demographic characteristics and use of technology

Just under half (43.3%; $n = 184/425$) had probable depression based on their CES-D-10 scores. Women were more likely to have probable depression than men (49.0% vs. 34.9%; $P = .004$). Youth with probable depression were likely to: spend ≥ 8 hours using a cellphone daily (55.7% vs. 38.2%, $P = .001$); receive an average income of more than 1600ZAR (55.7% vs. 39.6%; $P = .005$); have at least one dependent (54.9% vs. 38.6%; $P = .002$); and search for apps in the past 6 months (48.2% vs. 37.2%; $P = .02$) (Table 3). A higher proportion of youth with probable depression reported the use of Instagram than youth who did not have probable depression (45.1% vs. 31.0%, $P = .045$).

Overall logistic regression model for probable depression

In the multivariate model (Table 4), spending ≥ 8 hours using a cellphone daily (aOR: 1.83, 95% CI: 1.159–2.90; $P = .01$) was independently associated with probable depression. In addition, probable depression was significantly associated with: being a woman (aOR: 1.591, 95% CI: 1.032–2.454; $P = .04$), earning an average income of at least 1601ZAR (aOR: 1.726, 95% CI: 1.046–2.849, $P = .03$) and having one or more financial dependents (aOR: 1.712, 95% CI: 1.070–2.741; $P = .03$). Model fit was assessed using the Hosmer-Lemeshow goodness-of-fit statistic that indicated a good fit ($P = 0.51$).

Logistic regression models by gender for probable depression

In young women, probable depression was associated with spending ≥ 8 hours using a cellphone daily (aOR: 2.514, 95% CI: 1.465–4.313; $P = .001$), earning an average of more than 1601ZAR (aOR: 2.213, 95% CI: 1.108–4.420; $P = .02$) and having at least one financial dependent (aOR: 1.893, 95% CI: 1.046–3.426; $P = .03$). Model fit for women suggested a good fit under the Hosmer-Lemeshow statistics ($P = .96$) (Table 5). Unadjusted and

adjusted results for men found no significant associations.

Discussion

Our study examined the relationship between cellphone use and probable depression among South African youth. Of concern is that nearly half of the sample met the CES-D-10 criteria for having significant depressive symptoms or probable depression, with a higher prevalence of probable depression among young women than young men. Cellphone ownership and high cellphone use were significantly higher in young women. High cellphone use was independently associated with probable depression among women but not among men.

Our study contributes to a better understanding of depression post-apartheid in marginalised youth [55]. However, a comparison with previous South African studies on depression in youth is complex as different scales are used to measure depression; even when using the CESD-10, studies may use different cut-off scores [3]. Nonetheless, our results confirm a high proportion of youth with probable depression, which corroborates the results of previous research among adults that reported that living in an adverse (poorer) neighbourhood and being unemployed were independently associated with depression as measured by the CES-D-10 [56].

Nearly all participants in our study owned a cellphone, which is consistent with national cellphone ownership data among adults in South Africa [57] and previous research with youth in Soweto [46]. The continuously rising cellphone penetration rates among South African youth, including increased access and use of smartphones [58], provides a promising entryway for delivering mental health interventions tailored to individual needs. Our data suggest that technology-based depression interventions should be prioritised for young women since they seem to exhibit higher levels of depression and use their cellphones throughout the day. The findings are consistent with previous research on depression and cellphone use among youth in Soweto [4,39,46]. Cellphone-based health interventions show promise in improving public health outcomes [59,60], but it is still unclear how these are implemented. Their effectiveness among young populations in resource-limited settings such as South Africa requires investigation. The findings from this study provide an opportunity for future directed research in designing a cellphone-based mental health intervention for South African youth.

We did not find a direct association between general social network usage and probable depression in participants. In bivariate analyses, young people who

Table 3. Depression by demographic and cellphone use co-variables.

