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Mental Health Impacts of Information and Communication Technology Usage in South Africa

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ABSTRACT

This study examined mental health issues affecting the group of individuals who are in the social media contact list of the researchers. This was done by administering a closed structured questionnaire, covering information from participants' demographic characteristics, duration of time spent on ICT usage, to their perceived health effects thereof. Male respondents, largely unemployed are active ICT users, addicted to the Internet, and also suffer from unspecified ailments. Aged 31–35 and above, half of men and all women participants spend more than 5 h per day. High-intensive ICT use is associated, in general, with concurrent symptoms of information overload, depression and Internet addiction. It is insignificantly associated with composite stress. Medium intensive ICT use is correlated with fatigue and depression in equal measure but in opposite direction. There are significant differences in demographic attributes as they explain intensity of ICT Usage. The older the employed survey participants are, the less they suffer from composite stress. However, black South Africans suffer significantly from composite stress, fatigue and depression, though negatively from internet addiction. The results also indicate that South African men have negative experiences of composite stress, depression and internet addiction. Educated South Africans have negative experiences of fatigue, but positive experiences of composite stress, depression and internet addiction. Low intensive use of ICT has no impact on composite stress, fatigue and depressive moods of survey participants. It impacts negatively on internet addiction. Medium intensive use of ICT impacts positively on survey participants' experiences of fatigue, but negatively on composite stress, depression and internet addiction. High-intensive use of ICT impacts positively on survey participants' experiences of composite stress and depression.

KEYWORDS

Information and communication technology; mental health; Internet addiction; depression; fatigue

1 Introduction

There are limited studies that focus on information and communication technology (ICT) usage in South Africa, let alone on the mental health aspects of this phenomenon. This stimulates the interests of these researchers on this important aspect in a developing country that is confronted with serious challenges in the area of health.

South Africa is undergoing socio-economic transformation from its racially divisive, social segregation policy of apartheid to an all-inclusive society. The challenges of growing the economy have also emerged in the recent past. Government has laid strong emphasis on tackling unemployment, which currently stands at 29.1% [1], achieving economic growth and social transformation through emphasizing inclusive growth.

Social integration has been difficult; and it is particularly challenging in the workplace. Employees having tight deadlines to meet could be affected by stress. Those who get jobs in the country work very hard. Workers put in about 8.6 h per day, but have very low productivity, about $98 per hours worked [2]. However, [3] suggest that high workload and deadlines can encourage long duration of mentally demanding work at a hectic pace without adequate breaks, with stressful consequences.

The overwhelming body of opinion is that when an ICT user obtains relevant and interesting information, the likelihood of facing overload is low; irrelevant information is the one that increases the chances of information overload [4–7]. Work related distractions cost South African businesses up to R89 billion a year. This occurs even when employees, though present at workplace, are unproductive due to distractions [8]. Some businesses lose up to 5% of gross operating profits.

There is still controversy in the literature about the exact association between health and information and communication technology (ICT), with some evidence suggesting links between ICT usage and health problems. Symptoms of mental overload among ICT users has been reported to also be increasing [9].

Fatigue has been linked in the literature the condition involving a strong and persistent form of mental and/or physical tiredness, pain, weakness, exhaustion, and inability to concentrate [10,11]. Several inter-related risk factors which have been linked with the onset of symptom and its development include demographic, lifestyle and environmental factors, including psychosocial and physical working conditions [12]. Depression, as some kind of common psychiatric diseases, is characterized by the presence of low mood or loss of interest. Some researchers link intensive computer use and playing digital games with sleep delay and irregular sleeping pattern [13].

Stress suffered by individuals is identified as a contributory factor to reductions in organizational performance. This is largely due to the fact that individuals suffering from stress make a lot of errors leading to poor quality of work, absenteeism, emotional disorder and difficulties with balancing work and daily life commitments.

Some of the earlier research on ICT usage, and the associated mental health impacts are open to the criticism of not focusing on the relevant developmental perspective by ignoring thorough analysis of demographic differences of the mental impacts of ICT usage. By ignoring this, they are unable to answer pertinent questions on the interaction between demographic variables that are impacted by ICT usage. There are potential differential impacts of ICT usage by intensity of use, on men, women, young people and adults, the educated and those who are not educated etc. This aspect is what this study tries to uncover when determining the health effects on survey participants as a result of information and communication technology (ICT) usage in South Africa. We seek to test the hypothesis that differential usage in the intensity of ICT use is associated with problems of perceived health. This paper consists of five sections. Section one is introductory; while the second section reviews salient literature on the topic. Section three is the research methodology section. In section four, data collected from the online survey are analyzed; results are also interpreted and presented. The last section concludes the study and makes some recommendations.

1.1 Access to Information and Communication Technologies (ICTs)

ICT represents essential tools used for collecting, processing, storing, transmitting and dissemination of information [14]. It is the platform where computing and communications combine [15]; but it can also be

explained as any "platforms contributing to the display, processing, storing, and transmission of information through electronic means [16,17]".

Low-cost Internet access makes it easier to achieve information retrieval [18], yet the Internet offers enormous amounts of numerous information which some people may perceive as challenging. The explosion of Internet, emails, e-marketing introduce new phenomenon such as receiving too much information, involuntary extensions of social networking, and rapid changes in technological features.

Cost of data is expensive in South Africa, compared to neighboring countries. Hence, regulators in the country, concerned about expanding access to the Internet and are recently advocating the lowering of data costs. South Africa's Competition Commission, late in 2019 ordered Vodacom and MTN, the main network service providers, to reduce the cost of connectivity and make available free access to the poorer segment of the society. Government is also prioritizing access to free public Wi-Fi, as a way of providing an alternative to broad-band access especially among underserviced communities [19]. Facebook Lite was introduced in South Africa 2015 and some network operators allow Internet to be used free of data charges. Under conditions of high unemployment, the unemployed group of survey participants are unable to use the information received, perhaps because they are irrelevant to job search.

1.2 Social Media Could Be a Problem

The South African population is generally well connected as shown in Tab. 1. About 85% of the population uses any type of mobile phone. Sixty percent of the population uses smartphone, and 61% of Internet users prefer to complete tasks digitally whenever possible [20].

