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Birth Order and Prevalence of Substance Abuse: A Descriptive Study of Annexe Patients Diagnosed with Substance Related Disorders

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Abstract

The question of whether an individual's personality can be influenced by their birth order has been researched by several professionals in the mental health sector. Most researchers have found the latter variables to be somehow related. The current study focuses on the prevalence of substance use disorders among individuals with different birth orders. A sample of 79 participants were selected randomly with ages ranging from 17 to 48 years. The aim of the study was to describe the birth order and the prevalence of drug abuse. Results showed that substance abuse was more prevalent among first- and last-born children and less prevalent in middle and second born children and this was attributable to personality traits ascribed to each birth order and stressors they are subjected to according to their birth order. Conclusion drawn indicated that first and last-born children were more vulnerable to substance abuse. It is recommended that further studies be carried out ought to include more variables before drawing conclusion.

Keywords: substance use disorders, birth-order and prevalence

Introduction

Substance abuse has been a subject of research for so many years. Many researchers have focused on different aspects that fuel the problem. Despite all the findings and proposed interventions, drug and substance abuse remain a problem causing untold suffering to individuals, families, communities and society at large. The current research hopes to take a different route in understanding the subject focusing on birth order as one of the determinants of substance addiction.

Personality traits and substance misuse

Benzoni (2023) asserts that the study of personality and its formation has interested researchers, psychologists and scientists alike. It is believed that the order in which a child is born influences their personality. One of the proponents of birth order theory, Adler, avers that the desire is to understand how the social factors influence personality development (Benzoni, 2023). According to Benzoni (2023), birth order theory describes how the effect of birth order shapes children's thoughts and behaviours from first born children to the last born. Benzoni

(2023) further asserts that there are certain characteristics associated with individuals in each respective birth order, some of which are supported by research and some of which are seemingly old wife's tales.

Global perspective of drug abuse

Senay (1991) reported that, during the past 20 years, there has been a substantial increase in the data available on the prevalence and consequences of the use of drugs which are liable to abuse. From a global perspective, the evidence reviewed from various regions indicates that drug abuse is on the increase affecting public health and associated with social problems of great magnitude. Saney (1991) states that the commonly used drugs are alcohol, nicotine, cannabis and opioids. First, it was believed to be a problem that only affected men but now appears to affect both.

Drug misuse in Zimbabwe

Zimbabwe has seen a rise in substance abuse among youths. This has resulted in a rise in substance related disorders and admissions in mental health institutions. Common psychoactive substances used include cannabis, crystal meth and codeine, among others. These have become a serious concern as they relate to problems including crime, spouse and child abuse, poor school performance and dropouts, suicide and hospitalisation (Valkov, 2018). The purpose of this study is to investigate the birth order of patients affected by substance use disorder. The construct of birth order is one of the seven major constructs in individual psychology (Valkov, 2018). It has attracted several researchers in the field of psychology.

Aim and objectives of the study

Aim

The aim of the study was to examine whether ordinal birth order was prevalent more than other variables in substance use disorder patients at a Crisis Support Center.

Objectives

i) To determine frequency of substance abuse among different age groups.

ii) To determine birth order variable in relation to substance abuse.

iii) To explore gender differences in patients with substance related disorders.

Literature review

There are many theories of how personality is formed, adapted and affected by one's external environment that cuts across cultures and associations. Though the concept of birth order as a variable has drawn a lot of interest among researchers, not many studies have been carried out

to understand this phenomenon. Those studies that have been carried out have failed to draw conclusions as to whether this phenomenon exists.

According to Hartshone et al. (2009), the study of birth order and related disorders is very important. Furthermore, Hartshone et al. (2009), assert that past research studies in this area were short-lived, creating the need to revive them.

Birth order research studies show that there are several influences shaping personalities, in addition to birth order personalities (Valkov, 2018).

Common factors shaping personalities

Biological, children inherit many traits and features like intelligence, courage, and physical features from their parents. Other variables include the following:

Social factors: Interaction with others in the individual's circle

Cultural factor: Children grow up consciously or unconsciously adopting traits consistent with culture, beliefs and norms.

Physical environment: The individual's surrounding often has an impact on the development of traits.

Situational: Children face different situations which help them adapt and change aspects of their personality.

Birth order theory

The study is based on birth order theory by Adler who had a working relationship with Sigmund Freud, and sought to create a psychological movement based on a holistic view of an individual (Valkok et al., 2018). Furthermore, Valkok et al. (2018) observed that, in his theory, Adler illustrates how family environments and dynamics play a role in shaping individual psychology during the child's formative years. Although every family is different, there are many similarities between interactions of parents and children. Adlerians classify birth order in terms of 4 general positions, namely first, middle, youngest and only child. (Stewart& Stewart, 2001). In their study of the theory, Eclestein and Kaufman (2012) noted the following:

First child

The theory posits that first born individuals develop a feeling of special privilege and entitlement. They are anxious to do things, they tend to be responsible and rule oriented. In

their study, Eckstein and Kaufman (2012) found that the oldest children have the highest rate of academic success and are most likely to be leaders.

Second child

By having older sibling as role models, the second child often tries to catch up with the older sibling and is likely to be better adjusted in life. Second children could be more competitive, lacking undivided attention of parents, people pleaser, peacemaker, and developing abilities the first child does not exhibit to gain attention. The second child can also be rebellious, independent and does not need support of others.

Middle child

This group presents may suffer *middle child syndrome*. They can be frustrated and easily resentful. Middle children from bigger families are less competitive since their parents' attention is spread thinner for bigger family dynamics.

They also exhibit other characteristics that include the view that life can be unfair, they can be even tempered, and may feel unloved or left out a lot. They also do not have the rights and responsibilities of the oldest child or the privileges of the youngest, they can treat the younger siblings rougher and feel squeezed in the family environment.

Youngest child

The baby of the family tends to get more attention from parents since the older siblings are developing and becoming more independent. Traits of the youngest include charming and outgoing, attention seeker, can behave like the only child, and may feel inferior because everyone seems bigger or more capable. The child also may expect others to make decisions and take responsibility. However, the youngest child can become speedier in development to catch up with other siblings.

Only child

The only child tends to get more attention from adults than a child with siblings, meaning that many of their early interactions involve individuals significantly older than them. This can make them feel like *tiny adults* and can seem more mature than peers with siblings. Their traits include confidence, sensitive, uses adult language, self-centred, pampered, spoiled, and enjoys being the centre of attention. The only child may also refuse to cooperate with others and can be manipulative to get their way.

Application of the theory

The theory illustrates how family dynamics can shape individual psychology during a child's formative years. Understanding what conditions lead to substance abuse is essential to preventing dangerous drug addiction.

Other researchers interested in the study of birth order have come up with different perspectives with regards to personality traits and how they predispose one to substance abuse (Arbor, 2019). A psychological wellbeing publication, Arbor Behavioural Healthcare, published personality traits that may be influenced by birth order and can have a lasting effect on personal, professional and psychological wellbeing of individuals. Arbor Behavioural Healthcare views the youngest child as having inadequate coping mechanisms and is therefore likely to handle anxiety and depression using drugs. The oldest child feels anxious because of parental pressure to succeed, while middle child feels lost and unsupported. All these pressures can create a vulnerability to addiction under right circumstances. Looking at the vulnerabilities, none clearly points to one birth order being more vulnerable than the other.

In another mental health publication, BetterHelp (2023), stress has been singled out as the greatest influences of substance abuse. Each sibling may face their own kind of stress and resort to drugs and alcohol as a coping strategy. First born children have high expectations placed on them leading to the feeling of obligation to fulfil them thus causing stress. Middle children often struggle to live up to the level of the first born and may not receive as much attention. The youngest child may receive a lot of attention, but may also struggle to prove themselves among older siblings and can face issues in establishing autonomy.

All these levels of stress lead to substance abuse making it difficult to determine if one sibling is more likely to try drugs and alcohol more than the other.

Gender and drug addiction

According to Anderson (2019), for so many years research on drug addiction mainly focused on men only as subjects. However, things changed after the second wave of feminist movement of 1960s and 1970s when women became the subject of research as well. The issue of gender was brought into the equation even though the results proved that more males abused drugs than females.

