

ORIGINAL PAPER

Health Implications of Smartphone Addiction among Students of University of Lusaka, Zambia

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Abstract

Background: With smartphones growing to be an integral part of modern life, an overuse of smartphone has become epidemic around the world. It negatively affects people's life with profound implications on mental, physical, and social health and well-being. It is important to bring the public's awareness of this growing public health problem. This study sought to explore whether smartphone addiction is present among students at the University of Lusaka. **Subjects and Method:** This study was a mixed methods utilizing a sequential explanatory. The quantitative part established the levels of smartphone addiction using a smartphone addiction scale. Qualitatively a case study was employed to explore the health implications of those addicted. A total sample of 111 students was enrolled from the University of Lusaka. The data was collected using a Smartphone Addiction Scale- Short Version tool and a Depression Anxiety Stress Questionnaire. Data was analyzed using STATA version 14. Multiple linear regression was done to evaluate various interactions of depression, anxiety and or stress, and smartphone addiction. Qualitative data was analyzed using a thematic analysis. **Results:** 60.6% of the respondents were found to be addicted to their smartphones, 37.9% and 22.7% of them being moderately and severely addicted respectively. There was a moderate negative correlation between age and smartphone addiction ($r = -0.309$, $p = 0.016$). Smartphone addiction was found to be a strong predictor of depression ($r = 0.47$, $p = 0.001$), Anxiety ($r = 0.399$, $p = 0.001$), and Stress ($r = 0.504$, $p < 0.001$). **Conclusion:** An initiative of stress, anxiety and depression management programs should be introduced at universities in addition to the implementation of recreational and outreach health promotion programs that educate the public on the negative impacts of smartphone addiction on their health.

Keywords: Smartphone addiction, Health Implication, Smartphone Addiction Scale, Depression, Anxiety, Stress Scale Questionnaire

Background

Smart phone addiction among university students accounts for 20.5% of adult smartphone addicts in the world. University students are a large consumer of smartphone services and they are able to use smartphones freely regardless of time and space. They are a vulnerable target market for smartphone company producers due to the almost vital role that smartphones have come to play in their lives with information necessary for their studies at the tip of their hands, smartphones are able to facilitate learning due to easy and affordable internet access as well as the multitude of applications encompassed in them [1]. A large following on social networking sites leads to popularity amongst students, this in turn can boost one's confidence and self-esteem resulting in students heavily relying on their smartphones [2].

The competition among smartphone production companies to produce smartphones at affordable prices with advanced applications and desirable aesthetics has increased the likelihood of smartphone addiction among University students [3]. Smartphone manufacturers offer users a multitude of mobile phones to choose from often highlighting how their product improves the user's life in addition aggressive smartphone advertising and brand loyalty have all contributed to smartphone addiction [4]. The number of smartphone users is forecast to reach 2.1 billion, i.e. from 2014 to 2020 with the number of mobile phone users set to reach the 2.87 billion mark worldwide by 2019 [5]. In Zambia, only 13.5% of the individuals that own mobile phones have smartphones with the majority predominantly residing in urban areas i.e. 18.4% of all individuals that own phones in urban areas compared to 6.5% of individuals

that own mobile phones in rural areas. In the medical field smartphone addiction is slowly being recognized and accepted as a health condition [6]. Recent research studies have shown that smartphone addiction negatively affects brain functioning i.e. a convergence between smartphone addiction and emotional as well as psychological wellbeing has been shown.

According to the American Psychiatric Association [7], smartphone addiction is defined as a behavioral type of addiction as opposed to substance addiction like alcohol or drug addiction. Smartphone addiction is known to stem from internet addiction, where internet addiction is defined as an excessive and uncontrollable way in which individuals spend time online [8]. Behavioral addiction be understood to be a disorder characterized by behavior which ordinarily leads to feelings of pleasure and also normally relieves the emotions/feelings of stress and pain. Normally, this goes hand in hand with a person's lack of control of this behavior. This is notwithstanding the adverse consequences of such behavior [9].