Table 1: ICT user population in South Africa by type of platform 2019

ICT platform type	ICT platform description	ICT_User_Population (%)
Mobile phones	Mobile phone types	85
	Types of smartphone	60
Television	Any kind of TV	82
	Streaming TV TV with Internet content	3
Computers	Notebook or desktop	24
	Portable Tablet	12
Other electronic gadgets	Electronic-reader device	1
	Wearable technology device	2

Source: [<20].

Opportunities presented by access to the Internet are substantial! There were 31.18 million active Internet users in South Africa in 2018; of these 28.99 million were active mobile Internet users [20]. South Africans with access to the Internet do so for personal reasons on any device as follows: daily (65%), at least once weekly (22%), at least once monthly (8%) and less than once monthly (4%) On average South Africans spend approximately 9 hours per day on the Internet using any ICT device [20].

Fig. 1 shows South Africa's Internet penetration 2017–2023 as projected. It has been growing noticeably; and in 2018 by 7% year on year. Facebook and google search engine are the most popular. The social media penetration rate is 40% of the population. Facebook is by far the biggest platform, with a penetration rate of 53% [20].
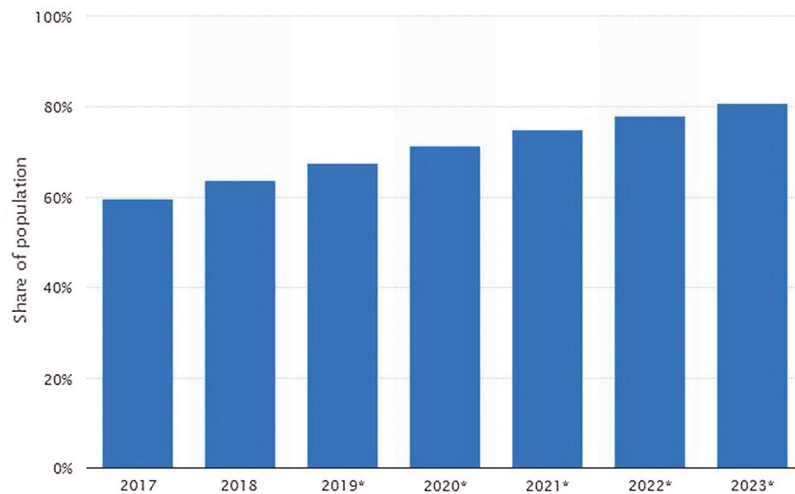
Figure 1: South African Internet user penetration from 2017–2023
Source: [21].

1.3 Information Overload Linked to Social Media

In South Africa, there's an increasing desire to know more about current affairs and to participate in trending discussions. Tweets, texts and even WhatsApp voice notes from the public are now being broadcast on air to express opinions or drive content [20]. The level of modernization of South Africa is also very high. Receipt of unwanted messages, advertisements, promotions, emails, etc., is substantial. There are enormous difficulties unsubscribing to some sites leading to the receipt of numerous messages over a prolonged period of time with stressful consequences. Therefore, this study sought to know participants understanding of the health impact of ICT usage on individuals in the country. Authors such as [22] report that the level of information literacy influences young people's perception of IO.

The notion of information overload (hereafter referred to as IO) has a long history [23,24]. Some authors traced IO back to Conrad Gesner in 1550s, Samuel Johnson in the 1750s and Vannevar Bush in the 1950s, others see it as being influenced by technological advancements [25]. A discussion was conducted, of the nature and causes of information overload. This is contained in [26].

In the field of psychology, overload is defined as a situation where the input of information is greater than the capacity of the human recipient to process it [27–29]. This is mainly due to the lack of control and ability to manage information by the information and communication technology (ICT) user. In this regard, information becomes ineffective, resulting in difficulties to process the message and confusion in the mind of the recipient. This results in psychological stress [30–32].

Results reveal that of the 15 platforms studied, only the use of 5 media outlets respectively substantively predicted IO [33]. These are print newspapers, news magazine, computer, netbook, iPhone, other smartphones, e-reader, iPod Touch, iPad, and news portals, Facebook, Twitter, YouTube, Blogs and TV). TV and iPhone usage negatively predicted IO; on the other hand, computer usage, usage of e-reader, and Facebook technologies positively predicted IO [34].

Overall, information overload as a result of ICT usage has brought health related dimensions like stress, back pain, upper limb pain, fatigue, continuous headache, sleep loss, addiction, and other related issues. This study will examine these psychological effect on individuals, resulting from their use of ICT devices, in South Africa.

1.4 Rationale for the Study

Concerns about what is happening in the public space is growing and there are difficulties with knowing the difference between the truth and fake information [35]. In this regard, concerns about emotional and

health impact of ICT usage is interesting both from theoretical and methodological perspectives [28]. This is due to the fact that secondary information could be distorted. Stories could be retold and circulated, by appealing to the emotions unsuspecting listeners [36], in an attempt to shape opinion [37,38]. These ICT users fall into different demographic categories which highlight different areas of concern to different interest groups. Contents of Internet that people access may markedly differ. The active presence of young people on the internet poses serious challenges regarding access to unwanted information especially in relation to pornography, child dating and child trafficking. Concerns in this regard are in the aspect of the destructive quality (or contents) of information and communication as a risk factor for mental health [39]. Bullying can be done via email, web pages, and by mobile phone, and includes misuse of picture taking. The observation of intensive female mobile phone usage may be part of a lifestyle and developmental stage characterized by close friendships, disclosing secrets, and sharing important first-time experiences.

The South African Stress and Health (SASH) community survey estimates that 4.5% of South Africans suffer from alcohol abuse, 4.9% from major depression, One third of all South Africans have mental illnesses and more than 17 million people in South Africa are dealing with depression, substance abuse, anxiety, bipolar disorder and schizophrenia. The survey estimated the prevalence of major depressive disorder (MDD) at 8.9% and that of anxiety-related disorders at 14.6% [40].