Variables	Overall (n = 425)	Probable depression (n = 184)	Not Depressed (n = 241)	P value
Site				
Durban (%)	220 (51.8)	95 (43.2)	125 (56.8)	0.96
Soweto (%)	205 (48.2)	89 (43.4)	116 (56.6)	
Gender				
Women (%)	253 (59.5)	124 (49.0)	129 (51.0)	0.004
Men (%)	172 (40.5)	60 (34.9)	112 (65.1)	
Age group (in years)				
16–20 (%)	315 (74.1)	133 (42.2)	182 (57.8)	0.45
21–24 (%)	110 (25.9)	51 (46.4)	59 (53.6)	
Sexual orientation ^c				
Heterosexual (%)	395 (93.2)	169 (42.8)	226 (57.2)	0.35
LGBTQ (%)	29 (6.8)	15 (51.7)	14 (48.3)	
Main home language				
IsiZulu (%)	310 (72.9)	134 (43.2)	176 (56.8)	0.96
Other (%)	115 (27.1)	50 (43.5)	65 (56.5)	
Type of housing				
Formal Housing (%)	301 (70.8)	129 (42.9)	172 (57.1)	0.78
Other (%)	124 (29.2)	55 (44.4)	69 (55.6)	
Head of household				
Female (%)	259 (60.9)	115 (44.4)	144 (55.6)	0.56
Other (%)	166 (39.1)	69 (41.6)	97 (58.4)	
Average own income (In Rand)				
None–1600 (%)	328 (77.2)	130 (39.6)	198 (60.4)	0.005
1601–More (%)	97 (22.8)	54 (55.7)	43 (44.3)	
Currently a student?				
No (%)	121 (28.5)	61 (50.4)	60 (49.6)	0.06
Yes (%)	303 (71.5)	122 (40.3)	181 (59.7)	
Number of persons financially depending on participant				
<1 (%)	303 (71.3)	117 (38.6)	186 (61.4)	0.002
≥1 (%)	122 (28.7)	67 (54.9)	55 (45.1)	
Ever had consensual sex				
No (%)	63 (14.9)	25 (39.7)	38 (60.3)	0.52
Yes (%)	361 (85.1)	159 (44.0)	202 (56.0)	
Do you have your own cellphone?				
No (%)	23 (5.4)	7 (30.4)	16 (69.6)	0.20
Yes (%)	402 (94.6)	177 (44.0)	225 (56.0)	
What do you use the cellphone for:				
General Communication (%)	410 (97.2)	178 (43.4)	232 (56.6)	0.49
Mobile Entertainment (%)	388 (91.9)	172 (44.3)	216 (55.7)	0.09
Facebook (%)	300 (71.1)	135 (45.0)	165 (55.0)	0.22
Twitter (%)	79 (18.7)	34 (43.0)	45 (57.0)	0.99
WhatsApp (%)	327 (77.5)	145 (44.3)	182 (55.7)	0.35
Instagram (%)	58 (13.7)	18 (31.0)	40 (69.0)	0.045
Amount of time in a day spent actively using a cellphone				
< 8 Hours (%)	296 (70.5)	113 (38.2)	183 (61.8)	0.001
≥ 8 Hours (%)	124 (29.5)	69 (55.7)	55 (44.3)	
How do you get airtime?				
Contract (%)	10 (2.4)	6 (60.0)	4 (40.0)	0.28
Prepaid (%)	412 (97.6)	176 (42.7)	236 (57.3)	
Who pays for the prepaid?				
Participant (%)	292 (71.2)	121 (41.4)	171 (58.6)	0.42
Other (%)	118 (28.8)	54 (45.8)	64 (54.2)	
Do you have access to the internet?				
No (%)	45 (10.6)	19 (42.2)	26 (57.8)	0.88
Yes (%)	380 (89.4)	165 (43.2)	215 (56.8)	
When you are on the internet what do you do or search for?				
Download music and videos (%)	214 (50.7)	86 (40.2)	128 (59.8)	0.22
Research for school projects (%)	247 (58.5)	104 (42.1)	143 (57.9)	0.61
To find information about health (%)	97 (23.0)	37 (38.1)	60 (61.9)	0.26
To find information about sex (%)	51 (12.1)	24 (47.1)	27 (52.9)	0.55
Apps (%)	226 (53.6)	109 (48.2)	117 (51.8)	0.02

^aLGBTQ: Lesbian, gay, bisexual, transgender, queer or questioning

used Instagram were less likely to be depressed or it could be that those with a higher socio-economic status were able to download and use Instagram. A 2015 study by Lup and Rosenthal found that although Instagram was associated with depression, the relationship with depression was tied to social comparison and following strangers, whereas positive associations were observed when individuals followed family and friends [61]. Although we did not collect

data on the nature of social media usage, there are likely to be multiple contributing factors which influence negative experiences with technology, and there is some evidence that personality constructs, gender, self-esteem, and social behaviours play an important role in determining problematic and excessive social media usage [27,28].