According to Mohril, [10] excessive use of smartphones can be detrimental to health most notably physical effects like neck, wrist and joint pain, auditory and visual problems brought on by exposure to rays and wireless waves. In addition to visual problems other prominent negative health effects of smartphone addiction are brain cancer caused by the rays and waves emitted by smartphones, headaches/ migraines, fatigue and sleep disorders (Aljomaa, [3]. Another health concern has been broached by Lim *et al.*, [11] this being the occurrence of accidents due to smartphone usage of users whilst driving. Kim *et al.*, (2018) [12] study findings strongly support this concern, the authors found that smartphone addiction had a strong association with road traffic

accidents and they provided a recommendation of the need for increased awareness of the risk of accidents with smartphone addiction. With regard to the psychological aspects mentioned above, the positive associations of smartphone addiction with depression and anxiety have been extensively reported [12]. Akashe *et al.*, [13] gives relevance to these reports by proving that smartphone addiction has a positive correlation between smartphone addiction and depression and anxiety.

A number of studies have identified several factors that influence smartphone addiction [14]. Some studies have purported that parent's education play a role in smartphone addiction among users [2]. Majority of parents believe smartphones are a positive educational tool and according to Zulkefly, [15], parents educational level is positively related to the monthly phone expenditure of university students in Malaysia. However, Ahn [16], found no direct relationship between parent's education and smartphone addiction. A few studies have examined the relationship between Smartphone addiction and students' field of study, nevertheless, [17] Abu-Jedy, was able to determine a significant difference in smartphone addiction among humanities students of a higher education in comparison to natural science students. He found that the humanities students had a higher level of smartphone addiction. He also hypothesized that university students attending private institutions had a higher level of smartphone addiction as compared to those that attended public universities. A topic that draws a lot of interest from researchers is how gender and smartphone addictions interact. [18]. However, despite gender differences being recognized as playing an influential role towards smartphone addiction, there has little consensus regarding what people group is most affected [19]. According to

Barashdi, [2] family income level is an important predictor of smartphone use, thus providing an opportunity for users to become addicted.

According to Demirci, [20] there are several negative health effects of smartphone addiction that have continued to emerge e.g. low self-esteem and poor social relationships are associated with majority of smartphone addicts, anxiety, irritability, insomnia, sleep disturbances, depression and psychological distress, visual and auditory effects, neck and wrist pains etc.

These effects have not received considerable attention especially in Zambia. The negative effects of smartphone addiction highlighted by the study will consequently create awareness to the public and add to the knowledge gap on smartphone addiction in Zambia. Health education on smartphone addiction is the most significant health promotion measure that can be successfully undertaken at population level. To explore whether smartphone addiction is present among Public Health undergraduate students at The University of Lusaka and to determine whether a relationship occurs between Smartphone Addiction, Depression, Stress and Anxiety

Subjects And Method

Study Design

This study was a sequential explanatory mixed methods design. The quantitative part established the levels of smart phone addiction using a smart phone addiction scale. Qualitatively a case study design was employed to explore the health implications on those addicted. The study was done at the University of Lusaka (UNILUS). UNILUS is a private university founded in 2007 in Lusaka, Zambia.

Sample and Population

A population of First year first and second semester distance Bachelor of Science in Public Health Undergraduate students from the University of Lusaka was considered for the study. There are 57 registered students in the first semester and 54 registered students in the second semester in the 2019 academic year.

Therefore, in terms of sampling, the researchers enrolled all the participants, making this study a population based study. All the 111 students were enrolled as a sample for the study. However, for the qualitative part of the study a theoretical saturation was utilized on arriving at the sample of people who are addicted to their smartphone. This sample was enrolled from the participants that were established as addicted using the smart phone addiction scale. An initial sample size of 12 reached saturation for the qualitative. Purposive sampling and a convenient sampling criteria were utilized and those that were severely addicted to smart phones were purposively enrolled for the qualitative part of the study. The primary outcomes in this study were smartphone addiction, depression, anxiety and stress.