Therefore, policy makers and opinion leaders are increasing concerned about how distributed information imparts and impacts on their constituents. Considering the widespread usage of information and technology devices, it is essential to examine the mental health effects of ICT usage on South Africans, De Wet et al. [41] suggest conducting further research on the impact of ICT usage on communication between employees, their colleagues and family members, particularly in South Africa. This has motivated these researchers to focus on contact group of friends and relatives and colleagues on social media in this study.

2 Research Backgroud

2.1 Research into Theoretical Relationship between ICT Usage and Health Effects

Research into ICT use in relation to the health and well-being of workers have been conducted by authors such as [42]. Authors suggest that a lack of social connection or the absence of family or other social support or social capital [43] can negatively affect mental state.

Women in general often use ICT to seek information or communicate while men use it to entertain. For women, the high combined use of computer and mobile phone and frequency of SMS messaging per day, are associated with increased risk of internalized behavioural problems such as stress and symptoms of risk [39]. Online chatting and e-mailing are associated with symptoms of depressions, while Internet surfing increased sleep disturbances. For males, excessive use of ICT may lead to internalized and externalized behaviour problems. When the number of mobile phone calls and SMS messages used by men are considered, they are usually associated with sleep disturbances, with SMS messages also being associated with symptoms of depression. Men find in-person self-disclosure difficult, they tend to benefit more from online communication.

It has been observed that individuals depend practically on internet search engines to source for information these days. Diverse search engines such as Google, Yahoo, Altavista, and networking sites have also affected the information seeking behaviours of many individuals and academic researchers [44]. In a search for new information, web pages allow a wide array of opportunities and avenues from across the world. In this context, experts have identified the Internet as the most popular information source for many young people around the world. Authors such as [45] point out that the Internet is just a medium of communication, and cannot in itself be considered good or bad for mental health. It has, however, been

observed that nearly 90% of European young people aged 16–24 years use the Internet daily, and 48% of them seek health-related information on the Internet [46].

However, recent research has not paid sufficient attention to the possible influences that ICT devices could have on the individuals or employees who navigate the internet regularly. They tend to be limited in scale and scope [47] and tend to be under-studied [48]. However, studies focusing on perceptions of information overload by individuals, and their effect on them suggest that rapid advances in digital communication technologies have impact on human health [49,50] and have identified strains as some type of negative health effect on the individual.

The South African Stress and Health (SASH) community survey estimates that 4.5% of South Africans suffer from alcohol abuse, 4.9% from major depression, One third of all South Africans have mental illnesses and more than 17 million people in South Africa are dealing with depression, substance abuse, anxiety, bipolar disorder and schizophrenia. The survey estimated the prevalence of major depressive disorder (MDD) at 8.9% and that of anxiety-related disorders at 14.6% [40,51] find both positive and negative experiences of ICT usage on employees' professional and personal lives, though the positive outweigh the negative. They identify Internet addiction and distraction from family lives to be a negative aspect of ICT usage, though it increases their availability to their employers and family. ICT facilities such as WhatsApp provide cheaper means of communication compared to traditional phone calls. This eliminates travel time and enables information sharing.

They however suggest conducting further research on the impact of ICT usage on communication between employees, their colleagues and family members, particularly in South Africa. Authors like [37] have provided results showing that social network users are less depressed, confirming evidence that social networks can have a positive influence on health and improve health outcomes for people with depression. The study conducted by [52] find that education, age and marital status are important determinants of depression among black women.

Some authors attribute the concurrent increase in intensive ICT usage and health problems to the deteriorated sleeping habits. They cite evidence of reduced sleeping times among individuals adolescents in recent years suggesting that sleeping time has decreased by approximately one hour since the end of the 1970s, particularly in the latter half of the 1990s. On the other hand, evidence reviewed by [53] suggests that moderate use of digital technology tends to be beneficial for children's mental well-being, while no use or too much use can have a small negative impact. In their study, Selfout et al. [54] report that for children with low-quality friendships, spending time just surfing seemed to lead to a slight increase in self-reported feelings of depression over time.

Message overload is a situation where engagement in social messaging exceeds users' communicative and cooperative capacities [55]. Some authors suggest that participants using a high number of social media platforms, can experience all three negative emotional states of depression, anxiety and stress [56]. Users may have many friends on social media and hence may receive many messages, news feeds, notifications and announcements from their friends at any time anywhere. In social messaging activities or communication are not easy to ignore. In its two-way framework, users' friends might be waiting for responses. Messages from intimate friends and family members are highly important and users have to deal with them. Nevertheless, in a number of situations, e.g., driving car, or meeting with others, it may not be convenient for users to communicate with friends and family members; hence incoming social messages would make them anxious. Authors suggest that a lack of social connection or the absence of family or other social support or social capital [57] can negatively affect the mental state.

Studies on extreme technology usage suggest that "overload" is the primary reason for concerns about undesirable consequences of ICT usage [58]. In many instances, compacting overloads consumes a lot of energy and might be related to experiences of tiredness [59]. Too much information may possibly

speedily drive consumers developing a feeling of being flabbergasted [43] with advanced ICT burdening people socially and psychologically [60].

Winkle (1998) cited in [61] identifies damaged health and bad judgment as some problems associated with information overload. According to him, studies have linked both decreased vision and cardiovascular stress to information overload. In brief, ICTs have the full potential to result in information overload, which undesirably distresses human conduct, frame of mind, and well-being [28].

Total time spent, using all ICT platforms, on social media, do not show a significant negative emotional effect on participants [34].

2.2 Mental Health and ICT Usage in South Africa

Sometimes referred to as "technostress", information overload (IO) is usually associated with ICT users losing control of the situation such that ICT now controls users, instead of empowering them [62] resulting in reduced intellectual presentation and deprived judgment. Additionally, stress can have dysfunctional consequences, diverting users from their everyday life imperatives [62]. These destructive effects are substantial and growing at the rate of advances in ICT. Others find that information overload influences information seekers' psychological ill-being, by manipulating their behavioral purpose to cease the use of online health information search [62]. Additionally, others reveal that higher levels of IO predict higher levels of perceived stress [60].

