

## RESEARCH PAPER

# INTERNET ADDICTION AND CORRELATES AMONG TERTIARY STUDENTS IN A SUB- SAHARAN AFRICAN COUNTRY – CASE OF KNUST, GHANA: A FOLLOW UP STUDY.

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## ABSTRACT

**Background:** A major drawback of the revolutionary technology of the internet is the tendency for addiction. Internet addiction (IA) is a modern menace affecting mostly the youth. Preventive counseling (PC) is needed to deal with this growing public health concern, however empirical data as a basis in terms of prevalence and correlates are non-existent in Ghana. **Objectives:** This study aimed to assess the prevalence of IA and its psychological correlates among Kwame Nkrumah University of Science and Technology (KNUST) students. **Methods:** Online cross-sectional method was used to survey one thousand, one hundred and sixty-five (1,165) students. Internet Addiction Test (IAT), Beck's Depressive Inventory (BDI), Index of Self-Esteem (ISE), Revised UCLA Loneliness Scale (RULS) and Satisfaction with Life (SWL) measures were used for data collection. The data were analyzed using statistical package for social sciences (SPSS) version 25. **Results:** 36.2% of the study participants (SPs) were normal internet users and 39%, 19.0% and 1.1% were mildly, moderately and severely addicted to the internet respectively with no responses from 4.7% of the study sample. Also, with higher scores indicating greater magnitude of problem, there were significant positive correlations between IAT and their Self-esteem ( $r = 0.288$ ,  $N = 1165$ ,  $p = 0.000$ ), loneliness ( $r = 0.228$ ,  $N = 1165$ ,  $p = 0.000$ ) and depression ( $r = 0.270$ ,  $N = 1165$ ,  $p = 0.000$ ) scores. Moreover, there was a significant inverse relationship with their IAT and SWL ( $r = -0.209$ ,  $p = 0.000$ ) scores. **Conclusion:** Approximately 1% of KNUST students sampled need addictive psychotherapeutic intervention. Also 58% with mild and moderate addiction may need preemptive counselling since they stand the chance of continuing to the severe end of IA continuum. Implications for policy, promotion of preventive health behaviors and clinical intervention at the institutional and national levels have been discussed.

**Keywords:** Internet addiction, students, loneliness, self-Esteem, satisfaction with life.

## INTRODUCTION

The Internet is a revolutionary technology described as a divine gift for communication, social connectivity and commerce (Masud *et al.*, 2016). It is also a source of information and entertainment, (Hoare *et al.*, 2017) as well as a lifelong learning tool for students and professionals (Haque *et al.*, 2016). It is unfortunately accompanied by its own set of problems, of which internet addiction is one of the most devastating (Kapahi *et al.*, 2013). Internet Addiction (IA) is “a behavioral addiction characterized by uncontrolled preoccupation and excessive use of the internet, associated with experience of negative emotional symptoms such as irritability, moodiness, nervousness and boredom when internet is unavailable, uncontrolled need for more time online at the expense of important social relations and occupational functioning” (Amoah *et al.*, 2020; 49). IA’s effects on the victims’ occupational functioning include negative impact on professional work output, students’ academic achievement and social life (Madhavika & Kodithuwakku, 2019). For students in particular, there has been a growing concern that compulsive online activities not only deteriorate study habits and reduce their lecture attendance, it also reduces interest in extracurricular activities and ultimately negatively impacts their academic performance (Madhavika & Kodithuwakku, 2019; Wallace (2014). Moreover, IA addiction socially isolates the youth from their friends and loved ones, and negatively impacts their health, emotions, and spirit (Nemati & Matlabi, 2017).