According to Benzoni (2019), many gender researchers now explain gender difference to be a result of the impact of society, for example, childcare, addiction, stigma and relationship

dynamics. In America, a national survey on drugs carried out in 2013 showed that more men were involved in drug and substance misuse (Benzoni, 2019).

Furthermore, Benzoni (2019) attributes the reason for that to the view of women as a gentler sex throughout many cultures around the world. Women are expected to adhere to their strictly outlined gender roles, and when they do not, they are judged harshly for breaking societal norms.

Women face societal stigmas in every area of life, for example, at work, home, school, in the community and even regarding drug and alcohol abuse.

Related studies

Birth order and addiction

According to Adler, alcoholics have built up their original character in a situation of great pampering in which they are dependent upon others. Usually this involves exploiting the mother. Analysing data from the National Longitudinal Study Survey of Youth, Argys, Rees, Averett and Witoonchart (2006) found that last born persons are much more likely to use substances and become sexually active than their first born counterparts. In Sweden, a study recruited over 770 000 participants to determine the connection between birth order and substance abuse. The findings showed that later born siblings were hospitalised for substance use disorder at a higher rate than first born children and there was a monotonic increase in the risk of hospitalisation with the later birth order (Barclays et al., 2016).

Valkov (2018) did an empirical study in Bulgaria to explore the relationship between birth order and substance abuse. The study used a sample of 166 participants who were both out-patients and in-patients. Results from the study showed that the majority of participants with substance use disorder were last born children followed by only child and first born, respectively. There was also statistically significant correlation between birth order and substance abuse (Chi-square – 12,340, p = 0,006). These results were constant with the work of preceding researchers, with last-born children involved in higher alcoholic use than first-born participants (Laird & Shelton, 2006).

In another study, Aslam (2015) explored the frequency of crime among individuals with drug addiction with respect to birth order. A sample of 332 male participants were selected from an in-patient facility. Percentages and frequency distribution were used to compute results. The

study established that the prevalence of substance abuse among first born was 21.98%, 56.63% among middle born, and 21.4% among last born.

Methodology

This study employed a quantitative approach (descriptive research) using secondary data. The method was chosen because the present study focused on birth order and prevalence of drug abuse which would not necessarily need any elaboration for participants.

Data collection

Data was collected from case notes of patients who were attending out-patient therapy sessions and were being managed for substance use related disorders. These included substance induced psychosis, alcohol use disorder, substance use disorder and any condition related to drug use. Notes for both males and females were used.

Inclusion criteria

i) Clients who were captured according to their birth orders in the case notes.
ii) Clients with a substance use related disorder.
iii) All age groups.

Data analysis

Data was analysed using the Statistical Package for Social Studies (SPSS 23). Data was analysed using descriptive statistics and presented using tables, bar graphs and pie charts.

Ethical consideration

Permission to carry out the study was sought from relevant authorities at Annexe. Clients' notes were treated with confidentiality.

Only the researchers had legal access to the notes at Annexe and all careful considerations were taken to ensure safe keeping of the case notes and information collected.

Data analysis and results

This section aims to present analysed data and show research results. Data was analysed using statistical package for social sciences (SPSS 23).

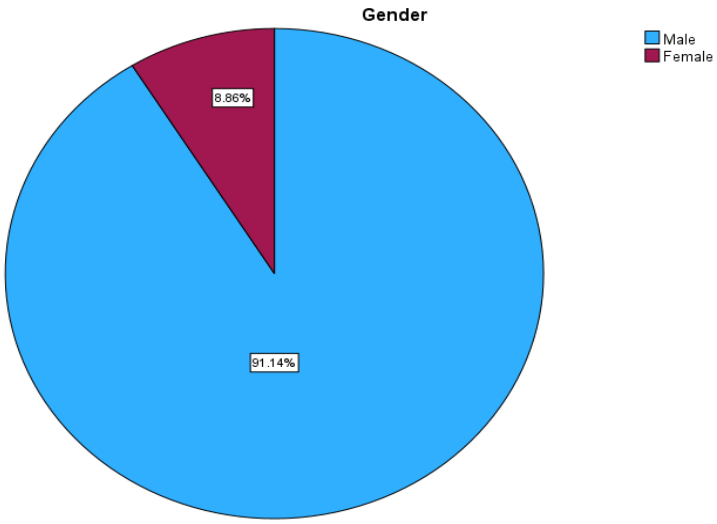

Figure 1: Gender of participants

Table 1: Gender of participants

Gender

	N	%
Male	72	91%
Female	7	9%
Total	79	100%

Figure 1 and Table 1 above show the gender of participants. Total number of participants was 79 (n= 79). A greater number of participants (72) were males (91%) and 7 were females (9%). This shows that there were more males diagnosed with substance use related disorders compared to females.

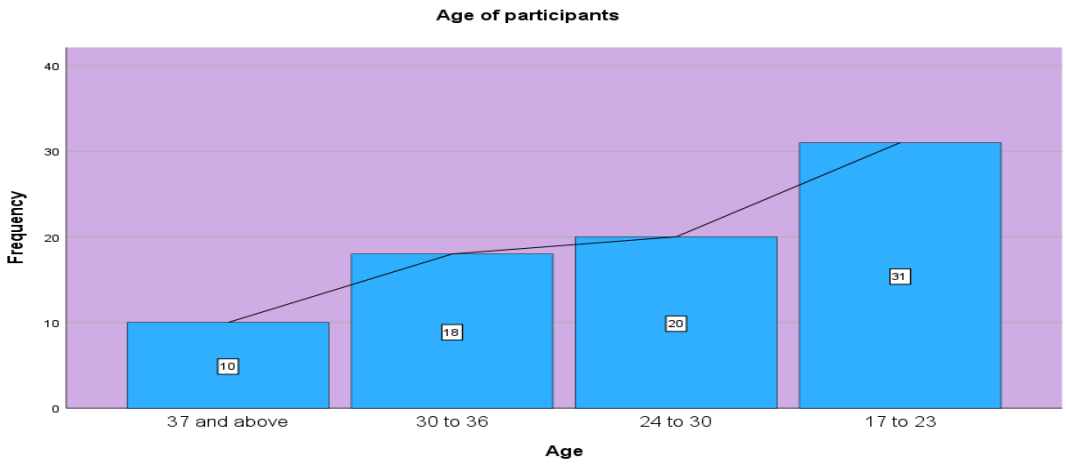

Figure 2: Age of participants

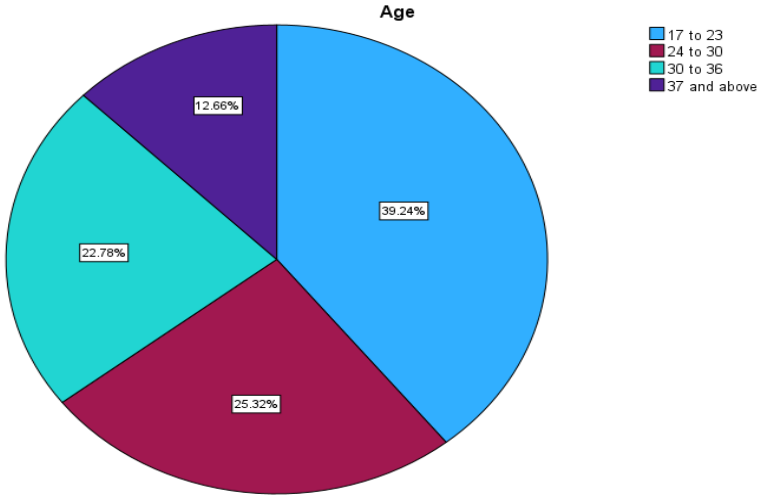

Figure 3: Age of participants

Figures 2 and 3 above show the age of participants. Participants' age ranged from 17 to 48. Out of 79 (n= 79) participants, 31 were between17 to 23 years (39%), 20 were between 24 to 30 years (25%), 18 were between 30 to 36 years (23%), and 10 were 37 years and above. This shows that there were more adolescents who were diagnosed with and being managed for substance use related disorders compared to older adults.