In European countries such as France, the use of the Internet to search for mental health information and other purposes is positively associated with poor mental health but not physical health [28]. The literature suggests that most people search the internet for health related topics such as stress, depression and anxiety [28]. Intensive ICT usage may contribute to health-related problems such as passive lifestyle and overweight by displacing physical activity and other health-enhancing practices [63]. The study by [39] identify salient consequences of high quantitative ICT use to include mental overload (interruptions, distractions, multitasking, speed of processing), time pressure, role conflicts, less time for other activities, neglecting bodily signals and personal needs (physical activity, nutrition, recovery, sleep), feelings of guilt due to unreturned messages, relationship stress, social isolation, physical symptoms, worry about electromagnetic radiation, addiction, and financial problems.

Some studies show that fatigue is moderately to strongly associated with various psychiatric disorders particularly anxiety and depression, and general psychological distress [64,65]. Some experts also point to interactive media usage, particularly the Internet, having the potential to become addictive for some, placing them at risk of losing control of their behaviour [66].

In South Africa, the prevalence of alcohol and other drug use disorders is high, with males having higher rates than females, though the gender gap has been narrowing recently [40]. Alcohol, tobacco and illicit drugs–among them cannabis and methamphetamine–are the most commonly used substances. In Western Cape and KwaZulu-Natal provinces, there is a high co-occurrence of substance use and mental disorders [67,68].

Experts find a significant association between substance use and unemployment in South Africa, especially by men ($p < 0.0001$) [69]. The most common substances used were cannabis, followed by alcohol and stimulants. Also, lifetime common disorder is 30% in South Africa and 16.5% in the previous 12 months [40]. In a country where about 85% of the people have mobile phones, about two thirds of Internet users do so on daily basis; this study suggests that Internet addiction, depression, and unspecified psychological health problems all positively contribute to information overload. Only fatigue contributes to reducing it and this is not a significant result.

The nationally representative South African Stress and Health (SASH) study shows that approximately 20% of youth in the country suffer from depression and stress-related conditions every year. Studies conducted among Sesotho-speaking depressive patients in the Free State Province, South Africa show

high incidence of symptoms such as a depressed mood, lack of energy, and thoughts of death and suicide [40,70]. Authors report that depression is found mostly among young black females, often present with various physical symptoms. This they attributed to the escalated levels of rape and social violence.

3 Research Methodology

3.1 Social Media Research Interest

Interest in researching on social media usage has been driven by the rapidly broadening user base for social media technologies, which is related to the continuing spread of Internet use itself. These sites are characterized by their ease of use, their generic nature, focusing on a particular subject or area of interest, and their wide penetration, meaning that significant portions of the population have created an account [71].

Many researchers suggest that the wide variety of social characteristics on social networks such as age, gender, and location could be used to construct more representative samples than might be achieved by simply selecting users at random [72]. This puts data collected from social media at an advantage over traditional survey data.

The Internet, hence, provides new opportunities for non-random or semi-random survey data [73] especially of hard to reach or hard to involve populations[1]. Online sampling is particularly popular in the field of health sciences[2]. Different from the erstwhile static websites, social media which interactive communication is now possible, and have attracted more attention as a source of health information. They have turned the Internet from a static source of health information into a more dynamic source of health communication. The main categories include social networking, blogging, microblogging, social news, social bookmarking, and media sharing.

3.2 Participants Selection and Data Collection

A non-list-based random sampling survey, was carried out online by posting a questionnaire link on different social media platforms (different response modes), to participants who freely participated. This was done by administering a closed structured questionnaire, covering information from participants' demographic characteristics, duration of time spent on ICT usage, to their perceived health effects thereof.

Demographic details are captured as follows: Age is stated in 6 cohorts of age groups with intervals of 5 years, falling between 20 and 40 years of age and over. There are no uneducated participants! As such educational attainment is measured starting at the undergraduate level. There are 4 racial categories and gender is either male or female, otherwise it is unspecified.

3.3 ICT Use Variables

Information about computer use was collected from the online survey participants, including average time spent daily on general computer use, on emailing or chatting in leisure, and on computer gaming, as well as how often the computer was used for more than 2 h without breaks, and how often sleep was lost because of getting stuck late at night by the computer. The study later adopts the approaches of [39] and [76] to classify ICT users, by intensity of ICT usage, into three categories of low, medium and high-intensive users.

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[1] Experts have noted that some individuals, particularly young people experience difficulties in accessing mainstream mental health services and are not inclined to seek professional help [74,75]. They prefer to explore alternative ways of acquiring knowledge on their psychological conditions [46].

[2] Authors such as [36] have discussed some of the salient advantages of online surveys. These include: (1) flexibility of formatting to accommodate language differences of respondents (Facebook has more than 110 languages), (2) time-efficiency, (3) cost-efficiency (4) ease of use, (5) convenience of administration, (6) ease of database compilation, (7) accommodates flexibility of questionnaire formats (multiple choice, open-ended types, scale types, dichotomous, etc.), (8) makes follow up easy, (9) questionnaires could be systematically answered, and (10) can be structured for orderly responses.

3.4 Perceived Information Overload Variable

Information overload is categorized into two (1) Perceived general information overload and (2) message overload. To assess information overload we asked participants, how often have they felt overwhelmed with the amount of information they have had to deal with in the last month. Also, for message overload we assessed the variable by posing the question: In the last month, how often have respondents felt that they received too many messages (e.g., SMSs, WhatsApp, general emails and/or spam emails, wall postings, event notifications, updates, etc.). Responses to the questions follow a 5-item Likert scale ranging from (0) not at all, (1) just a little, (2) to some extent, (3) quite a lot, and (4) very much.

Perceived information overload, refers to participants own evaluation of experiences of information overload consequence of ICT use, and is scaled from 1–5, 1 being the lowest and 5 being the highest. Since this variable is not dis-aggregated, information overload being measured is thus its composite form.