In terms of global IA prevalence, the rates vary greatly (Cheng & Li., 2014) due to lack of uniform research methods and measures in use in diverse cultures around the world (Gregory, 2021). For example, while Cheng & Li, (2014) estimated 6.0% in a systematic study involving 31 countries, Treglia & Tomassoni,

(2018) suggested between 1 – 25%. Also, Gregory, (2021) estimated 8.9% IA rate among the American population and reported up to 38% from other parts of the world. More so, some researchers (e.g., Christakis *et al.*, 2011; Servidio, 2017; Sharma *et al.*, 2014) found 4%, 0.5% 0.3% and 0.9% respectively among American college, Italian, Indian and Asian students. Other researchers (e.g., Amoah *et al.*, 2020; Chamika & and Dias, 2018; Haque *et al.*, 2016) however found no addiction among their participants. At the national levels, IA prevalence is as varying as the global levels (Cheng & Li, 2014; Gregory, 2021). Psychometrically, it is highly inappropriate to formulate IA preventive policies for clinical intervention at national levels based on global prevalence rates. It is therefore important for every nation to establish its own national IA prevalence rate for that purpose.

Demographically, research evidence points to an inverse relationship between age and IA (Treglia & Tomassoni, 2018), and that the youth are becoming more vulnerable and fast becoming problematic internet users than adults (Ha *et al.*, 2007). Provision of virtually free Wi-Fi, availability of smart gadgets and relatively less stringent parental supervision predisposes more university students to IA (Erol & Cirak, 2019a; Kuss *et al.*, 2013; Nduanya *et al.*, 2018; Young, 2004).

Like other mental health conditions, IA comes with some correlates and comorbidities. For example, there is evidence of a relationship between IA and some psychological correlates such as personality characteristics, depression, self-worth, loneliness and life satisfaction. Thus, some studies have found positive correlation between IA and declined social involvement as well as with loneliness (Bahrainian *et al.*, 2014; Chamika & and Dias, 2018; Erol & Cirak, 2019a; Ezoë & Toda, 2013; Morahan-Martin & Schumacher, 2000). The IA - loneliness relationship has been explained by the fact that vulnerable youth who lack social

assertiveness tend to compensate by over relying on computer-mediated online social interaction to overcome loneliness, stress and boredom (McKenna & Bargh, 2000; Velezmore *et al.*, 2010), which predispose them to problematic internet use (Caplan, 2002).

Also, there is evidence of a link between IA and depression (e.g., Adiele & Olatokun, 2014; Christakis *et al.*, 2011; Hoare *et al.*, 2017; Uddin *et al.*, 2016; Yen *et al.*, 2008), and with other moderating personality characteristics such as shyness, locus of control, inadequate social skills and feelings of alienation (Caplan, 2002; Chak & Leung, 2004; Treglia & Tomassoni, 2018). More so, there is evidence of a significant negative relationship between IA and self-esteem (Bahrainian *et al.*, 2014; Ko *et al.*, 2007; Seabra *et al.*, 2017; Salarvand *et al.*, 2018), as well as with life satisfaction (Erdogan, Yildirim & Cıgdem, 2018; Lachmann *et al.*, 2018; Longstreet & Brooks, 2017; Shahnaz & Karim, 2014).

As of 31<sup>st</sup> December, 2021, Ghana's internet penetration stood at 45.9%, representing internet growth of 49.12% between years 2000 and 2021 (Miniwatts Marketing Group, 2021). Also, in this post COVID -19 era where online teaching and learning has become an integral feature of academic work, there is the need to counsel the youth as a preventive measure, to gain mastery over their internet use. This preventive intervention will be difficult without knowledge of the current prevalent levels of IA and possible correlates among the youth.

In West Africa, there is a dearth of knowledge as only a few peer-reviewed papers on IA (e.g., Nduanya *et al.*, 2018; Omoyemiju & Popoola, 2021) have been published. In Ghana, even fewer studies on internet addiction have been carried out. Among the few, IA prevalence investigations using Young's diagnostic psychometric test, popularly referred to as Internet Addiction Test (IAT) among tertiary students in Ghana is limited. The only work on

the subject to date, is the authors' preliminary IA prevalence study (Amoah *et al.*, 2020), to the best of their knowledge. The limitation of small sample size affecting statistical power and exclusive use of medical students as participants, limited generalizability of findings to KNUST and students of similar tertiary institutions. A follow-up study has therefore become necessary to provide a more reliable basis for institutional and national internet policy, preventive counseling and treatment. The aims of the present study therefore were (i) to assess the prevalence of Internet Addiction (IA) among KNUST students, and (ii) to assess the associations between participants' IA scores and those of their psychological correlates such as self-esteem (ISE), depression (BDI), satisfaction with life (SWL) and loneliness (RULS) among KNUST students.