Study Instrument

A Smartphone Addiction Scale- Short Version (SAS-SV) tool and a Depression Anxiety Stress Questionnaire (DASS) were used to collect data.

The SAS-SV is a scale which originally formulated in South Korea. It was published in English (Kwon et al., 2013). This is effectively a shortened version of the original 40 itemed scale. It is a questionnaire used to assess levels of smartphone addiction). It consists of 6 factors i.e. a six-

point Likert scale (1: “strongly disagree” and 6: “strongly agree”) based on self-reporting. The six factors will be daily-life disturbance, positive anticipation, withdrawal, cyberspace-oriented relationship, overuse, and tolerance. The total scores of the scale range from 10 to 60 with the maximum presence of addiction in the past year being represented by the highest score obtained by the scale.

DASS is used to measure mental health, focusing on the three traits of depression, anxiety and stress. The test consists of a list of 21 symptoms, each of which is to be rated on a four-point scale of how much you had that symptom in the last week. Since the DASS21 is a shortened version of the DASS42, the final score for each variable, that is, depression, anxiety and stress, obtained is multiplied by 2.

Data Analysis

Data was analyzed using a computer package; STATA - version 14. Some descriptive statistics was performed in respect of the total sample as part of this analysis. The study made use of Multiple linear regression which was used to evaluate how various variables interact – such as mental health i.e. depression, anxiety and or stress, and smartphone addiction. We did not categorise numeric variables as suggested in cardiovascular study among HIV patients by Chiluba [21]. Preliminary analyses were conducted to ensure no violation of the assumption of normality, linearity, multicollinearity and homoscedasticity. Spearman correlation coefficients was used to evaluate the associations among the different variables. Qualitative part of the study utilized a thematic analysis. Themes were developed from the transcribed data and verbatim quotes based on predetermined themes have been reported.

Results

Characteristics of Study Participants (n = 66)

A total sample consisting of 111 UNILUS Public Health first year undergraduate Public Health students aged between 20 and 42 years were given SAS-SA and DASS21 questionnaires to answer. The study had a response rate of 59.5%, that is, only 66 out of the 111 total sampled participants completed their questionnaires. In gender terms, female students constituted 32 (48.5%) and males 33(50%) of the total study respondents. The mean age was (28.1

years) with the standard deviation of (5.64 years). Out of the 66 respondents, 39(60.6%) were found to be addicted to their smartphones, 37.9% and 22.7% of them being moderately and severely addicted to their phones respectively.

Furthermore, the study found that age groups 20-25 years of the participants were the most frequent to have smartphone addiction whereas those older than thirty-five years in age had a normal to moderate addiction. Thus, the study found that as age increases the level of smartphone addiction reduces. The basic characteristics of the study participants are shown in Table 1.

Table 1. Characteristics of study participants in the study of health implications of smartphone addiction among UNILUS 2019 Public Health first year Distance undergraduate students

Characteristic Variable	Overall	Normal Addiction Status	Moderate Addiction Status	Severe Addiction Status
Addiction status (%)	66(100)	26(39.4)	25(37.9)	15(22.7)
Standardized age groups				
20-25	28	7	10	11
26-30	21	8	9	4
31-35	7	5	2	0
>35	9	6	3	0
Gender				
Male	33	17	9	7
Female	32	9	15	8
Age				
Mean(SD)	28.1 (5.64)			

Simple Linear Regression Analysis for the assessment of Smartphone Addiction, Gender and Age as predictors of Depression, Anxiety and Stress among UNILUS 2019 undergraduate Distance first year Public Health Students

Simple linear regression was used to assess whether phone addiction, gender and age of students significantly predicted stress, anxiety and depression in 2019 academic year public health students at UNILUS. Addiction, depression, stress and anxiety were all scored. For example, the study found that phone addiction in students explained 22% of variance in the depression scores of students, $R^2=0.220$, $F(1, 64) = 18.09$, $P < .001$. Phone addiction in students significantly predicted depression in UNILUS 2019 undergraduate Distance first year Public Health Students, $B=0.470$, 4.253 , $P < 0.001$. The study found a positive moderate correlation ($r=0.477$) between phone addiction and depression, that is, the higher the addiction levels (scores) in students the higher the depression levels (scores) in the UNILUS 2019 Public Health first year Distance undergraduate students.