3.5 Health Impact Variables

Health impact of ICT use is, however, first measured in its composite form and later disaggregated into individual components. In order to disaggregate composite stress, participants were asked if they had complained of (1) anxiety, (2) fatigue, (3) depression or depressed mood, reduced performance due to stress, Internet addiction, sleep disturbance/loss and perceived stress which have influenced their performance over the past 14 days. This question allowed participants to offer a range of multiple choice answers.

The possibly destructive quality (or contents) of information and communication as identified by [39] is possible risk factor for mental health in the country, though it has not been the focus of our research at this time.

However, stress is defined to mean a situation whereby a person feels tense, restless, nervous, or anxious or is unable to sleep at night because his/her mind is troubled all the time. We asked respondents whether they were currently experiencing this kind of stress. Similarly, responses follow a 5-item Likert scale ranging from (0) not at all, (1) just a little, (2) to some extent, (3) quite a lot, and (4) very much. Sleep disturbances were similarly assessed.

Following [63] composite stress has been defined to mean a situation when a person feels tense, restless, nervous, or anxious or is unable to sleep at night because his/her mind is troubled all the time. It has been operationalized using a 4-item scale consisting of 0 (no stress) to 3 (highest). The sleep disturbances variable was constructed for the study by including the most common sleep disturbances such as difficulties falling asleep, fragmented sleep, and premature awakening into a single item described as sleep loss.

3.6 A Hypothesized Model of Possible ICT Use and Mental Health Impact

The theoretical underpinning of Fig. 2 is contained in the model proposed by authors [39]. This relates some hypothesized pathways to anxiety, fatigue, stress, depression, and sleep disorders, via the consequences of high quantitative ICT use, negative qualitative use, and user problems. The authors identify a number of central factors to explain high quantitative ICT use which are theoretically pertinent to South Africa. These include demands for, and expectations of, achievement and availability, originating from the domains of work, study, social life, and individual aspirations. These demands could also be direct sources of stress or symptoms of mental ill health. Another central reason for high use was personal dependency. They also suggest that dependency on ICT could be a direct source of stress or a correlate to mental ill health.

We concur with [39] that in addition to the pathways leading from ICT use to symptoms, there are possibilities of paths leading in the opposite direction, for example mental ill health leading to altered (higher or lower) ICT use. The optimal direction of causality is still unsettled in the literature. There could also be highly beneficial effects of ICT use on mental health. These are acknowledged as alternative ICT use-health impact pathways, though they are not particularly the focus of the present model.

ICT Exposure	1st Consequence	Consequences Later	Mental health impacts	Significance in model studied
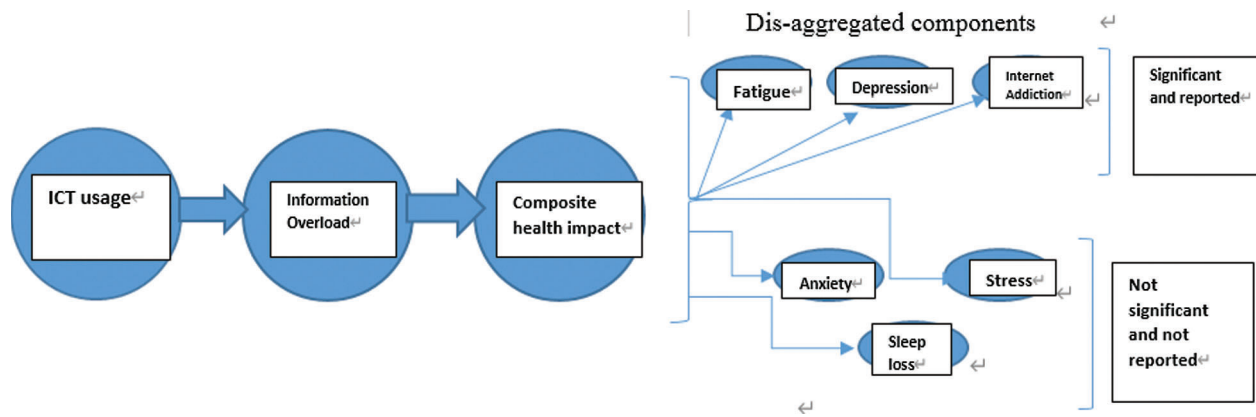
Figure 2: The hypothesized theoretical model mediating between ICT usage and perceived health impact in South Africa

4 Data Analysis and Results Presentation

The survey was carried out during the second half of 2019, July to August. This is an exploratory study that covered one month during the academic year. This is for reason of the University's academic time constraint. In all, 48 completed questionnaires were received and 8 were discarded for being incomplete and lacking in crucial information. Typically, online survey response rates are low! A similar study by [45] obtained 45 completed responses[3].

Data used were first filtered by composite stress experiences of participants. This enabled the researchers to correlate relevant demographic variables with information overload. Then, the study estimated a number of models to determine the relation between composite stress and individual stress impacts on survey participants analyzed by demographic variables and ICT usage.

4.1 Descriptive Statistics of Variables Included in the Analysis

Spearman correlation analysis was used to examine associations between the different information and communication technology (ICT) use variables, and between ICT use and demographic variables.

4.1.1 Correlation between ICT Intensity Use Variables

Like [39] our interest is on the association between ICT usage and mental health variables. Tab. 2 shows high correlation between daily ICT use and low (r = –0.95, $p < 0.0001$) as well as high ICT use (r = 0.95, $p < 0.0001$) but in opposite directions. Medium ICT use is insignificant in the daily ICT use due to its low association with it. There is also a high correlation between low and high ICT use categories (r = 0.81, $p < 0.0001$). Medium ICT usage is weakly correlated with high intensity ICT use (r = 0.41, $p < 0.0001$). This indicates that low ICT use as well as high ICT use make up most of the daily ICT use in South Africa. Authors such as [39] find that ICT exposure variables generated a higher or equivalent prevalence ratio compared to the medium category. They interpreted this result to theoretically indicate a dose–response relationship between the ICT exposure variables and mental health outcomes, though not all associations

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[3] Some Authors explain that the response rate of online studies is influenced by personalization of contact strategies [77], the interest of the target participants on the topic considered [78], the incentives and the length of the survey [79] and some other technical factors [73].

were statistically significant. In our study, dose-response relationship appears to be between low and medium, as well as low and high ICT use. Within the daily use of ICT, it appears that low intensive and high intensive ICT usage are collinear.