## **MATERIALS & METHODS**

**Study Design:** The study used a cross – sectional online survey method to achieve its objectives.

**Setting:** The study was conducted in KNUST, a public University in Kumasi, in the Ashanti Region of Ghana, West Africa. The University runs a collegiate system consisting of 6 colleges, namely; College of Humanities and Social Sciences (CoHSS), College of Art and Built Environment (CABE) and the College of Agriculture and Natural Resources (CANR). The rest are College of Science (CoS), College of Engineering (CoE) and the College of Health Sciences (CoHS). KNUST currently has a student population of approximately 60, 000 and a staff strength of about 4,000.

**Participants:** Using Creative Research System, (2012) sample size calculator at 99% level of confidence, 5.0 confidence interval and a student population of 60000, a sample size of 383, plus 30% (for potential losses), worked up to a minimum of 497 participants. To increase

the statistical power, the authors aimed for an estimated minimum of 1500 participants.

**Sampling and Procedure:** A simple random sampling method was used to target 1500 representative samples from the 60 000-student population. Thus, a minimum of 250 students from each college were contacted and invited to participate in the study using the University Information Technology (UIT) messaging system. The UIT’s invitation message link provided participants with the necessary information on the study such as participants’ information sheets and a Google-form for consent and participation. Inclusion criteria were that participants must be KNUST students and aged above 16 years. Exclusion criteria were non-students and those aged below 16. Ethical clearance, (Ref number: CHRPE/AP/687/19) for the study was provided by the Committee on Human Research, Publication and Ethics (CHRPE) at School of Medical Sciences and Dentistry (SMD), College of Health Sciences, KNUST, Kumasi, Ghana.

**Measures:** The measures used covered sociodemographic information, Internet Addiction Test (IAT), Revised UCLA Loneliness scale (RULS), Index of Self – Esteem (ISE), Satisfaction with Life and Beck’s Depression Inventory (BDI), all of which have been described below. Internet Addiction Test (IAT). IAT is the most popular internet screening test developed by Dr. Kimberly Young, the director of the Center for Internet Addiction, USA (Young, 2009). It consists of 20 questions examining IA symptoms and rated on a five-point Likert scale ranging from 0 to 5 (i.e., not applicable, rarely, occasionally, frequently, often and always). It is scored by summing all 20 items to obtain a score range of 0-100 with severity impairment index ranges summarized in table 1 below.

**Table 1: A table of IA score ranges and severity of addiction.**

SCORE RANGE	SEVERITY
0-30	normal internet user (no addiction)
31-49	mild internet addiction
50 to 79	moderate internet addiction
Above 80	Severe internet addiction

Source: Young (2009)

According to Young, (2021) some studies found internal consistency of the IAT to be between 0.60 and 0.72 Cronbach alpha. Pretesting yielded a high internal reliability Cronbach’s Alpha values of respectively 0.859 and 0.907 in our previous preliminary research and this follow-up study. Satisfaction with Life Scale (SWLS): SWLS was constructed by Emmons, Larsen & Griffins, (1985). It is a 5–item instrument that measures an individual’s personal mental appraisal of his/her quality of life. The questions feature a 7-point Likert scale from “strongly disagree” to “strongly agree”. An example of an item on this scale is - “In most cases my life is close to ideal”. The scale has shown good psychometric properties in several studies (e.g., Gouveia *et al.*, 2009; Pavot *et al.*,1991; Sachs, 2004; Siebert *et al.*, 2020). Revised UCLA Loneliness Scale (RULS): RULS by Russell, Peplau and Cutrona, (1980), is a 20-item popular scale that assesses loneliness. The RULS asks simple questions such as “I lack companionship” and requires the respondent to choose from a Likert scale between 1 (I have never felt this way) to 4 (I have felt this way often). After some manipulations, the RULS’s responses are summed to produce a score range of between 20 and 80, with higher scores indicating greater loneliness. Corcoran and Fischer, (2000) reported an excellent internal consistency of 0.94 alpha coefficient, very good validity figures and consistent correlation with various mood and personality inventories. Index of Self Esteem (ISE): This ISE test was