A weak negative correlation ($r = -0.155$) and no significance ($p = 0.219$) between gender and depression was found, hence, the study found that gender played no role of being a predictor of depression among the sample used. Age explained 14.1% of variance in the depression scores of students, $R^2 = 0.141$, $F(1,63) = 10.380$, $P = 0.001$. Age in the students was able to significantly predict depression in UNILUS 2019 undergraduate Distance first year Public Health Students, $B= -0.694$, -0.222 , $P = 0.001$. the study found a negative moderate correlation ($r = -0.376$) between age and depression, that is, the higher the age in the UNILUS 2019 Public Health first year Distance

undergraduate students, the lower the depression levels (scores).

In regards to determining whether smartphone addiction, gender and age significantly predicted anxiety amongst UNILUS 2019 Public Health first year Distance undergraduate students without controlling for the other variables, the study showed that both age and smartphone addiction have a significant predictive effect on anxiety scores. For instance, smartphone addiction explained a 16% of variance in anxiety scores, significantly predicted anxiety among the students ($p = 0.001$) with a positive moderate correlation ($r = 0.399$) whilst age the study significantly predicted anxiety ($p = 0.001$) and had a negative moderate correlation ($r = -0.390$) between age and anxiety. This means that as the age of the respondents decreased by one the anxiety levels (scores) increased. Gender however was found to not significantly predict for anxiety among the students ($p = 0.113$) with a weak negative correlation of $r = -0.198$. It was also found that smartphone addiction, age and gender all significantly predicted stress in UNILUS 2019 Public Health first year Distance undergraduate students. Smartphone addiction and stress showed a positive correlation ($r = 0.504$, $p < 0.001$) whereas gender and stress showed a weak negative correlation ($r = -0.272$, $p = 0.028$). Lastly, age and stress showed a weak negative correlation. Table 3 gives the predictive results for age, gender and addiction on depression, stress and anxiety.

Multiple Linear Regression for the assessment of Smartphone Addiction, Gender and Age as predictors of Depression, Anxiety and Stress among UNILUS 2019 undergraduate Distance first year Public Health Students

In table 2. Multiple linear regressions were also conducted to predict depression, anxiety, and stress based on gender, age and addiction.

When predicting for Depression in Public Health distance undergraduate students, based on their gender, age, and addiction, a significant regression equation was found to be $F(3,61) = 8.19, p = 0.001$ with adjusted R

of 0.25. The predicted students stress levels equation was $13.45 - 0.45(\text{age}) + 0.39(\text{phone addiction}) - 1.69(\text{gender})$. Therefore, depression was found to increase by 0.39 for every single score increase in smartphone phone addiction while controlling for gender and age. Results also showed a strong correlation between depression levels of students and smartphone addiction ($r = 0.47$) in comparison to age and gender.

Table 2. Multiple Linear Regressions of Age, Gender and Phone Addiction on Depression, Anxiety and Stress

Depression							
Factor	Regression Coefficient (B)	Pearson Correlation Coefficient (r)	Adjusted Coefficient of Determination (R ²)	P-Value	t Statistic	F Statistic	Degree of Freedom (df)
	13.453						
Gender	-1.694	-.155	.252	0.456	-0.750	8.194	3.61
Age	-.450	-.376		0.037	-2.128		
Phone Addiction	.386	.471		0.001	3.409		
Anxiety							
	15.682						
Gender	-2.041	-.198	.218	0.254	-1.151	6.941	3.61
Age	-.392	-.390		0.021	-2.363		
Phone Addiction	.231	.400		0.012	2.598		
Stress							
	15.060						
Gender	-3.974	-.272	.316	.060	-1.916	10.848	3.61
Age	-.385	-.377		.052	-1.982		
Phone Addiction	.400	.505		< .001	3.847		

Feelings about Smartphone Use

The study revealed that using one’s smartphone during lectures was a common occurrence among the students under study. The size of lecture rooms plays a major role in how easy it was for students to use their

smartphones during lectures. The vast majority of respondents believed they could text and browse on their smartphones without the lecturers being aware due to the magnitude of the classes used. Crowded classes make it convenient for students to freely use their smartphones during lectures.