Table 2: Tests of significance of correlation between ICT usage intensities and demographic variables

	ICT Intensity use variables				Demographic variables			
	Daily ICT use	Low ICT use	Medium ICT use	High ICT use	Age	Race	Gender	Education
Daily ICT use	1.000							
Low ICT use	−0.95***	1.000						
Medium ICT use	−0.11	−0.22	1.000					
High ICT use	0.95***	−0.81***	−0.41***	1.000				
Age	0.25	−0.26*	0.06	0.21	1.000			
Race	0.26*	−0.22	−0.11	0.27*	0.06	1.000		
Gender	0.39***	−0.33**	−0.17	0.41***	0.09	−0.17	1.000	
Education	0.28*	−0.35**	−0.21	0.19	0.01	−0.02	0.67***	1.000

Note: ***, **, * denote significance at the 1%, 5% and 10%, respectively.

4.1.2 Correlation between ICT Intensity Use Variables and Demographic Variables

Tab. 2 shows that levels of ICT Usage are correlated with some of the demographic variables. Low intensive ICT Usage is correlated with all the demographic variables as well as with high intensive usage of ICT. On the other hand, high intensive ICT usage is correlated significantly with only the gender of participants, though weakly with race. The results show that there are differences in ICT use intensities by demographic variables. Female ICT users, use their gadgets only highly intensely. They are not involved in low as well as medium intensive ICT usage. Male ICT users on the other hand use their gadgets for all the intensities of ICT use but their usage is highly significant in the low-intensive use category.

4.1.3 Tests of Correlation between ICT Use and Disaggregated Classification of Demographic Variables

In Tab. 3, we present further disaggregated analysis of the correlation between ICT usage intensities and disaggregated measures of demographic variables.

4.1.4 Gender and Intensity of ICT Use

Thirty percent of study participants are men, making low intensive ICT usage, using ICT for longer than 2 hours continuously with break. Ten percent and forty of the overall sample are men making medium and high intensive use of ICT. Women are not at all represented in the low and medium ICT intensive use categories, but make up twenty percent of overall ICT usage though they only make high intensive ICT use. Other studies suggest that females, young people from Spain, and Nursing students, in general, are more likely to use the Internet for mental health information-seeking than Computer Science students, while studying in Ireland decreased the probability of doing so [80].

4.1.5 Age and Intensity of ICT Use

There were also no respondents in age cohorts 1 and 3, just like there were no respondents in the education cohorts 4 and 5. In Tab. 3, it is shown that in the low intensity ICT use is positively correlated with our participants belonging to the second age cohort and negatively correlated with belonging to the

fourth age cohort. Medium ICT usage is positively and significantly associated with participants belonging to age cohort 5. Belonging to age cohorts 2 and 4 is associated equally with making high intensive use of ICT though in opposite direction.

Table 3: Tests of correlation between ICT usage intensities and demographic variable cohorts

	Low_ICT Usage	Medium ICT Usage	High_ICT Usage
Men	12 (30%)	4 (10%)	16 (40%)
Women	0 (0%)	0 (0)	8 (20%)
Race1	0.22	0.11	–0.27*
Race3	–0.22	–0.11	0.27*
Age cohort 2	0.51***	–0.11	–0.41***
Age cohort 4	–0.33**	–0.17	0.41***
Age cohort 5	–0.09	0.41***	–0.17
Age cohort 6	0.05	–0.22	0.09
Education cohort1	0.36**	–0.27*	–0.17
Education cohort2	–0.09	–0.27*	0.25
Education cohort3	–0.22	1.000***	–0.41***
Education cohort6	–0.22	–0.11	0.27*

Note: ***, **, * denote significance at the 1%, 5% and 10%, respectively

4.1.6 Education and Intensity of ICT Use

There were no respondents possessing educational qualifications in the 4th and fifth categories. Low intensive ICT usage is positively associated with belonging education cohort1. Belonging to educational cohorts 1 and 2 is negatively associated with making medium intensive use of ICT. Participants belonging to educational cohort 3 appear to make significant and positive use of ICT in the medium category. High intensive use of ICT is associated negatively with belonging to educational cohort 3 and positively with belonging to educational cohort 6.

4.2 Correlation between Information Overload, Sleep Loss and ICT Intensity Use Variables and Gender

In Tab. 4, it is shown that information overload, as the primary consequence of ICT use is, in general associated with sleep loss. It is also associated with high ICT use for both male and female participants. However, there seems to be an associated sleep loss for men with high ICT use compared with women. Women are absent in the low and medium ICT use categories where information overload as well as sleep loss are negative for men.

4.2.1 Gender, ICT Use and Mental Health Outcomes

We present results of the associations between ICT use variables and mental health outcomes.

Tab. 5 shows that high intensive ICT use is associated, in general, with concurrent symptoms of depression and Internet addiction. It is insignificantly associated with fatigue and composite stress. Low intensive ICT use, on the other hand, is negatively correlated with all mental health variables though the association appears to be significant only for Internet addiction. Medium intensive ICT use is correlated with fatigue and depression in equal but opposite measure. High intensive use of ICT by women is insignificantly correlated with any mental health outcomes. In general terms, high ICT intensities generate a higher measure of association with mental health outcomes compared to the low and medium intensive categories.

Table 4: Correlation between information overload, sleep loss and ICT intensity use variables and gender

	Primary consequence of ICT use		Aggregate measure	Gender of users by intensity of ICT use			
	Information overload	Sleep loss	Daily ICT use	Low ICT use by men	Medium ICT use by men	High ICT use by men	Female high ICT use
Information overload	1.000						
Sleep loss	0.30**	1.000					
Daily ICT use	0.37***	0.49***	1.000				
Male low ICT use	–0.29*	–0.39***	–0.95***	1.000			
Male Medium ICT use	–0.23	–0.29*	–0.111	–0.22	1.000		
Male high ICT use	0.41***	0.53***	0.95***	–0.53***	–0.27*	1.000	
Female high ICT use	0.42***	–0.04	0.39***	—	—	——	1.000

Note: ***, **, * denote significance at the 1%, 5% and 10%, respectively.