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constructed by Hudson, (1997) to measure an individuals' appraisal of his/her self-concept. It consists of 25 items to which an individual has to choose between a 7 – item Likert scale ranging from 1 (none of the time), to 7 (all of the time). The scoring produces a score range of 0 to 100 with higher scores indicating greater magnitude of the problem (i.e., lower self-esteem). Corcoran and Fischer, (2000; 383) reported a mean internal consistency of 0.93 alpha and a 2 – hour test – retest correlation of 0.92. Internal consistency analysis in the current study revealed 71.7% (0.717) Cronbach alpha. Beck's Depression Inventory (BDI): BDI is a popular depression scale constructed by Beck *et al.*, (1961). It consists of a total of 21 items rated on a four-point Likert scale from 0 (none) to 3 (severe). The scoring is done simply by summing chosen options to produce a score range of 0 to 63. Symptom severity is categorized as shown in table 2 below.

**Table 2: A table of Becks' Depression Inventory scores and severity ranges.**

SCORE RANGE	SEVERITY
1-10	Normal (no depression)
11-16	Mild mood disturbance
17-20	Borderline clinical depression
21-30	Moderate depression
31-40	Severe depression
Over 40	Extreme depression

Source: Beck *et al.*, (1961).

According to Beck *et al.*, (1961), a score above 17 is an indication of a need for clinical intervention and higher scores represent a higher level of depression. Data collection for this study started from 23rd October, 2019 and ended on 19th December, 2020.

## STATISTICAL ANALYSIS

The study adopted descriptive and inferential approaches in the analysis of the dataset. Thus, the sociodemographic characteristics and their relationships with the latent psychological measures were analyzed using a descriptive method and Pearson correlation value and the results illustrated in tables 3 and 4 respectively.

## RESULTS

The results have been presented according to the research objectives above. This study received 1165 responses out of the targeted 1500 students, giving a response rate of 77.66% with an average age of 21.19 (SD = 3.76). The sociodemographic characteristics of the study participants (SPs) are as summarized in table 3 below.

**Table 3: A table showing the sociodemographic characteristics of Study Participants**

Variables	Frequency(%)
Age (years) (meanSD)	21.19 ± 3.76
<b>Gender</b>	
Male	675 (58.4)
Female	480 (41.6)
<b>Religious Background</b>	
Christian	1082.29 (92.9)
Muslim	76(6.6)
Others	6( 0.5)
<b>Level of Study</b>	
First Year	548 (48.0)
Second Year	281 (24.6)
Third Year	194 (17.0)
Fourth Year	79 (6.9)
Postgraduate	40 (3.5)

Source: Researcher’s constructs.  
Abbreviation: SD = Standard deviation.

The relationship of the sociodemographic characteristics of the participants with the latent psychological variable (i.e., IAT, SWL, ISE, UCL, BDI) was analyzed using correlation and the results summarized in table 4 below.

Table 4: A table of relationships between sociodemographic characteristics and the psychometric measures used.

	IAT	SWL	ISE	RULS	BDI
<b>Gender</b>	0.041	0.093	0.000	0.104	0.016
<b>p-value</b>	0.164	0.002	0.997	0.000	0.589
<b>Level of Study</b>	-0.008	0.007	0.011	-0.001	-0.028
<b>p-value</b>	0.800	0.802	0.707	0.980	0.347
<b>Religion</b>	0.031	0.043	-0.024	-0.007	0.048
<b>p-value</b>	0.284	0.142	0.416	0.824	0.102
<b>Age</b>	-0.007	0.028	-0.025	-0.117	-0.027
<b>p-value</b>	0.823	0.339	0.393	0.000	0.367