The most prominent feeling among respondents associated with using their smartphones while a lecture was underway was guilt. They felt their smartphones was a source of distraction and felt they were being 'unfair' to themselves. However, despite feelings of guilt, respondents justified their actions by rationalizing that if the smartphone was being used for clarification on what is being discussed during classes then smartphone use was acceptable. Some respondents felt that if a lecture was monotonous then there was nothing wrong with using their smartphones. This is what one of the respondents had to say in regards to their feelings on smartphone use during a lecture:

"It depends on what I'm using it for, if it's something constructive I feel good but if I'm using it for social media then I feel guilty"
(28 year old Male student)

Conversely, about 30% of the 15 students felt there was absolutely nothing wrong with using their smartphones during lectures. They felt that time moved faster when they were using their phones and that they preferred to use their smartphones when lectures weren't engaging. One respondent had this to say concerning this:

"I think it's good, depending on how serious the lesson is, I also think time moves faster when I am on my phone during boring lectures"
(21 year old female student)

Smartphone dependency

Majority of the respondents were highly dependent on their smartphones. The inability to remain in a room without their smartphone was a common pattern among the responses given. Fear, anxiety and panic were mostly mentioned by the students in

reference to the initial feeling or thought that they would have if they weren't with their smartphone. An obsession and lack of control was prominent with some of the students saying they would go into a panic and quickly search for their phones. They said that they would be apprehensive and would feel like they are missing out. The presence of the smartphone within their vicinity gave the students a sense of security, with some saying they would make sure they brought their smartphones to the room in which they are in no matter what. One respondent had this to say:

"My phone is always with me and if it happens that it's not with me, I follow it"
(22 year old Male student)

Three students however, showed a lack of concern if their smartphones were not in the same room with them. Their responses lacked fear, panic, anxiety or any sense of foreboding if they didn't immediately get up to retrieve or find their phone. They instead saw this as an opportunity to finish doing what they were currently doing then find the phone if need be or alternatively work towards something constructive like a hobby of theirs. This is what one of the students said concerning the action they would take if they didn't have their smartphone in the same room with them:

"I would probably be sketching"
(21 year old Female student)

Five out of the fifteen severely addicted respondents said they would be ok with leaving their smartphones behind as long as the place they were going to would be interesting. They felt no reservations about abiding to the rule of not carrying your smartphone and actually thought that it would be more relaxing to go without their

smartphone in tow. Additionally, said they would substitute their smartphones with their laptop or use another device to listen to music to keep their mind busy. One student in particular had this to say concerning this;

“When I’m not supposed to bring my phone, I just accept it and in most cases I feel more Relaxed”
(22 year old Male student)

Nonetheless, the remaining 10 severely addicted students expressed having a fear of missing out (FoM) if they were unable to have their smartphones with them. They stated that they would worry about the safety of their phones, feel uncomfortable and anxious if their smartphones were left behind. They adamantly refused that they would agree to leave their smartphones due to the loss of entertainment the phones would provide them with, the inability to communicate with loved ones in case of an emergency and or to chat with friends who are in very distant locations. One of the ten students in particular indicated that they would be anxious because they essentially use their smartphone for both professional and academic work. This is what one of them had to say:

“I would try by all means to find a phone, because without a phone it feels like I’m out of place”
(28 year old Male student)