Table 5: Tests of significance of correlation between ICT Usage intensities and mental health variables and gender

	Male respondents			Female	Total
Mental health/ Probability	Low ICT use intensity	Medium ICT use intensity	High ICT use intensity	High ICT use intensity	High ICT use intensity
Composite stress	–0.12	–0.06	0.23	–0.09	0.15
Fatigue	–0.22	0.33**	–0.0000	0.00	0.00
Depression	–0.22	–0.33**	0.41***	0.00	0.41***
Internet addiction	–0.43***	–0.22	0.37**	0.22	0.53***

Note: ***, **, * denote significance at the 1%, 5% and 10%, respectively.

4.2.2 Age, Information Overload and Health Impact of the Intensity of ICT Use

In Tab. 6, age cohort 2 appears to be negatively associated with mental health outcomes but significant only with information overload, fatigue, and depression. Belonging to age cohort 4 is linked positively with experiencing information overload and Internet addiction, while belonging to age cohort 5 is positively correlated with experiencing fatigue. Belonging to age cohort 6 is negatively associated with experiencing composite stress, information overload, and Internet addiction.

Table 6: Tests of significance of correlation between IO, the age of users and ICT Use intensities and mental health variables

Mental health/ Probability	Age cohort 2	Age cohort 4	Age cohort 5	Age cohort 6
Composite stress	–0.06	0.37**	0.23	–0.53***
Information overload	–0.49***	0.81***	–0.09	–0.29*
Fatigue	–0.33**	–0.50***	0.82***	–0.22
Depression	–0.33**	0.0000	–0.0000	0.22
Internet addiction	–0.22	0.76***	–0.09	–0.43***

Note: ***, **, * denote significance at the 1%, 5% and 10%, respectively.

4.2.3 Education and Intensity of ICT Use

In Tab. 7, mental health outcomes are mixed for participants in the first education cohort. It is significantly negative for depression and significantly positive for Internet addiction. The reverse is the case for participants belonging to educational cohort 2. Those belonging to educational cohort 3 experience fatigue and depression in opposing degrees of significance. Participants in the educational cohort 6 have positive experiences of informational overload, depression, composite stress and Internet addiction. They have negative experiences of fatigue. Authors such as [37] find that educated participants are less depressed than the non-educated ones. Our results show that this is applicable to those in educational cohorts 1 and 3. However, our survey participants in educational cohorts 2 and 6 show positive correlation with depression. Participants in educational cohorts1 and 2, just like those belonging to educational cohorts 2 and 6 show equal but opposite measures of correlation with depression.

Table 7: Tests of significance of correlation between IO, the educational attainment of users, ICT use intensities and mental health variables

Mental health/ Probability	Educational cohort 1	Educational cohort 2	Educational cohort 3	Educational cohort 6
Composite stress	–0.15	–0.15	–0.06	0.56***
Information overload	0.06	–0.25	–0.23	0.54***
Fatigue	–0.000	–0.000	0.33**	–0.33**
Depression	–0.41***	0.41***	–0.33**	0.33**
Internet addiction	0.36**	–0.53***	–0.22	0.51***

Note: ***, **, * denote significance at the 1%, 5% and 10%, respectively.

4.3 The Multivariate Regression Analysis

The study adopts a multivariate regression approach being a statistical method that examines the effect of two or more independent variables on two or more dependent variables. Multivariate regression analysis designs are appropriate when multiple dependent variables are included in the analysis. A 99%, 95% and 90% confidence intervals (CIs) have been used for multivariate analyses of prospective associations between ICT use variables (low, medium and high intensities) and mental health outcomes [39].

4.3.1 Independent t-tests

Models estimated in the study covered the dimensions of individuals' perception of composite stress experience resulting from ICT usage. Items loaded on the three dimensions of composite stress; and the second model is based on the composite stress experience (fatigue, depression and Internet addiction) in intensity of ICT use and are based on the following hypotheses:

Hypothesis 1: The psychological experience of composite stress on ICT users is composed of three independent but positively interrelated components, namely: fatigue, depression, and feelings of Internet addiction to ICT use.

The prescribed condition of linearity of dependent variables means they should be moderately correlated, i.e., having correlation of reasonably between 0.3 and 0.7 [81]. Our results, in Tab. 8, show that the dependent variables are correlated with each other between 0.28 and 0.6. ICT use variables have correlation with the dependent variables of between 0.33 and 0.41. This suggests that the components in the model were fairly independent and can be used as independent variables; it allows us to examine the health impact of participants at each ICT usage intensity scale. Homogeneity of variances requires that the dependent variables should have apparently equal levels of variance across the range of the predictor variables (factors) and there is homogeneity of covariances, i.e., the inter-correlations (covariances) between pairs of dependent variable across all the levels of factors are approximately equal [81]. We also performed tests for equality of means between coefficients of the dependent variables (fatigue, depression and Internet addiction) on those of intensities of ICT Usage and demographic variables. The Levine F-Value Test was F(2,38) = 28.7. This result is highly significant at the 1% level. This confirms results of the individual correlation tests reported in Tabs. 2–7.

Table 8: Correlation test of Linearity of dependent variables

	Composite stress	Fatigue	Depression	Internet addiction
Composite stress	1.000			
Fatigue	–0.19	1.000		
Depression	0.56***	–0.20	1.000	
Internet addiction	0.28*	–0.22	0.22	1.00

Note: ***, **, * denote significance at the 1%, 5% and 10%, respectively.

4.3.2 Results of Multiple Regression Analysis on ICT Usage

A series of hierarchical regression analyses (incorporating key covariates) were conducted to test the hypothesized relationships among independent/predictor, moderator, and predicted/dependent variables. Descriptive analysis, correlations (Pearson r), and Generalized Least Square Method (GLM) were implemented. This was done in order to test whether or not survey participants differed in their use of ICT; it was carried out to distinguish those with low-intensive ICT use with those making medium and high-intensive ICT use. All demographic variables were included in the models. Only the impact of significant stress types is reported in Tab. 9. These are depression, fatigue and Internet addiction.