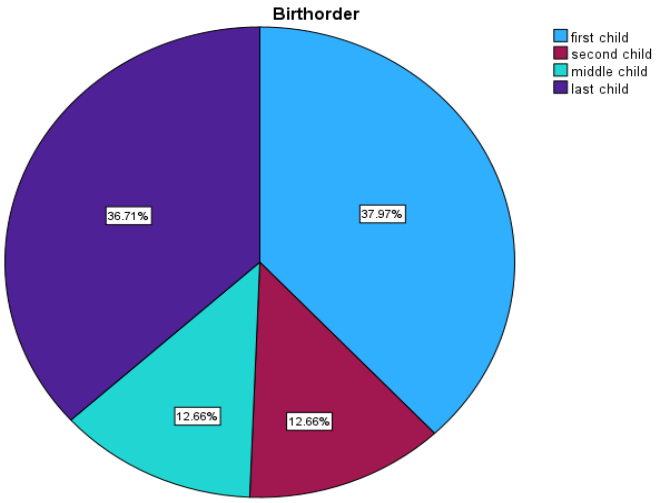

Figure 4: Birth order and prevalence of substance abuse related disorders

Table 2: Birth order and prevalence of substance abuse related disorders

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	first child	30	38%	38.0	38.0
	second child	10	13%	12.7	50.6
	middle child	10	13%	12.7	63.3
	last child	29	37%	36.7	100.0
	Total	79	100%	100.0	

Figure 4 and Table 2 above show birth-order and the prevalence of substance related disorders. The frequency distribution shows that substance related disorders are more prevalent in first-born and last-born children compared to second born and middle child. Out of 79 participants (n=79) who were diagnosed with substance use disorders, 30 were first born children (38%), 29 were last born (37%), 10 were middle children (13%), and 10 were second born children (13%).

Discussion

The findings of the study shows that drug addiction in the 17-23 years age range, followed by 24-30 years, 31-36 years and, lastly, 37 to 48 years. Age group distribution shows that age of

initiation into drugs is mainly at adolescence, which is the most volatile and vulnerable stage of development.

Birth order distribution

Percentages and frequency distribution done showed that substance abuse was more prevalent among first born children followed by last born children, and an equal number among second and middle children. This study was guided by Adler's theory of birth order which claims that the order in which a child is born shapes their development of personality.

Even though various studies have shown some variation in frequency distribution of substance abuse among different birth order positions, the results of this study seem to concur with other researchers that first and last-born children had a high frequency rate compared to the second, middle and only child. This may be because the last-born children are brought up mostly when other siblings are either grown up and working; and are therefore exposed to the use of alcohol and other drugs from older siblings. This is worsened if the siblings live away from parental household where they can easily influence each other.

The other reason which has also been found by other researchers about the last-born children could be related to their inadequate coping mechanism which is brought about by their position in the family. Lastborn child is protected by parents and older siblings and may fail to develop their own autonomy and coping skills. Due to that, they may resort to using drugs once they are faced with life stressors.

However, there are many other factors to be considered before drawing conclusions about the correlation between birth order and substance abuse.

Gender and substance abuse

The second objective which sought to examine gender differences among the study participants showed that more males were found to be users of drugs and other addictive substances. Males accounted for 91% of all the cases with females accounting for only 9%. There are many factors that may explain this outcome, for example, the boy child is unrestricted in socialisation compared to the girl child. Traditionally, there is a belief that alcohol is meant for men; any woman found to be using alcohol is generally looked down at and labelled with all sorts of names. Women who abuse/misuse drugs are judged harshly by society and they lose their respect in the community compared to men. True to the previous studies, the trend of having more males abusing drugs continue to show and the gap is quite wide.

Conclusions

The following conclusions were drawn from the study:

Substance abuse is more prevalent in first born, last born, second, and middle child, respectively, and the issue of birth order could apply. In addition, substance abuse continues to be a problem which is more prevalent in men than women.

Recommendations

It is recommended that further research be conducted qualitatively and include interviews and focal group discussions.

Further research could also include variables such as biological, social and environmental factors as determinants of substances abuse.

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Prevalence of Depression and Anxiety among Zimbabwean Healthcare Professionals Who Migrated to United Kingdom between 2018 – 2022

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Abstract

This study sought to ascertain the prevalence of depression and anxiety amongst Zimbabwean health care workers that migrated to the United Kingdom between the years 2018 – 2022. A cross-sectional online survey research design was applied focusing on the quantitative method. Google forms were utilized to gather data. The survey employed the Shona Symptoms Questionnaire 14 which was inputted on the online google forms. Random sampling was applied, everyone in the target population had an even and independent probability of participation. Results from the study indicated a high prevalence of depression and anxiety symptoms, with 63.63% of the study participants having scores above 8/14 and 37.37% participants with scores below 8/14. A percentage comparison of gender indicated a 90% and 59% variation of depression and anxiety amongst males and females. In addition, findings from the current study suggested that depression and anxiety levels are not the same based on professional background. In conclusion, it is important that, before migrating into the United Kingdom, Zimbabwean healthcare workers together with their families, be psychologically prepared to adjust their lifestyles to fit in a new multi-cultural society. Furthermore, a comprehensive psychological tool kit, along with regular and intensive employee wellness programs must be introduced for newly arrived migrants in developed countries.

Keywords: depression, anxiety, migration.

Introduction

Globally, depression and anxiety prevalence amongst migrants, has been reported as varied based on country of orientation (Brunnet, 2017). Evidence from the meta-analytic reviews represent a significant prevalence of mental health challenges amongst immigrants. In a meta-analytic review including 25 studies of depression and migrants, Shea et al. (2018) reported a depression prevalence of 15.6% among migrants. A comparison of labour migrants and refugee migrants in a meta-analysis review of 35 studies, Lindert et al. (2022) indicated that the

combined prevalence rates for depression were 20 percent among labour migrants vs. 44 percent among refugees. Furthermore, anxiety combined estimates were 21 percent among labour migrants vs. 40 percent among refugees (Lindert et al., 2022). In addition, the severity of psychological challenges has been distinguished for labour migrants to refugee migrants with the later experiencing considerably lower levels of depression and anxiety when compared to the former. According to Brunnet et al (2017), Haitian migrants in southern Brazil experience a 9.1% prevalence of PTSD and reports of Depression and anxiety symptoms were in the clinical range of 10.6% -13.6% for all the participants.

According to the pull – push theory (Lee, 1966), people migrate from one place to another based on various pull and push factors. The concept of human migration dates to over 60,000 years ago. Over the past decade the world has witnessed a significant escalation in the numbers of international migrants towards developed countries. According to Levesque and Van Rossem (2010), migrants have been forming an increasing group in Europe, with a record percentage of about 8.7% of the population in 2010. Within the midst of human migration, individuals experience various degrees of adaptation and adjustment challenges. The psychological impact of migration is often underestimated and under reported, especially amongst newly arriving migrants (Lindert et al., 2009).

Less consideration and interventions on the relationship between migration and psychological vulnerability has globally contributed to higher incidents and cases of suicide, depression, and anxiety related symptoms amongst migrants in the host countries (James et al., 2022). Most international migrants who experience psychological difficulties at most times do not seek professional help due to fears of victimisation, stigma, and discrimination as well limited access to opportunities (Borho, 2022). The psychological impact of migration is dependent on variables such as gender, age, and race (Lindert et al., 2009).

African migrants contribute a substantial figure towards global migration statistics. According to Bai et al. (2022), in a meta-analytic study focusing on the prevalence of anxiety, depression, and post-traumatic stress disorder among African migrants, a 34.60% prevalence was reported.

Mwanri et al. (2022) described post-migration stressors in South Australia which precisely imposed difficulties in parenting, care provision and children's attitudes. In the same line of thought Breiner (2016) described the limited community collective responsibility in the welfare of children in some European countries as detrimentally impacting the psychological well-

being of African migrants. In German, post migration stressors impacting migrants emotional well-being have been reported amongst adolescents. Experiences of discrimination were reported on an individual basis as well at an institutional level (Borho, Morawa, Schug & Erim, 2022).