Some of the participants acknowledged the harmful impact their smartphones were having on their daily lives, they welcomed the possibility of being away from their smartphones. They stated that it would provide them with the opportunity to relax and spend time focusing on reflecting on their lives as well as concentrating entirely on the vacation experience. Others gave the ultimatum of only going on the vacation if

energetic, adventurous and fun activities would be present to keep their minds preoccupied from thoughts of their smartphones. Commenting on this, one student said:

“Yes. I would be able to enjoy the experience more if I concentrated entirely on the experience”
(22 year old Male student)

There were, however, some negative comments amongst other students that felt that going on vacation without their smartphone was extreme. They unwaveringly refused the notion of leaving their smartphones behind because they felt they could not live without their smartphones. Reasons like having to take pictures, communicate with friends and family, feelings of discomfort and the need of the smartphone as a source of entertainment were given to justify why they would be against going on the vacation. Some argued that they would go on the vacation if they would be allowed access to their smartphones during lunch breaks or any stipulated time given at the vacation spot. One student candidly wrote this:

Discussion

Prevalence of smartphone addiction

The prevalence of smartphone addiction in this study was 60.6% which was measured with the SAS-SV. This percentage is exponentially higher than that of previous studies conducted in Europe i.e. university students in Belgium at 21.5% and Spain at 12.8%, South Korean students at 24.8% and China at 29.8% [22]. A study carried out among medical students in South India found 36.8% of the students were addicted

to their smartphones. The different scales used, inclusion and exclusion criteria as well as variables and participants studied could have contributed to the inconsistencies in the prevalence percentages obtained in the previous studies conducted. In spite of this, the elevated prevalence rate found in this study should be viewed as an impending public health concern among UNILUS 2019 undergraduate Distance first year Public Health Students.

One of the concerns of the study was to determine whether gender was an indicator of smartphone addiction. The results showed an insignificant correlation between gender and smartphone addiction ($r = -0.094$, $p = 0.689$). This result is compatible with (Sanal & Ozer, [23] whose study on smartphone addiction and use of social media among university students which found no significant correlation between smartphone addiction and gender.

Gender differences

The results of this study revealed no statistically significant gender differences in the prevalence of smartphone addiction ($t = 0.747$, $p = 0.458$). This is in agreement with [19,24] who also found no gender differences in smartphone addiction. Other studies have found opposing results that suggest that the prevalence of smartphone addiction is significantly higher in females than males [25]. It is worth noting that [26], proposed that the higher prevalence of smartphone addiction in females could be related to the nature of their smartphone usage, that is, females tend to use their smartphones for social media and entertainment purposes whereas males will use their smartphones for work related purposes.

Smartphone use

Smartphone use in the 21st century has become apparent across all age groups; in this study the prevalence of smartphone addiction was found to vary according to differences in age. For instance, the youngest age group, 20yrs – 25yrs, were found to have the highest addiction scores where's as the oldest age group, >36yrs, had the lowest addiction scores. Similarly, results found by De-Sola *et al.*, [25], showed that the age groups 16-25yrs and 26-35yrs had the highest addiction scores while the oldest age group displayed the lowest addiction scores, this also concurs with the study done by Mitchel *et al.*, [24], that concluded that problematic smartphone usage was age-dependent. Furthermore, in this study age and smartphone addiction were found to have a significant moderate negative correlation ($r = -0.309$, $p = 0.016$), therefore suggesting that there is an inverse relationship between age and smartphone addiction, that is, as age decreases of the students in the sample, the higher the level of smartphone addiction. These results are consistent with results obtained by Pugh, [27], who also found a significant moderate negative correlation between age and smartphone addiction ($r = -0.339$, $p = <0.005$). Nonetheless, Lane & Manner [28] proposition that an older individual seeking higher education will most likely develop an addiction to their smartphone due to the academic purposes. Thus, it would erroneous to focus on smartphone addiction and its relationship with depression, anxiety and stress among young adult university students alone. For instance, the study conducted by Harwood *et al.*, [29] that consisted of a sample of 16 to 59-year-old participants, found a positive correlation between depression, anxiety and stress with smartphone addiction.