The multivariate analysis examining the impact of ICT use (low-intensive, medium-intensive and high-intensive users) on the dimensions of techno-strain we specified fatigue, depression, Internet addiction as the dependent variables and included demographic variables with ICT use categories also as independent variables. The specified models show the significance of the multivariate effects of ICT use in impacting on technostress variables.

Table 9: Mental health impact of ICT use by intensity of use

	Demographic variables				Univariate intensity of ICT intensity use categories as included in models			
	Age	Race	Gender	Education	Low ICT	Medium ICT	High ICT	R^2
Composite stress	−0.12***	0.46***	−0.76***	0.34***	0.06	—	—	0.84
	−0.11***	0.38***	−1.07***	0.41***	—	−0.65***	—	0.94
	−0.14***	0.39***	−0.92***	0.34***	—	—	0.21***	0.86
Fatigue	0.12*	0.27**	0.33	−0.15**	−0.15	—	—	0.22
	0.10**	0.41***	0.86***	−0.27***	—	1.09***	—	0.56
	0.15**	0.38***	0.58**	−0.15**	—	—	−0.30*	0.27
Depression	0.15***	0.22*	−0.47**	0.21***	0.02	—	—	0.33
	0.18***	0.10	−0.99***	0.35***	—	−1.14***	—	0.73
	0.12***	0.09	−0.78***	0.23***	—	—	0.45***	0.48
Internet addiction	−0.16***	−0.25**	−0.06	0.03	−0.59***	—	—	0.36
	−0.09	−0.19*	−0.15	0.13*	—	−0.52**	—	0.16
	−0.15***	−0.37***	−0.46***	0.11***	—	—	0.79	0.61

Note: ***, **, * denote significance at the 1%, 5% and 10%, respectively.

The older the employed survey participants are, the less they suffer from composite stress. However, black South Africans suffer from significantly from composite stress, fatigue and depression, though negatively from internet addiction. The results shown by the gender variable indicate that South African men have negative experiences of composite stress, depression and internet addiction. Educated South Africans have negative experiences of fatigue, but positive experiences of composite stress, depression and internet addiction.

Low intensive use of ICT has no impact on composite stress, fatigue and depressive moods of survey participants. It impacts negatively on internet addiction. Medium intensive use of ICT impacts positively on survey participants' experiences of fatigue, but negatively on composite stress, depression and internet addiction. High-intensive use of ICT impacts positively on survey participants' experiences of composite stress and depression.

5 Conclusions and Recommendations

This study is about seeking to understand mental health impacts of ICT use by intensity of usage in South Africa. This was done among survey participants who are in the online contact list of the researchers. This group includes followers on Facebook, WhatsApp contact, email contact list and twitter contact. The group of unemployed survey participants report being unable to use the information received. This might suggest that they were receiving irrelevant information especially for their job search.

High intensive ICT use is associated, in general, with concurrent symptoms of information overload, depression and Internet addiction. It is insignificantly associated with composite stress. Low intensive ICT use, on the other hand, is negatively correlated with all mental health variables though the association appears to run from information overload to Internet addiction. Medium intensive ICT use is correlated with fatigue and depression in equal measure but in opposite direction.

The multivariate results showed significant differences in demographic attributes as they explain intensity of ICT Usage of survey participants. The older the employed survey participants are, especially of black South Africans, the less they suffer from composite stress and internet addiction but the more

they suffer from fatigue and depression when they intensely make use of ICT. This is indicated by the negative coefficients of these variables in the regression table. Educated participants suffer more from internet addiction and composite stress and less from fatigue and depression as they make intensive use of ICT. Older educated black women suffer from depression while younger educated women suffer from depression and internet addiction.

6 Limitations of Research

The question about whether Internet can be a viable scientific research tool is still being investigated. The main query is related with the possibilities of online methodologies to produce valid and reliable data. One limitation of social media research is the inability to guarantee their longevity going forward. Social media sites such as Bebo and Myspace have come and gone implying that relying on social media outlets for data gathering has its shortcomings. However, there is also a sense in which the current leaders appear to have learnt from some of the mistakes made by these previously dominant sites, and certainly appear to be well positioned to last for a significant amount of time.

Experts have raised questions around the existence of sample bias when collecting social media usage data. This is because Internet population constitutes a biased sample of the total population in terms of demographic characteristics. This raises doubts about its usefulness in social research [82,83]. Social media usage is also not distributed evenly across the population. It is particularly imbalanced across different age groups. Social networking site use is very common amongst younger age groups compared with the older folks. Also, across many different social media sites, there is appears to be a consistent pattern that the majority of content is created by a relatively small minority of users, referred to as "residents", who actively spend their lives online, and "visitors", who go online to search out particular bits of information, and leave when they have found it [84]. Age, education and skills also appear to have some kind of influence on content creation [85].

Authors have mentioned that social media can be useful for tracking expressed reactions to a particular policy. These reactions cannot be easily generalized to broader public opinion. Methods for analyzing public sentiments via the social media outlets are still a work in progress [71]. Although results cannot be generalized to cover the whole population, because the units of observation are not randomly selected, there are other aspects that must be considered in the analysis of external validity, for example, the importance of the theory [86]. In this context, statistical generalization is only referring to the predictive validity of the study. It must be mentioned that not all research questions pursue the aim of predicting results to the population. For instance, many authors have explained that it is possible to make valid inferences from any sample within a theory's domain [86]. Researcher should note the importance of the concept of transferability which acquires great importance in exploratory studies that do not pursue statistical generalization but theoretical validation of the results.

The overall data collection period for this study was also small, especially in the context of collecting data on the health impact ICT usage and getting this to penetrate into public consciousness in South Africa. Further work taking in a much longer time period would be useful in terms of further validating results obtained in this study. There could be much to gain by encouraging future researchers to increase the pool of participants in their contact list. Such an approach ensures that much more interesting policy-relevant research finding is produced in a transparent way, is computationally reproducible manner.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

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