Over the past decade Zimbabwe has been witnessing a massive migration of skilled workers to the United Kingdom, United States of America, and Australia. The United Kingdom Home Office reported a total of 15041, Tier 2 and skilled worker visas having been issued between years 2019 – 2022 to Zimbabwean nationals. A comparison of Zimbabwean professionals who have migrated to the United Kingdom over the past 5 years suggests a high percentage amongst health professionals such as registered nurses, medical doctors and health care assistants when compared to other disciplines. According to the Zimbabwean government's Health Service Board (HSB, 2021), a total of 767 health professionals left the country in 2019, that is, a further increase from 756 who left in 2018.

The process of migrating and settling in a new country presents an array of socio - economic and psychological challenges, which at most times go unreported by those affected (James et.al, 2022). However, there has been limited evidenced based information to describe the psychological difficulties that Zimbabwean health care professionals encounter in foreign European countries. Describing some of these psychological difficulties being encountered by Zimbabwean health care professionals in foreign countries will enable psychological preparedness for those intending to migrate as well encourage those that will be experiencing psychological challenges to seek psychological support early.

Research objectives

Aim

This study sought to ascertain the prevalence of depression and anxiety disorders amongst Zimbabwean health care workers that migrated to the United Kingdom between the years 2018 – 2022.

Objectives

The specific objectives of this study are:

i) To identify prevalence of depression and anxiety.
ii) To compare the occurrence of depression and anxiety by gender.
iii) To demonstrate incidence of hallucinations and suicidal ideations.

iv) To detect frequency of depression and anxiety by occupation.

Methodology

Research design - Cross-sectional survey research

The study utilised the cross-sectional survey research design, focusing on the quantitative method. The variables of concern in the current survey study were measured using self-reports from the participants. The current study utilised survey research as it is instrumental in estimating the prevalence of various mental disorders, in addition survey provide extremely precise approximations of what is valid in the population (Converse, 1987).

Data collection

The survey research made use of google forms to gather data. Data was gathered between January 2023 and February 2023. A google form is a product in the form of a template or worksheet that can be used separately or simultaneously with an objective of acquiring data. This product functions in Google Drive cloud storage adjacent to other applications such as Google sheets, Google Docs, and other enhancements. It is very straightforward to distinguish and make use of and is easily accessible. Conditions for utilising involve creating or using an already existing Google account (Nurmahmudah & Nuryuniarti, 2019).

The survey utilised the Shona Symptoms Questionnaire 14 which was inputted on the online google forms template. It comprised 14 questions requiring a YES/NO response. SSQ 14 is one of the 3 validated screening tools for screening common disabling mental disorders. The instrument contains high contextual equivalence amongst Zimbabweans, in addition it is widely used as it is in vernacular (Shona) making it reasonably easy to comprehend (Patel et al., 1997). The sensitivity and specificity of the SSQ-14 against a diagnosis of either depression and/or general anxiety is 84% and 73%. Internal reliability is high with a Cronbach α=0.74 (Chibanda et al., 2016).

Data processing

The survey incorporated a variety of data processing stages which included editing, where regular checking and adjustments on the google form was done as needed by the research data. The SSQ14 questions were exported to the google form and a link was shared with all participants. Responses from the participants were classified into numeric scores and charts generated by the view sheets section of the google form.

Sample size, sampling procedure and technique

The online survey encompassed healthcare workers working in the United Kingdom from Zimbabwe, who arrived between the years 2018 up to 2022. The sample had a total of 71 participants. These were medical doctors, registered nurses, health care assistants, and other related health professionals. Random sampling was utilised, everyone in the target population had an even and independent probability of participation.

Ethical approval

The study was not conducted at any designated institution or health facility. Participation was voluntary, in addition, for a participant to meet the inclusion criteria, they were supposed to have completed an online consent form.

Results

Demographic characteristics of the study participants

Table 1: Summary Table

Characteristic	**(n =71) Participants %**
Gender	
Males	14%
Females	86%
Total	**100%**
Age	
45+ years	6%
41 - 45 years	23%
36 - 40 years	38%
31 - 35 years	27%
26 - 30 years	6%
20 - 25 years	1%
Total	**100%**
Profession	
Registered Nurse	28%
Health Care Assistant	59%
Medical Doctor	3%
Social Workers	6%
Psychologist	3%
Research support worker	1%
Total	**100%**

Table 1 indicates a summary distribution of the study participants by gender, age, and professional occupation. Females represented a high proportion of the total participants contributing eighty six percent (86%), when compared to fourteen percent (14%) for males. Thirty-eight percent (38%) of the participants were in the 36 – 40 years age band contributing a higher representation when compared to the 20 – 25 years age band which was represented by one percent (1%) of the study participants. Health care assistants provided a high population of study participants with fifty nine percent (59%), followed by registered nurses who were twenty-eight percent (28%). The lowest representation by professional occupation was from research support workers with a one percent (1%) participation.

Prevalence of depression and anxiety

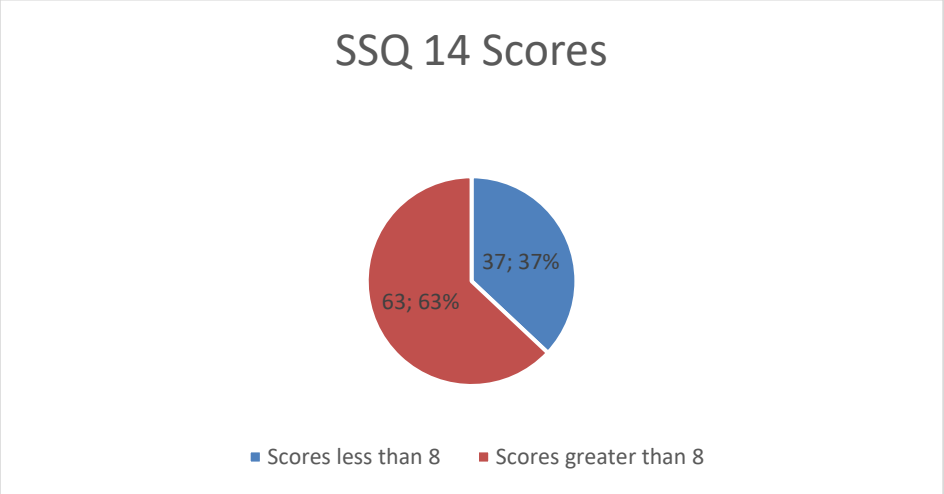

Figure 1: Shona symptoms questionnaire 14 scores

Figure 1 represents an all-encompassing summary of the Shona symptoms questionnaire 14 response scores for all participants guided by a threshold of above 8 **YES** responses. Results from the study indicated an overall depression and anxiety prevalence of 63.63%.

Depression and anxiety symptoms occurrence by gender

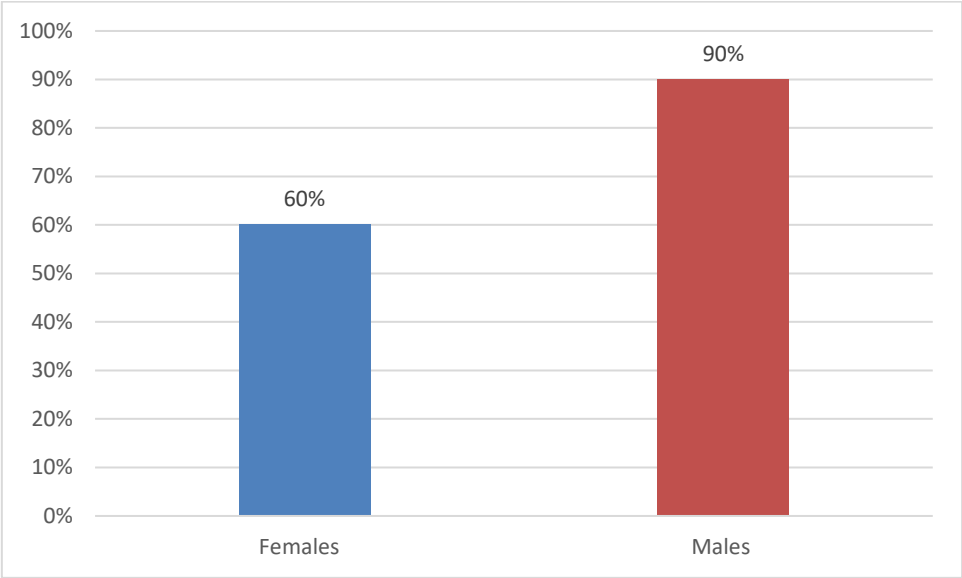

Figure 2: Participants with scores above 8/14

Figure 2 indicates the total number of participants with scores above 8 / 14 by gender. A percentage comparison of males and females indicated a 90% to 60% occurrence of depression and anxiety respectively.