The prevalence for moderate to extremely severe depression, anxiety and stress status in this study were 33.4%, 39.4% and 19.7% respectively. This is much lower than a study done by Manap et al., [30] where the percentages found were 30.7%, 55.5% and 16.6% for depression, anxiety and stress. The findings in this study are a cause for concern in regards to the risk this poses on potentially adding to the burden of psychiatric morbidity amongst UNILUS 2019 undergraduate Distance first year Public Health students. There are numerous factors that could be attributed to high prevalence rates of depression, anxiety and stress among undergraduate students.

The findings regarding whether smartphone addiction, gender and age of students significantly predicted stress, anxiety and depression in 2019 academic year public health students at UNILUS showed smartphone addiction as the most powerful independent positive predictor of depression, anxiety and depression in comparison to both gender and age. These results resonate well with findings from previous studies that looked at the relationship between smartphone addiction and psychological traits such as depression, anxiety, stress, anxiety, loneliness and social phobia [24, 27].

This study reported a positive correlation between depression levels of students and smartphone addiction ($r = 0.47$) in comparison to age and gender which showed a moderate negative correlation ($r = -0.376$, $p = 0.037$) and insignificant results ($r = -0.155$, $p = 0.456$) with smartphone addiction respectively. Even after controlling for other variables, smartphone addiction still emerged as having a strong association with depression. This can be compared to Toda *et al.*, (2015) who similarly found a strong dependent relationship between smartphone

addiction and depression among university students. The study carried out by Kim *et al.*, [31] investigated the effects of smartphone addiction on depression, anxiety and Attention Deficit Hyperactivity Disorder (ADHD) among South Korean adolescents. The results showed that those who fell in the smartphone addiction groups had a higher probability of developing significant depression and anxiety and ADHD symptoms. Higher depression scores (depression levels) are positively associated with problematic smartphone used which can also be characterized as smartphone addiction. Likewise, in a sample of 414 Chinese university undergraduate students, loneliness, which has a significantly high positive association with depression had a positive correlation with smartphone addiction [32]. However, depression is a complex and multidimensional condition and its relationship with smartphone addiction must be studied extensively to yield substantial results based on different demographic factors.

When predicting for Anxiety in the respondents, a significant regression equation was found to be $F(3,61) = 6.94$, $p = 0.01$ with adjusted R^2 of 0.220. The predicted student's anxiety levels equation was $15.06 - 0.39(\text{age}) + 0.23(\text{phone addiction}) - 3.97(\text{gender})$. Thus, the study found that anxiety increased by 0.23 for every single score increase in smartphone addiction while controlling for both gender and age. A strong correlation ($r = 0.40$) was found between smartphone addiction and Anxiety levels. This result is comparable to Darcin *et al.*, [33] who found a predictive relationship between smartphone addiction and anxiety in surveys that were carried out on a sample that consisted of 367 Turkish University Students. Findings by Demirci *et al.*, [20], revealed positive correlations between smartphone addiction scale scores

and anxiety levels among university students. They were able to determine an association between anxiety and smartphone overuse by using regression analyses that indicated that higher levels of smartphone use i.e. (smartphone addiction, predicted anxiety. The study also recommended that the students must be carefully monitored for any signs of smartphone addiction. In addition, findings by Kim *et al.*, [31] showed that the smartphone addicted group had an increased risk of anxiety (relative risk =1.402, $p < 0.001$) compared to the normal users. These results were able to demonstrate the significant effects that smartphone addiction has on anxiety and highlighted the need for implementation of policies that will be able to hamper smartphone overuse.

When predicting for stress in Public health distance Undergraduate students at UNILUS based on their gender, age and addiction, a significant regression equation was found to be $F(3, 61) = 10.85$, $p < 0.001$ with adjusted R^2 of 0.32.