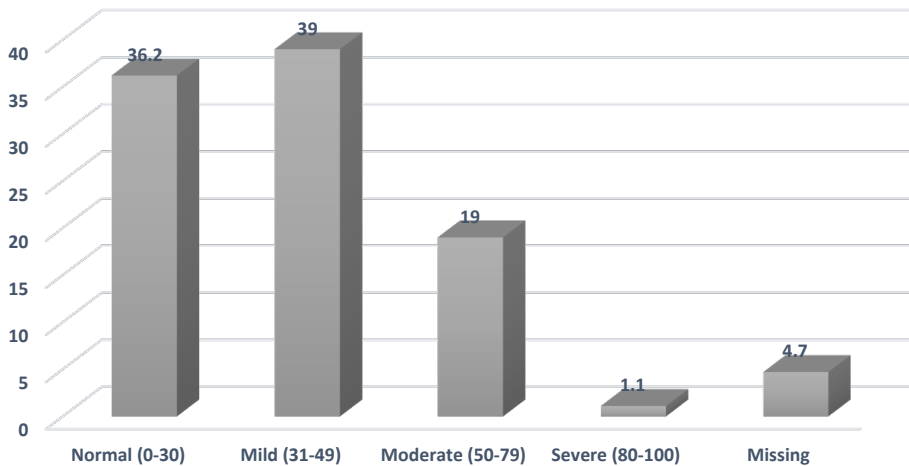
Source: Research data.

It was shown that gender had a significant weak positive correlation with satisfaction with life, and with revised loneliness scale with a p-value of 0.002 and 0.000 respectively. Also, the index of self-esteem had no association with gender. More so, IA and depression had insignificant weak positive correlation each, with the gender of the SPs. Moreover, all the psychometric measures used in the study (i.e., IAT, SWL, ISE, RULS & BDI), had insignificant relationships with the study level of the participants. Furthermore, the religious background of the study participants had no relationship with all the psychometric measures.

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Finally, the age of the study participants had no relationships with all the psychometric measures except with revised loneliness scale with which it had a significant but weak negative correlation ( $r = -0.117, p = 0.000$ ).

The first objective of the study sought to assess the prevalence of Internet Addiction (IA) among KNUST students. Using the IAT score ranges above, the participant’s scores were analyzed using a descriptive method and illustrated in figure 1 below.



**Figure 1: A figure showing study participants’ internet addiction test scores.**

Source: Research data.

The results show that 36.2% of the study participants were normal internet users without addiction and 39% had a mild addiction to the internet. Also 19% and 1.1% were respectively moderately and severely addicted to the internet. Participants’ overall mean IA test score and those of exclusive males and females were also computed and summarized in table 5 below.

**Table 5: A table of the mean IAT scores for all participants and for both genders**

IAT	Summary	
N	Valid	1165
	Missing	0
Mean IAT score		36.82
Median IAT score		36.00
Std. Deviation		16.334
Mean IAT score for Males		36.12
Mean IAT for Females		37.94

Source: Researcher’s constructs.

The average overall, male and female IAT scores were 36.82 (SD = 16.33), 36.12 (SD = 15.84) and 37.94 (SD = 17.03) respectively. The overall mean score suggests that the SPs are generally operating within mild addiction range, implying they generally have a measure of control of their internet use according to the IAT user manual.

The second research objective sought to assess the associations between IA scores and those of psychological correlates, specifically, self-esteem, depression, satisfaction with life and loneliness of study participants. This was achieved using correlation analysis and the results summarized in Table 6 below.

**Table 6: A table of correlation between SPs’ IAT scores with their scores on SWL, ISE, RULS & BDI**

	IAT	SWL	ISE	RULS	BDI
<b>IAT</b>	1.000				
<b>p-value</b>					
<b>SWL</b>	-0.209	1.000			
<b>p-value</b>	0.00				
<b>ISE</b>	0.228	0.087	1.000		
<b>p-value</b>	0.000	0.002			
<b>RULS</b>	0.228	-0.087	1.000	1.000	
<b>p-value</b>	0.000	0.062	0.000		
<b>BDI</b>	0.270	-0.340	0.091	0.170	1.000
<b>p-value</b>	0.000	0.000	0.002	0.000	

Source: Researcher’s constructs.