a) *Incidence of hallucinations amongst health care workers*

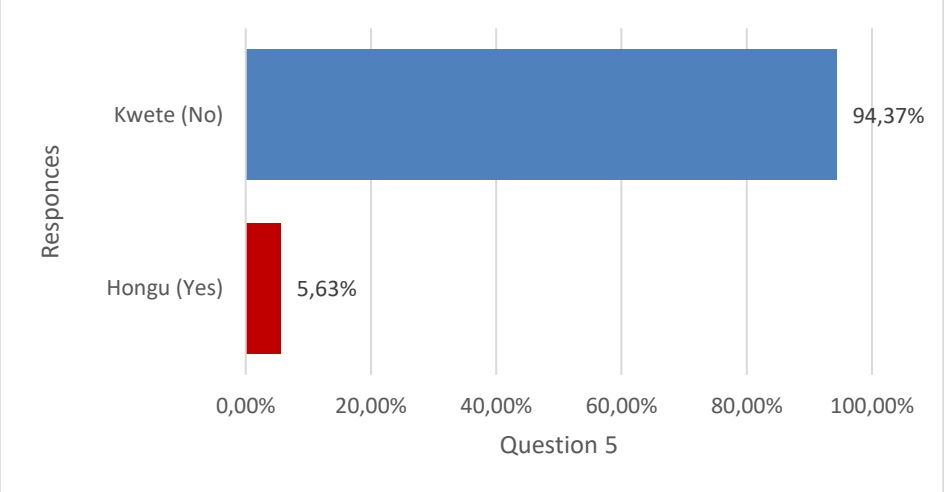

Figure 3: Percentage outline of hallucination YES responses

Figure 3 implies the percentage distribution of **YES** responses to hallucinating experiences, both auditory and visual. 94.37% of the participants revealed a 'NO' response, on the contrary, 5.63% answered 'YES' suggesting having been experiencing hallucinations.

b) *Suicidal ideations amongst health care workers*

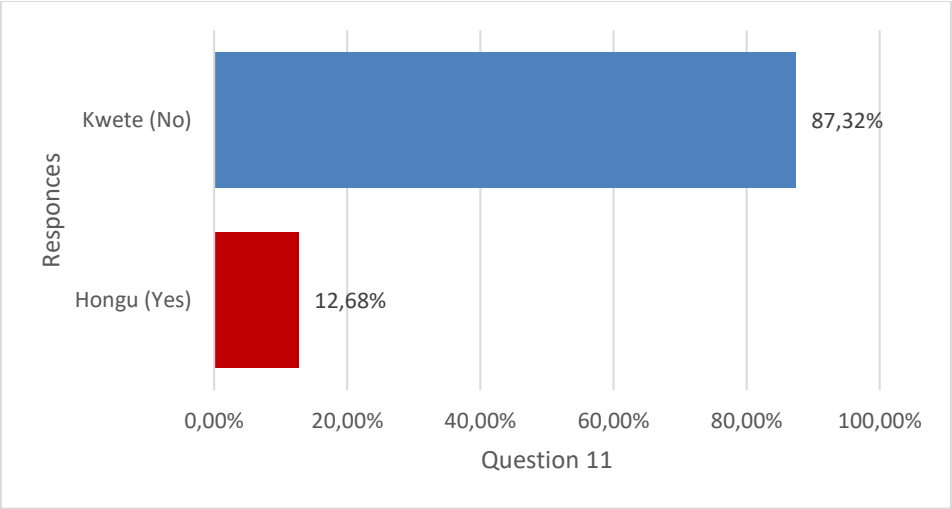

Figure 4: Percentage distribution of suicidal ideation responses

Figure 4 displays the percentage distribution of suicidal ideation responses by all the participants. The majority (87.52%) reported 'NO' suggesting having not been experiencing any suicidal ideation related symptoms when compared to 12.68% 'YES' respondents who reported having experienced active suicidal ideation thoughts over the past 14 days.

Frequency of depression and anxiety by occupation

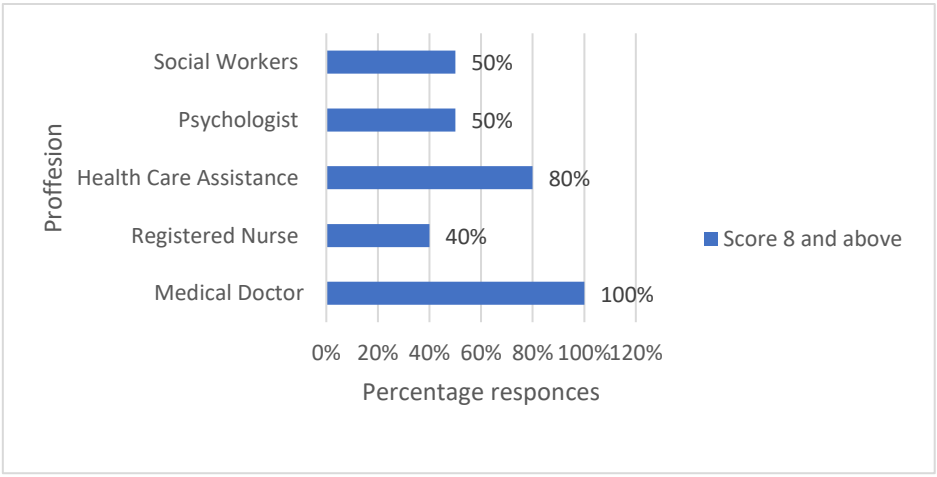

Figure 5: Score 8/14 and above by occupation

Figure 5 illustrates the percentage frequency of participants with scores above 8/14 by occupation. The study outcomes indicated a 50%, 50%, 80%, 40% and 100% frequency of depression and anxiety for social workers, psychologists, health care assistants, registered nurses, and medical doctors respectively.

Discussion

The benchmark of the current study was established based on the huge exodus of Africans, mainly those within the health and care professions, towards European countries over the past decade. Self-reports and existing literature suggest experiences of emotional and psychological difficulties amongst new migrants, which at most times exist at above moderate risk, within the first 5 years of stay in Europe (Mesa -Vieira, 2022). The number of foreign-born residents in the UK escalated from nearly 5.3 million in 2004 to over 9.5 million in 2021 (Vargas-Silva & Rienzo, 2022). Zimbabwean health care professionals have contributed a significant proportion of immigrants in United Kingdom, validating the migration trends by Vargas-Silva and Rienzo (2022). In the current study, the health care workers represented included medical doctors, registered nurses, heath care assistants, psychologists, social workers, and research support workers. A diverse representation of Zimbabwean healthcare workers in United Kingdom established in the current study aligns with the current statistics as provided by Deakin (2022) that, at present, more than 110 000 employment opportunities exist across NHS trusts in United Kingdom and numerous primary care institutions.

Existing literature suggests a prevalence of depression and anxiety amongst immigrants in European countries. According to Kirmayer et al., (2011), migration presents certain stresses, however, nearly all immigrants do well with changes towards resettlement residential status. Furthermore, not all immigrants experience depression and anxiety as personal vulnerabilities and experiences of the migration process contribute significantly to the genesis and perpetuation of symptoms (Gkiouleka et al., 2018). Results from the current study reported an overall 63.63% of the study participants as having scores above 8/14 indicating existence of depressive and anxiety related symptoms. The high prevalence of 63.63%, converge with outcomes of a systematic review and meta-analysis by Shea et.al. (2018) which established vulnerability factors such as cultural shock and different cultural identity as contributing to the genesis of anxiety and depression.