The predicted student's stress levels equation was $15.06 - .39(\text{age}) + .40(\text{phone addiction}) - 3.97(\text{gender})$ where age was measured in years, phone addiction was scored, and gender was coded as 1=female and 2=male. Stress was found to increase by 0.40 for every single score increase in phone addiction while controlling for gender and age. The study further showed that phone addiction strongly correlated ($r = .51$) with student's stress levels and it was a better predictor of stress in students compared to age and gender. This is supported by Chiluba-Mwaba, [34] who suggested that technology overuse is associated with increased stress levels. Similarly, a study done by Vahedi & Saiphoo [35] found a positive correlation between smartphone use, stress and anxiety.

Mae, [36] however, challenges the notion that addictive smartphone use has a predictive effect on depression, anxiety and stress. Instead the researcher postulates that excessive smartphone use on its own may not have a direct relationship coming with symptoms of some depression, that of anxiety and also stress. Her theory is that addictive smartphone usage coupled with negative perceptions of its impact on mental health could be the determinant behind the presence of high depression, anxiety and stress levels in users.

The themes surrounding this research, which were feelings about smartphone use, smartphone dependency and smartphone habits, gave further insight into what the students themselves view about the type of relationship they have with their smartphone. Self-justification was a common trend amongst the respondents whenever they were faced with a question about their excessive smartphone use. Although majority of the students were aware that they had bad smartphone habits that they described as bad, addictive and pathetic, they were unwilling to reduce the amount of time spent using their smartphones. The most common fear was a fear of missing out which refers to a feeling of anxiety that's brought on by insecurities and notions that one has in respect to missing out on fun and exciting experiences that others may be having [37]. A fear of missing out will inevitably lead to stress and anxiety in users, for instance the respondents indicated that they would not go anywhere without their smartphones in case they missed out on any social media notifications. Ugur & Kor, [37] did a study on whether smartphones are a detracting tool among college students, the results revealed that 56.9% of the students during their classes used their smartphones to check their WhatsApp messages, 41% sent messages,

32.9% of them surfed the web and 22% used Facebook. In this study, students openly stated that they used their smartphones during lectures and often fell behind as the lecture progressed. Moreover, despite knowing the harmful effects that their smartphones posed on their academic and daily lives and experiencing feelings of guilt when using their smartphones in class, respondents in the study were unwilling to give up or change their smartphone habits.

Taking into consideration that the respondents clearly stated that they were aware of the potential harm their smartphones had on their health i.e. cause of stress and anxiety when they cannot find or have their smartphone with them as well as bad smartphone habits that they exhibited, they continued to over use their smartphones, should be a cause for concern in respect to the behavioral and psychological mechanisms that aid in identifying the public health concern of smartphone addiction [2].

Other respondents in the study showed a lack of self-control when expressing the need to constantly have their smartphone nearby even when they didn't need it. Obsessive and addictive behaviors towards smartphones was observed from the responses of the respondents. Another common occurrence amongst the respondents was the tendency to substitute their smartphones with another device like their laptop or tablet for entertainment purposes. This points to an addiction to technology.

The refusal by majority of respondents in the study to go on a vacation without their smartphones shows how dependent they are on their smartphones. It further shows how extensive the problem of smartphone addiction among the students actually is.

Conclusion

This study is the first of its kind that has explored the effects of smartphone addiction and its relationship with depression, anxiety and stress among undergraduate students in Zambia. Despite the rise in negative effects of behavioral addictions like smartphone addiction in our generation, minimal research has been carried out on the public health implications and manners in which to address this growing epidemic. Hence this study provides an important contribution in regards to this topic. Therefore, an initiative of stress, anxiety and depression management programs should be introduced at universities in addition to the implementation of recreational and outreach health promotion programs that educate the public on the negative impacts of smartphone addiction on their health.

Declarations

Author Contribution

BCC and SM conceptualized the study. Data was collected by SM and analyzed by BCC. Results were interpreted by BCC. BCC drafted the manuscript and all authors inputted and approved of the final copy.

Funding and Sponsorship

There was no external funding.

Conflict of Interest

We declare that there was no conflict of interest.

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