Our study found that participants with probable depression were less likely to use their phones to

Table 4. Unadjusted and adjusted odds ratios (95% confidence intervals (CI)) of variables associated with probable depression among young men and women overall, South Africa (n = 419).

Variables	Unadjusted		Adjusted	
	OR 95% (CI)	P-value	OR 95% (CI)	P-value
Primary exposure				
Amount of time in a day spent actively using a cellphone				
≥ 8 hours vs < 8 hours	2.03 (1.33–3.11)	0.01	<i>1.83 (1.16–2.90)</i>	<i>0.01</i>
Potential Confounders				
Site				
Soweto vs Durban	1.01 (0.69–1.48)	0.96	-	-
Gender				
Women vs. Men	1.79 (1.20–2.67)	0.004	<i>1.59 (1.03–2.45)</i>	<i>0.04</i>
Age group (in years)				
21–24 vs 16–20	1.18 (0.77–1.83)	0.45	-	-
Sexual orientation^d				
LGBTQ vs heterosexual	1.43 (0.67–3.05)	0.35	-	-
Type of housing				
Other vs formal housing	1.06 (0.70–1.62)	0.78	-	-
Head of household				
Female vs. Other	1.12 (0.76–1.67)	0.57	-	-
Average own income (in Rand)				
1601–More vs None–1600	1.91 (1.21–3.02)	0.006	<i>1.73 (1.05–2.85)</i>	<i>0.03</i>
Are you a student				
No vs Yes	1.51 (0.99–2.3)	0.06	1.09 (0.68–1.74)	0.72
Number of persons financially depending on participant				
≥1 vs 0	1.94 (1.27–2.96)	0.002	<i>1.71 (1.07–2.74)</i>	<i>0.03</i>
Ever had consensual sex				
Yes vs No	1.25 (0.69–2.07)	0.52	-	-
Do you have your own cell phone?				
Yes vs No	1.88 (0.72–4.47)	0.21	1.78 (0.58–5.80)	0.33

^dLGBTQ: Lesbian, gay, bisexual, transgender, queer or questioning. The italicized ORs are significant as they do not contain the null.

download and use apps. In addition, socio-demographic factors may influence the association between high cellphone use and mental health and may be applicable only to South African youth who can afford to pay for enough data to download apps and spend extended periods on their phones. In South African adults, depression is directly associated with limited material wealth [62]. Our data indicate that higher income is associated with poorer mental health outcomes. However, within the context of this study, higher income was still below a living wage in South Africa [63]. We can assume that participants did not have access to sufficient financial resources to meet their basic needs. Unfortunately, income is a difficult variable to modify, and youth may have had even more data restrictions and loss of income due to the impact of the COVID-19 pandemic and stay-at-home measures. Certainly, a more nuanced understanding is required to explore how cellphone use, particularly smartphone functionalities, could be leveraged for mental health support in youth, and in particular during times where stay-at-home orders are recommended.

Limitations

A limitation of this paper is that we did not include a validated scale to measure high cellphone usage, indicating a need to investigate the threshold at which cellphone use is deemed excessive in South African populations. As the analysis used cross-sectional data, the direction of effect between depression and excessive

cellphone use cannot be determined. However, our regression analysis does provide some guidance about the direction that we investigated. For our study, the dependent or exposure variable was frequency of daily cellphone use.

Having surveyed individuals in a predominantly lower socio-economic area who probably experienced limitations in data access also affected our assessment of excessive usage, including social media, and thus may not be representative of the general population. However, nearly one-third of participants reported using their phones for ≥8 hours a day indicating some accessibility to cellphone usage despite socio-economic status. Future research should explore the association between increased screen time as well as problematic use, resilience and coping, as a means to better understand the high levels of dependency on cellphone technology in young South Africans.

Conclusion

Our study found high prevalence of depressive symptoms and high cellphone use in youth, with high cellphone use associated with probable depression in women but not in men. The high proportion of participants reporting significant symptoms of depression indicates a need for intersectoral initiatives focused on meaningful mental health support for youth living in vulnerable communities, to support positive growth and development.

Table 5. Crude and adjusted logistic regression models examining associations between high cellphone use and depressive symptoms among young women and young men participating in baseline AYAZAZI survey (n = 420).