Findings of the current study suggests that depression and anxiety levels are not uniquely based on professional background. For registered nurses it was 18%, health care assistants 76%, medical doctors 4.44% and psychologists 2.22%. These results offer a different standpoint when compared to existing literature. In a meta-analytic study incorporating 57 studies from seventeen countries, Olaya et al. (2021) established that prevalence of depression and anxiety in healthcare workers was reported to be 24%, 25% for registered nurses, 24% for medical doctors and 43% for frontline professionals. In addition, a systematic review and meta-analysis based on seven cross-sectional studies conducted in China in 2020 reported a depression and anxiety prevalence of 12.2% amongst health care workers whilst amongst the sample of Zimbabwean health care workers in the United Kingdom who arrived between the years 2018 – 2022, the prevalence was 63%, which is significantly higher. The higher prevalence and manifestation of depression and anxiety amongst health care assistants is attributed to high work caseloads, unfavourable working conditions characterised by unpaid leave days and long working hours with minimum off days.

Outcomes of the current study indicated a higher occurrence of depression and anxiety related symptoms amongst males when compared to females, represented by 90% and 60%, respectively. The current study results offered a distinct point of view and understanding of depression and anxiety disintegrated by gender. During the COVID–19 pandemic the Roehampton University in United Kingdom published an article which explained that, being a female frontline worker was significantly associated with severe psychiatric symptoms. Female health care workers were more likely to display psychiatric symptoms when compared to their male counterparts as a high anxiety (35% vs 24%), depression (29% vs 22%) and stress (20% vs 11%) was reported (Gilleen, 2020). From the current study outcomes, a 90% prevalence of depression and anxiety amongst Zimbabwean men is attributable to minimal health seeking behaviours towards mental health support together with problem sharing. These factors, accompanied by extended family financial responsibilities, immensely exacerbated the exhibition of depression and anxiety amongst men when compared to females who are extra open to each other when affected by anxiety.

Results of the current study highlight the existence of severe symptoms of anxiety and depression amongst Zimbabwean health care professionals working in United Kingdom. Two items of the Shona symptoms questionnaire 14 were considered as a measure of severe symptoms, that is, experiences of hallucination together with suicidal ideations. From all the

participants, 5.63% reported to have been experiencing suicidal ideations vs 12.68% who reported to have experienced hallucination related symptoms. Amongst migrants, suicidal ideations are exacerbated by extreme feelings of loneliness, marital difficulties together with degrees of stigma and discrimination. The results of the current study are consistent with reports from other countries. When compared to other non-medical professionals, healthcare professionals in Germany shared high levels of depression and anxiety particularly during the COVID–19 pandemic. Severe degrees of depression symptoms were represented by a 9.3% and severe symptoms of anxiety by 5% of the participants (Skoda et al., 2021). In addition, a cross-sectional study of 737 participants conducted in Saudi Arabia discovered that 10.7%, 73.5%, and 15.7% of health care workers had a mild, moderate, and severe levels of generalised fear and anxiety, respectively (Mohsin et al., 2021).

Conclusion and recommendations

Majority of times when people get an opportunity to migrate and start a new life in Europe, they are full of high hopes and expectations. However, upon arrival a different reality presents itself, causing a psychological shock manifesting as depression and anxiety, as people will be trying to adjust and cope with the new reality. It is imperative that, before migrating into the United Kingdom and other European states, African families and individuals should be psychologically prepared to adjust their lifestyles to fit in a new multi-cultural society, as well not setting unreal goals for themselves. This can be achieved through listening to other people's stories as well utilising available NHS, mental health wellbeing toolkits together with psychological self-referral pathways.

It is important that United Kingdom companies recruiting international health and care skilled workers, enhance programs that offer satisfactory diversity and inclusion orientation collectively with psycho-social support for the newly arrived individuals and families. These programs must be specific targeting individual needs based on country of origin. To make the programs more effective, the author recommends that well-established and settled immigrants be actively included in orientation programs towards delivering mentorship by experienced services. This is essential as well-established and settled immigrants have first-hand understanding of how it is being in a new country.

Before commencing their roles in United Kingdom, Zimbabwean healthcare workers ought to be introduced to a comprehensive psychological tool kit, along with regular and thorough employee wellness training programs towards safeguarding their psychological well-being. The author recommends that depression and anxiety be routinely screened without victimisation of identified health care workers who are at great risk and requiring concentrated interventions to lower possible precipitating psychological and emotional difficulties.

Although 5.63% of the study participants reported experiences of hallucination, the nature of the hallucinations was unclear, whether auditory and or visual. Future studies therefore should introduce a qualitative methodological approach towards understanding experiences of hallucinations in detail.

The United Kingdom offers mental health support for all legal immigrants who would have paid the Immigration Health Surcharge which entitles them to free NHS mental health services. However, Zimbabwean healthcare workers are recommended to increase their health seeking behaviours whenever in times of psychological difficulties, utilising available online support programs as well finding out groups that exist in their place of residence towards getting linked to appropriate social support services. Social isolation and limited social engagement exacerbate incidents of depression and anxiety amongst Zimbabwean healthcare workers who would have recently arrived in United Kingdom. It is of paramount importance that individual, and families join social networks as this is helpful for improving mental health and wellbeing, in addition, it helps in increasing self-reliance, self-esteem, empowerment and communal connectivity.

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Healing from War Trauma: The Psychological Benefits of Land Ownership among War Veterans in Gweru, Zimbabwe

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Abstract
Post war psychological adjustment of veterans has been a topical issue. However, there is a need to explore context specific ways of helping veterans heal from war trauma, especially in low resources countries. This qualitative exploratory study sought to understand the psychological benefits of owning land among veterans who received land during the land redistribution program. In-depth interviews were done with eight veterans who were selected through convenient sampling. The inclusion criteria was the veterans who answered yes to the question – "Besides other benefits, would you say you having land helped you psychologically?' The interviews sought to probe into the psychological benefits of land ownership. Content analysis was used and the following themes revealed the psychological significance of owning land: it led to a sense of satisfaction, seeing crops grow helped foster a sense of achievement, being occupied (as participants worked on the land) helped to as a distraction from ruminating about the war, land was seen as a source of legacy and security, connection with nature helped foster a sense of self-worth, land ownership helped participants to interact with other veterans and improved social support and the land gave the participants peace of mind as they felt they could leave an inheritance for their children. The study provides a glimpse into the post war psychological benefits of land ownership and research on trauma healing in low income countries can build upon this study.

Keywords: veterans, land, trauma healing, Zimbabwe

Introduction
Ways of healing veterans' war trauma have been under discussion globally. Some countries are well resourced and can afford symptom focused and office based approaches to healing. However, some veterans may not respond favourably to such regimens and, in countries where skilled manpower is lacking, calls have been made to adopt low resource, innovative approaches that are context specific. Amongst the approaches that are being recommended are nature/environment based modalities. Studies have shown that nature in its various forms is healing, redemptive, unspoilt, and curative (Walton, 2021).

Nature has been found to provide additional benefits compared to traditional therapy (Westlund, 2015). Ecotherapy refers to forms of treatment that encompass the natural world in healing and growth with a therapeutic basis (Chalquist, 2009). Agricultural programs on the other hand have a range of foci besides therapy but also link nature, human health and resilience (Fusaro, 2010). Activities done in horticultural therapy like gardening, ranking leaves, sowing seeds and weeding were found to have curative effect (Ulrich, 1999; Lewis, 1996). Integrating natural surroundings in the design of healthcare settings added to healing in medical interventions and helped improve patient outcomes, wellbeing and socialisation (Dustin et al., 2010; Pretty et al., 2005). A study that focused on nature as a buffer of life stress among rural children found that nearby nature moderated the impact of stressful life events (Wells & Evans, 2003).