## DISCUSSION

IA deteriorates students’ study habits, reduces their lecture attendance behavior, interest in extracurricular activities and ultimately negatively impacts their academic performance (Madhavika & Kodithuwakku, 2019; Wallace, 2014). This is a follow-up study aimed at assessing the prevalence of IA among students of KNUST and its relationships with their scores on satisfaction with life (SWL), self-esteem (ISE), loneliness (RULS) and depression (BDI). The ages of participants ranged between 17 and 46 years with a mean of 21.19 years and a standard deviation of 3.76. One thousand, one hundred and sixty-five (1165) of the estimated 1500 students voluntarily participated in this research, giving a

response rate of 77.66%. **Sociodemographic characteristics:** The study found no association between any of the sociodemographic characteristics and IAT scores, implying their addiction to the internet does not depend on any of their sociodemographic characteristics. This requires further investigations since previous studies (e.g., Haque *et al.*, 2016) found negative correlation between IA and age. Also, the study found weak significant positive relationships between gender and satisfaction with life ( $r = 0.093$ ,  $p = 0.002$ ) and with loneliness ( $r = 0.104$ ,  $p = 0.000$ ) (table 4), and further investigations are needed to determine which gender is more satisfied and lonelier among this cohort. Even though there was no significant direct relationship between age and IA ( $r = -0.007$ ,  $p = 0.823$ ) from table



4, our data supports an inferred relationship through loneliness as an intermediary variable. This could be explained by the fact that there was a significant negative relationship between age and loneliness ( $r = -0.117$ ,  $p = 0.000$ ) implying younger participants are lonelier than older participants. Since increased loneliness is associated with increased vulnerability to IA (Chamika & Dias, 2018; Ezoë & Toda, 2013; Morahan-Martin & Schumacher, 2000), it confirms previous research evidence of an inverse relationship between age and IA (Ha *et al.*, 2007; Treglia & Tomassoni, 2018). Thus, per the results of this current study, only lonelier youth are vulnerable to IA, which confirms a significant positive correlation ( $r = 0.228$ ,  $p = 0.000$ ) obtained in table 6 above.

### **Internet Addiction (IA)**

Generally, the results showed that the SPs could be categorized as normal to mildly addicted internet users considering their mean overall, males and female IAT scores respectively. These mean scores were lower compared to available mean IAT scores among Asian students (Haque *et al.*, 2016; Nemati & Matlabi, 2017). This may be attributable to the period of availability of free internet (Wi-Fi) to students in this university, and perhaps the means of accessibility of internet resources in our part of the world. A significant finding was that out of the 1165 voluntary participation, the majority (36.2%) were normal internet users (figure 1). This is lower compared to 48.36% in preliminary study (Amoah *et al.*, 2020) although numerically higher. The difference may be due to the higher number of participants in the current study.

Another key finding was that 13 (1.1%) students scored within the severe addictive range on the IAT (figure 1). This finding is in sharp contrast to the observation in their preliminary study (Amoah *et al.*, 2020) in which no participant scored within this range. It however confirms their prediction

that widening the scope to cover the whole KNUST student population may reveal the actual percentage of students addicted to the internet (Amoah *et al.*, 2020). The difference may be attributable to two factors namely; widened scope of participation to include students from all colleges and increased voluntary participation. This finding presents a representative picture of IA levels among KNUST students who have been exposed to virtually free Wi-Fi with relatively less rigorous parental supervision which usually predispose more tertiary students to IA (Erol & Cirak, 2019a; Kuss *et al.*, 2013; Young, 2004). Compared to extant IA prevalence evidence, a finding of 1.1% IA prevalence rate is lower than findings from previous studies (e.g., Christakis *et al.*, 2011; Gregory, 2021) among some Western and Asian students (Kapahi *et al.*, 2013; Masud *et al.*, 2016; Wallace, 2014; Treglia & Tomassoni, 2018; Uddin *et al.*, 2016). More so, it is lower than the global prevalence of 6.0% obtained by Cheng & Li., (2014) after a meta-analysis of studies involving 31 nations across seven world regions. The relatively lower prevalence observed in the Ghanaian sample is similar to what is reported among some Nigerian undergraduate (Nduanya *et al.*, 2018; Omoyemiju & Popoola, 2021) students. The differences may possibly be reflective of the quality, speed and penetration of internet services in Ghana, relative to that in other countries (Miniwatts Marketing Group, 2021) and the availability of free internet (Wi-Fi) to students at the various universities. Moreover, the 1.1% prevalence rate is higher than prevalence rates found among students from some Asian countries (Chamika & Dias, 2018; Haque *et al.*, 2016; Sharma *et al.*, 2014) who found no IA addiction among their participants. The differences may be attributed to lower sample size and possibly their reliance on mostly health professional trainees as participants, as was the case with the authors' preliminary studies. It appears that health professional trainees' cohorts are generally

more resistant to problematic internet use, given the comparatively demanding nature of their program of study (Amoah *et al.*, 2020).