Variables	Women (n = 252)			Men (n = 168)		
	Univariate OR 95% (CI)	P-value	Multivariate OR 95% (CI)	Univariate Adjusted OR 95% (CI)	P-value	Multivariate Adjusted OR 95% (CI)
Amount of time in a day spent actively using a cell phone						
< 8 hours	(ref)	-	-	(ref)	-	-
≥ 8 hours	2.29 (1.37–3.85)	.002	2.51 (1.45–4.31)	0.88 (0.35–2.17)	.77	0.87 (0.35–2.16)
Potential confounders						
Site						
Durban	1.02 (0.62–1.67)	.94	-	0.93 (0.50–1.74)	.82	-
Soweto	(ref)	-	-	(ref)	-	-
Age group (in years)						
16–20	(ref)	-	-	(ref)	-	-
21–24	1.25 (0.71–2.20)	.45	-	1.13 (0.56–2.29)	.73	-
Sexual orientation^e						
LGBTQ	1.70 (0.64–4.53)	.29	-	1.06 (0.30–3.78)	.93	-
Heterosexual	(ref)	-	-	(ref)	-	-
Type of housing						
Formal housing	1.16 (0.69–1.95)	.57	-	0.80 (0.377–1.72)	.57	-
Other	(ref)	-	-	(ref)	-	-
Head of household						
Female	0.91 (0.54–1.52)	.72	-	1.35 (0.71–2.55)	.36	-
Other	(ref)	-	-	(ref)	-	-
Average own income (In Rand)						
None–1600	(ref)	-	-	(ref)	-	-
1601–More	2.56 (1.33–4.94)	.005	2.21 (1.11–4.42)	1.70 (0.86–3.36)	.13	1.39 (0.66–2.94)
Are you a student						
No	2.29 (1.30–4.02)	.004	-	0.83 (0.41–1.68)	.61	-
Yes	(ref)	-	-	(ref)	-	-
Number of persons financially depending on participant						
<1	(ref)	-	-	(ref)	-	-
≥1	2.00 (1.16–3.43)	.01	1.89 (1.05–3.43)	1.70 (0.84–3.45)	.14	1.48 (0.68–3.2)
Ever had consensual sex						
No	(ref)	-	-	(ref)	-	-
Yes	1.83 (0.95–3.5)	.07	1.31 (0.64–2.67)	0.57 (0.21–1.57)	.28	-
Do you have your own cell phone?						
No	(ref)	-	-	(ref)	-	-
Yes	8.13 (1.00–66.01)	.049	-	0.69 (0.23–2.10)	.52	-

^eLGBTQ: Lesbian, gay, bisexual, transgender, queer or questioning. P-values that are italicized are statistically significant at the 0.05 level.

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Disclosure Statement

All authors declare that they have no competing interests. The views put forward in this article are based on a thorough consultation process. The views expressed in this paper are the collective views of the authors.

Ethics and consent

The AYAZAZI study was approved by the University of the Witwatersrand, Johannesburg, South Africa, and Simon Fraser University, Burnaby, Canada. Written informed consent was obtained for participants 18 years and older. Written assent was obtained from minors younger than 18 years, together with written informed consent from a parent or legal guardian. Participants received a 150 ZAR (~\$12 USD) reimbursement per scheduled visit to compensate for transportation and time.

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Paper context

This research found high prevalence of probable depression and high cellphone use in a youth cohort from Soweto and Durban, South Africa, with high cellphone use associated with probable depression in women but not in men. The high proportion of participants reporting significant symptoms of depression indicates a need for public health initiatives focused on meaningful mental health support for youth living in vulnerable communities, to support positive growth and development.

Author contributions

JJD conceptualised the area of study for this paper and received guidance from KJH, AK and KC in terms of data analyses and design. JJD and SH were responsible for data collection at PHRU, and MB and JS were responsible for data collection at MRU. PS was responsible for overall data co-ordination. KO and KH conducted the data analyses. JJD, KJH, AK and KC contributed to data interpretation. All authors contributed to writing and preparing the final version.

ORCID

Janan J. Dietrich  <http://orcid.org/0000-0002-1949-3138>
Kennedy Otjombe  <http://orcid.org/0000-0002-7433-4383>

Khuthadzo Hlongwane  <http://orcid.org/0000-0002-0882-9599>

Mags Beksinska  <http://orcid.org/0000-0002-4169-4112>

Mark Brockman  <http://orcid.org/0000-0001-6432-1426>

Jenni Smit  <http://orcid.org/0000-0002-5337-5995>

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