The recognition that nature has therapeutic effects has led to the development of care farming in some regions. Care farming involves using and working on farms and agricultural landscapes to promote mental and physical health. Care farms are used to help military veterans to heal psychologically and to socially reconnect (Greenleaf & Roessge, 2017). Healing through nature by using care farming was found to have similar effects to other treatments that enhance emotional wellbeing like cognitive behavioural therapy, acceptance and commitment therapy, positive psychology interventions and mindfulness techniques (Greenleaf & Roessge, 2017). Care farms help foster peer to peer support and help veterans in their integration into civilian life (Westlund, 2015). A study to explore the therapeutic nature of gardens among individuals with stress disorder in Sweden found several positive experiences, for example, positive sensory experiences, physical and psychological well-being and more social interactions with other participants and caregivers (Adevi & Martensson, 2013).

Veterans reported that the farms provided comfort and prepared them for reintegration into the larger community. Engagement at the farms also gave veterans hope, motivation to change and improved feelings of self-worthy (Lederach & Lederach, 2010). More than 50% of participants reported that care farming helped them to increase life satisfaction and 40% said it helped them to become optimistic about the future. Care farming was found to decrease loneliness (Greenleaf & Roessge, 2017). In care farming, clients engage in various horticultural activities, including crop and vegetable production, animal husbandry, and woodland management.

Through this participation, they learn important skills within a natural environment and this has been shown to improve mental and social wellbeing (Hine, Peacock, & Pretty, 2008).

A study on the experiences of war veterans in Zimbabwe has shown that they experience unresolved bereavement issues, shattered hopes and expectations, feelings of worthlessness, resentment, strained relationships, fear and compromised spiritual wellbeing (Mutambara & Sodi, 2016). There were no formal programs in Zimbabwe to help war veterans in their reintegration into civilian life as well as psychosocial support in coping with traumatic experiences (Tony & Liisa, 2003). Veterans need interventions that best suit the experiences that they have been through. It has been noted that very few veterans utilise mental health services (Goldberg Looney, 2014). Veterans have been found to have difficulties in self-disclosure and help seeking (Bonar & Domenici, 2011), and have reported negative stigma from traditional therapies which some say made them feel weak and removed the warrior spirit in them (Goldberg Looney, 2014, Burnam et al. 2008). In addition, the mental health needs of military veterans differ from those of the rest of the population, and some may require unique interventions (Goldberg Looney, 2014). Use of nature to heal war trauma has been found to be effective and has been given different names, for example, ecotherapy, care farming or horticulture therapy depending on what is involved.

The study investigated the psychological benefits of owning land among veterans in Zimbabwe. Owning land is an important factor in the life of the people of African people. At independence (1980) around two-fifths of the total land area in Zimbabwe was occupied by the minority white commercial farmers, while the majority black peasants remained in less arable communal areas (Skalnes, 1995). Across the country, the formal land re-allocation through the fast trek land reform program in 2000 has resulted in the transfer of land to nearly 170,000 households by 2011 (Scones et al, 2011). Many war veterans were beneficiaries of that land reform program.

After the war, veterans faced post war hardships which include poverty, community and domestic violence, insecurity, inadequate housing and health care, stigma and discrimination, lack of social support and insufficient financial resources. These problems are usually compounded by mental health problems (Amone-P'Olak et al., 2014; Betancourt, Agnew-Blais, et al., 2010) like mood disorders, anxiety, psychotic disorders which predispose to drug and substance abuse and psychotic symptoms (Odenwald et al.,2005). Veterans may feel

isolated from loved ones, friends and communities and may withdraw even when they are surrounded by people who care. Mostly, they may find it difficult to relate to civilians whom they perceive as not appreciative of their combat experiences (Greenleaf & Roessge, 2017).

Aim of the study

This study sought to explore the psychological benefits of owning and working on the land among war veterans in Zimbabwe. Some of the questions that were asked were: What do you think are the therapeutic benefits of tilling the land and growing crops? What are the healing benefits of being a landowner? What are the therapeutic benefits of rearing animals?

Method

Research design

The study was qualitative in nature. The researchers interacted with the subjects of the study to obtain data (Coll & Chapman, 2000; Cousins, 2002). The in-depth interviews were conducted at the war veterans` district office. According to the qualitative approach, to better understand people`s experiences events must be placed within a cultural frame to pinpoint causal influences and consequences (Marsella & Christopher, 2004). The qualitative study helped to describe the experiences of war veterans in relation to psychological benefits of land ownership (Leedy & Ormrod, 2001).

Participants and sampling

A total of eight veterans participated in this study. Five participants were male and three were female. The participants had received their farms/plots between 2000 and 2002 during the fast-track land reform program. The study targeted individuals who were previously based in urban areas before acquiring land. All participants provided verbal consent. Convenient sampling was used to identify participants through the help of the war veterans' Gweru district office staff. The age of the participants ranged from fifty-seven to seventy-two years. Two females and one male participant were formally employed. In terms of education, three of the participants had secondary education, three had a diploma and one had primary level qualification. Participants were recruited in accordance with following criteria: (a) answering yes to the question - "Besides other benefits, would you say having land helped you psychologically?'; (b) having resided in an urban area before occupying the farm; (c) having relocated to the farm.

Data collection procedure

Interviews were done at the war veterans' district office using a structured interview guide. Cousins (2002) contends that in-depth interviews are important in phenomenological research because they allow the researcher to probe into individuals' subjective experiences. The interview guide helped to ensure consistency and credibility across each interview. Selection of war veterans to participate in the in-depth interviews ended when there was saturation of data (Ziebland & McPherson, 2006).

Participants were approached when they visited the district office. In total fifteen veterans were initially approached to take part in the study but seven were dropped because they did not meet the inclusion criteria. The staff at the district office helped to introduce the researchers and briefly explained the purpose of the study to the participants and thus helping to create rapport.

Interviews lasted about forty-five minutes to one hour. Prior to each interview and discussion, the participants were given an oral description of the study in a language that they understood. Interview data was audio recorded and transcribed.

Data analysis

Content analysis was used to analyse the data. Content analysis refers to qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meanings (Zhang & Wildemuth, 2009). Data analysis was ongoing and from the first to the last interview in line with Ziebland and McPherson (2006). Two of the researchers were involved in data analysis. They first familiarised themselves with the text by reading through the transcribed material. Each researcher then reread the transcripts taking note of the main points and topics and these were used as codes. The codes grouped together common ideas in line with the psychological benefits of land ownership.

Ethical considerations

Permission to conduct the study was obtained from the war veterans' executive. All participants verbally agreed to be interviewed. Participation in the study was voluntary. The aim of the research was explained to the participants before the interviews. Confidentiality was maintained throughout the study process.

Study findings

Six main themes emerged from the interviews with the veterans. These were: self-discovery/sense of achievement; opportunity to bond/social support; feeling valued/ sense of satisfaction; hope/peace of mind; managing emotions; and being able to forget.

Self-discovery/sense of achievement

Participants revealed that owning land helped them to be at peace with their selves and to really know the types of person they were. Below are excerpts from the participants that showed that owning land and working on the land allowed them to discover themselves:

> From the war I was a person who was withdrawn and would like to be isolated most of the time. When I began working on the land I now relate more and it's like I am back to my old self again. (Participant 4)

> I have always known myself to be a person who should not be constrained by circumstances, thus land ownership has helped me to take charge of my life once again. I can plan my things and expect results without any hindrances. (Participant 1)

> My parents were always hardworking they would always told us not to be lazy. I feel I have had good nurturance and the lessons that my parents instilled in me are bearing fruits from the hard work that I am putting in growing crops. (Participant 5)

Thus, to a greater extent, working on the land was therapeutic for the study participants because it gave them space and opportunity to rediscover their true selves.

Opportunity to bond/social support

Study participants also mentioned that land ownership helped them to bond with other veterans. Most of the participants reported that their plots were close to those of other veterans. This they said allowed for a sense of oneness among veterans. This helped them to interact with other veterans.