Another key finding was that 454 (39%) participants had a mild addiction to the internet (figure 1). This means even though they devote extra unplanned time on the internet than desired, their addiction to the internet is manageable than found among Malaysian and Italian medical students (Haque *et al.*, 2016; Servidio, 2017) respectively. This may be explained by the fact that KNUST students are probably generally normal to mildly addicted internet users.

Another important finding was that unlike the preliminary finding of 9.84%, 19.9% (221) of the SPs scored within the moderate IA range on the IAT (figure 1). This is higher than 12.7% found among Nigerian students (Nduanya *et al.*, 2018) and 12% of Sri Lankan students (Chamika & Dias., 2018). It is however lower than 21.9 and 32% among Italian Servidio, (2017) and Malaysia students (Haque *et al.*, 2016) respectively. This figure represents an increase of 10.06 percentage points with widening participation to include students from other KNUST colleges. This suggests that as internet speed, availability and penetration increase over the years in Ghana (Miniwatts Marketing Group, 2021), many more mild and moderate users may move to the severe end of the addiction continuum, if KNUST (like most tertiary institutions in the Sub-Saharan Africa), continue to offer unrestricted high-speed internet services to their students (Amoah *et al.*, 2020), for which preventive education must begin.

## **The relationships between IA and psychological variables**

### **Correlation with Self-Esteem and Loneliness**

The results revealed a significant but weak positive correlation ( $r = 0.288$ ,  $N = 1165$ ,  $p = 0.000$ ) between participants' IA scores and

both of their Self-esteem and loneliness (table 6). From the face validity, these results may seem counter intuitive, however, it is accurate since higher scores for both variables indicate greater severity or magnitude (please refer to description under measures used). This is in line with research evidence that low self-esteem (higher score) predisposes addicts to IA (Erol & Cirak, 2019a; Ko *et al.*, 2007). This finding also replicates the authors' preliminary findings and other findings among Iranian undergraduates (Bahrainian *et al.*, 2014). It however contradicts significant but inverse correlation found by Salarvand *et al.*, (2018) and Seabra *et al.*, (2017). The differences may be explained by differences in scoring methods and measures used.

As noted earlier, increases in loneliness are associated with increases in internet addiction ( $r = 0.288$ ,  $N = 1165$ ,  $p = 0.000$ ) from table 6. This finding corroborates previous findings (Chamika & Dias, 2018; Ezoe & Toda, 2013; Morahan-Martin & Schumacher, 2000) and consistent with authors' preliminary findings (Amoah *et al.*, 2020). Loneliness – IA link has been explained by the finding that unassertive vulnerable lonely youth tend to use online computer-mediated social interaction as a compensatory behavior to overcome loneliness, stress and susceptibility to boredom (McKenna & Bargh, 2000; Velezmoro *et al.*, 2010), which in-turn, contribute to generalized problematic internet use (Caplan, 2002). The overall weakness of association may be explained by the fact that low self-esteem as a construct, may be related to other constructs such as personality characteristics of shyness, inadequate social skills, lack of confidence and feeling of alienation, (Corcoran and Fischer, 2000; 644). Further investigation is warranted for better elucidation on the subject.

### **Correlation with Depression**

Our analysis in table 6 found a positive association between depression and IA ( $r = 0.270$ ,  $N = 1165$ ,  $p = 0.000$ ). This is consistent with previous research evidence (Chamika & Dias, 2018; Hoare *et al.*, 2017; Adiele & Olatokun, 2014; Christakis *et al.*, 2011; Yen *et al.*, 2008). Though significant, the relative weakness of the correlation, like loneliness, may be attributed to the possible moderation of personality characteristics such as shyness, locus of control, inadequate social skills and feelings of alienation (Caplan, 2002; Chak & Leung, 2004; Treglia & Tomassoni, 2018). Christakis *et al.*, (2011) for example, have suggested a mutually enhancing cyclical relation between problematic internet use and depression whereby each of the two may precipitate the other with social isolation as an intermediary factor. The possible mediating roles of the above-mentioned personality characteristics have not been investigated in this cohort in Ghana and must be considered in future studies

### **Correlation with Satisfaction with Life (SWL)**

An inverse relationship ( $r = -0.209$ ,  $p = 0.000$ ) found between IAT and SWL in table 6 implies that as a participants' internet addiction increases, their personal evaluative estimation of their satisfaction with life (SWL) decreases and vice versa. As with the other variables above, increases in use of the internet may be a compensatory behavior for lower social competency and overcompensation may eventually engender addiction. The current correlational magnitude is lower but confirms findings in the previous preliminary study by authors (Amoah *et al.*, 2020) and replicates findings from other previous studies (Erdogan, Yildirim & Cigdem, 2018; Lachmann *et al.*, 2018; Longstreet & Brooks, 2017; Shahnaz & Karim, 2014). It also validates research evidence that IA is higher in citizens in nations

with greater dissatisfaction with life (Cheng & Li., 2014).

### **Limitations of the Study**

The findings from this study must be interpreted with caution for a couple of reasons. First of all, cross-sectional methodology used in this study does not permit a causal inference between the psychological variables of interest. This could serve as a basis for more rigorous experimental studies to obtain causal relationships. Secondly, generalization of the findings from this research to other Ghanaian youth must be done cautiously since it is based on only representative samples from one university; KNUST. That notwithstanding, the findings so far could be a useful basis for IA preventive education, counseling and treatment.

### **Suggestions for Future Studies**

The current study was carried out with a limited scope of IA prevalence and its associations with psychological variables of interest. Equally important areas such as average time participants spend on the internet and the youths' reasons for internet use, have not been explored in this cohort. Also, other predisposing factors such as the number of smart gadgets, social media accounts the youth possess, the amount of time they spend on their internet sites of interest to mention a few, are important areas to explore in future studies. Moreover, the possible moderating role of personality characteristics between IA and loneliness, self-esteem and with depression need to be subjected to further investigation because of the weak correlations obtained in this study. Finally, even though the IAT user manual enjoins researchers and clinicians to use test takers' pattern of symptoms (i.e., subgroup scores), to compliment IA test scores, it has not featured in the IA research to date. It will be interesting to compare research involving subgroup averages from different parts of the globe.

## CONCLUSIONS

It has been established in the current study that approximately 1% (i.e., about 660) of KNUST students are severely addicted to the internet who need clinical intervention. Also 58% (i.e. 39% and 19.0%) mild and moderately addicted KNUST students stand the risk of continuing towards the severe end of the internet addiction continuum. The study also found positive correlation between IA and higher problems with participants' self-esteem, loneliness, depression and an inverse relation with satisfaction with life, which must all be considered during preventive education, counseling and treatment.

## IMPLICATION AND RECOMMENDATIONS

IA is becoming a global mental and public health concern. The findings from this study therefore have policy, preventive health behavior and clinical implications at the institutional and national levels. First and foremost, an internet policy in terms of regulation of its use, must be considered for educational institutions in Ghana as a whole. As it stands now, the youth have unbridled access to any internet site without any form of regulation. The question is whether or not they use this privilege responsibly. Our recommendation therefore is that stakeholders such as school authorities, parents, civil society, religious organizations etc., must take steps to regulate and to monitor the youths' internet activities.

Secondly, in terms of preventive health promotion, education on the negative consequences of internet use, especially on its high addictiveness, must be routinely carried out among the youth in educational institutions in Ghana in general. Last but not the least, for the bulk (58%) of the mild and moderately addicted youth, pre-emptive counseling is recommended in institutions

of higher learning to obtain mastery of their internet use in order to prevent them from falling victims to IA. More so, we recommended that IA screening and considerations of its psychological correlates be integrated into the University Counseling Units' routine work. Moreover, this study could be used as a basis for a bigger national research for advocacy, formulation of a national guideline and youth policy for internet use, as well as for future addiction monitoring and treatment programs.

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