> I know I am living with people who understand my situation. They have been through the same experiences as I had so they really know how we suffered during the war. (Participant 2)

> I wish we had been given farms just after the war in 1980. I had a lot of problems trying to integrate into the civilian life after the war since no one knew what I had gone through. It seemed as though the civilians never cared. Most of the people thought I was very difficult but now I have friends who really know me. (Participant 6)

Some participants said they connected with other veterans during meetings. They said the meetings helped them to discuss issues that concerned them. One participant said:

> I have made a lot of friends. We drink together, we do politics together. The neighbours that I have here are like my second family. I feel less alienated now. (Participant 8)

Feeling valued and sense of satisfaction

Participants also indicated that since they moved to the farms, they felt they were people of worth. They felt their confidence has been boosted because they could now provide for their families. This is shown by the extracts below:

> I am now a person to be looked upon by my family members. If anyone is in need of something they look up to me to provide and assist and I am always happy do help my family. This makes me very proud (Participant 7)

> I am staying with my aged parents at the plot. They are now in their late eighties and they had no one to live with. So they had to come to stay with us. Now I have a big family and I am proud of it. I always say to myself what could have become of my parents if I had not received this farm. They would be rotting in poverty now. I am proud to be doing something and this makes me feel good. (Participant 6)

Some veterans reported that although they would feel some civilians did not accept them when they were living in the urban areas; at the plots there was room for respect since the civilians could see their achievements.

Hope and peace of mind

Study participants reported that owning land helped them to be positive about the future. Most noted that, even though they were previously worried that they had no inheritance to leave for their children, land was a form of legacy/ inheritance for their children. This gave them encouragement and hope. Some participants noted that land ownership had transformed them to being important people in society. To most people, owning land was important as it pointed to a better future. Below are narratives from the participants that showed that owning land helped the veterans to be hopeful:

> After the war I had lost everything. I had no formal education (as I had to leave school to go to war) and only had a four roomed house in town. I was always worried about how my children were going to survive after I passed on. I now have hope that my children can continue with a peaceful life because they now are entitled to the land as an inheritance. (Participant 5)

> My future and that of my family is bright. We now produce our own food and I am happy that with the land that I got I am a father again. I had been struggling to make ends meet but am now very hopeful since I can see the benefits of owning land. (Participant 3)

Managing emotions

Participants reported that one way that farms helped them was to cope with anger and to better manage their emotions. Most noted that working hard on the land helped them to be at peace with their souls. Caring for crops from planting to harvesting helped to change their attitudes towards nature and helped them to care more about other people. Some reported that this gave them a sense of calmness and peace. Following are extracts from the participants that showed the usefulness of land in managing emotions:

> I spend most of my time working on the land. This has helped me to change greatly. Being occupied most of the time has helped to reduce redundancy and boredom. Before getting this farm I would sit at home the whole day doing nothing. After getting land I am occupied most of the time. I am happy now compared to the days I was staying in town. (Participant 4)

> My relationship with my family changed when I started to work on the land. I used to be someone who did not value relationships. I used to shout at my children and wife. My behaviour changed when I started working on the land. I now have a better relationship with my family. We now work as a team (Participant 5)

> Being unoccupied for a long time had led me to abuse alcohol. When I drank alcohol I would become very violent most of the time. So, I would end up fighting with people. But when I started to work on the land, I now have few friends, I only drink beer during the weekend because most of the time I will be occupied. (Participant 6)

Some participants reported that caring for crops had helped them calm down and be more patient. The process of caring for crops was found to be beneficial.

Being able to forget

Study participants noted that working on the land was a distraction that helped them to forget the war experiences and the hardships that they had gone through. They noted that:

> We can now boast that finally we have worn the war. We had independence in 1980 but for us war veterans the war was not over because the resource that we fought for was unevenly distributed. Getting land was the end of the war in my mind. (Participant 4)

> I am now at peace with myself because I got the land that I fought for. I feel a sense of achievement (Participant 8)

> I am happy to see that even people who did not even participant in war are benefiting from the land resource. I rarely think of my war hardships because people are now able to produce food for themselves and their families and that makes me celebrate. (Participant 7)

Discussion

The study participants reported that engaging in farming activities helped them to rediscover themselves. This implies that it made them aware of their potential and the ability to make a

difference. This, they said, was helpful for their metal wellbeing. Other studies have found that farming activities helped increase self-esteem, self-respect, responsibility and usefulness to society among participants with psychological disorders and addiction (Elings & Hassink, 2008). In addition, interaction with nature through agricultural activities promotes the formation of trusted interpersonal relationships and community connectedness (Krasny, Pace, Tidball, & Helphand, 2014).

Findings of the study were that participants had an opportunity to interact with other veterans at the farms and this was a source of social support and belonging. Interaction with nature through agricultural activities was found to promote the formation of trusted interpersonal relationships and community connectedness (Krasny et al., 2014). Being close to others who have been through the same experience helps to foster happiness and wellbeing while feeling disconnected from others has a negative impact on mental health (Chernyak & Zayas, 2010; Baumeister & Leary, 1995). The study found that veterans could link up with other veterans and help each other. This interdependence helped to reduce loneliness. Belongingness and social support are important for psychological and physical well-being. Studies have shown that social support and belonging helped to improve self-esteem, conscientiousness, wellbeing and helped reduce negativity caused by social rejection (McConnell et al., 2011). Farming has been found to reduce loneliness among veterans more than any other therapeutic intervention (Greenleaf & Roessge, 2017). Veterans have reported that farming together with other veterans in care farms greatly helped improve their sense of wellbeing and gave them hope also allowing them to reconnect (Greenleaf & Roessge, 2017).

Veterans also reported that they got respect from civilians by proving that they could work productively on the land and this made them feel worthy. Similarly, studies in the USA found that working on agricultural land helped veterans to feel that they were doing something that was important. They felt their lives had purpose again and it helped to boost their self-worth (Greenleaf & Roessge, 2017). Farming also helped the study participants to boost their confidence in executing tasks. They felt valued because they were able take care of family members who now resided at the farms. This finding is an addition to research that has been done on the importance of care farms and other uses of nature as a therapeutic tool. In this study, more benefits were recorded since individuals owned the land and had to decide who to

stay with. Research has shown that people are psychologically healthy if they feel what they are doing is meaningful, for example, helping others (Kaplan & Kaplan, 2001).

Being landowners was said to be helpful as participants were assured of an inheritance to leave to their children in the event of death. They felt their children now had a secure future. This gave them a sense of contentment and hope. Land ownership has been found to be important in boosting farmers` psychological wellbeing and resulted in more happiness. Studies have found that owning land had more psychological benefits compared to renting land among farmers in Bangladesh (Khan, Jahan & Haque, 2007).

Another therapeutic nature of working on the land that was reported by the study participants was that it helped them to manage their emotions. Some of the study participants said that working on the land had helped them to be calm and cope with anger. Similarly ex-military personnel with combat-related mental health problems in the UK reported feeling relaxed after engaging in farming activities like planting and growing flowers and vegetables, making plant and bird boxes, and fishing classes (Atkinson, 2009). Participating in community agricultural programmes has been found to help participants to manage their emotional issues (Twill, Norris, & Purvis, 2011); and improved sleep and mood (Adevi & Martensson, 2013).

Caring for crops was reported as having therapeutic benefits as well. Participants said caring for crops had helped them to be calm and to be more patient. Caring for plants was found to result in improved self-esteem among participants who had stress disorder in Sweden (Adevi & Martensson, 2013). In addition, Kaplan and Kaplan (2001) noted that people are healthier psychologically and more reasonable if they have opportunities to explore new environments and experience the restorative value of nature. Care farming among USA veterans helped to improve self-esteem and offered a restorative environment, that is, an environment that promoted recovery from attention fatigue by allowing people to leave customary roles and distance themselves from stressors of daily life (Greenleaf & Roessge, 2017). Time spent working on the land was reported as a helpful distraction against terrifying memories of the war. Farming/plots greatly helped to reduce redundancy. Similarly, it has been found that spending time outdoors in care farms was therapeutic. These environments helped individuals to feel more energetic, active and connected with others (Elings & Hassink, 2006; Hassink, Elings, Zweekhorst, van den Nieuwenhuizen, & Smit, 2010).

Conclusion

The study revealed the therapeutic nature of owning land and growing crops among veterans in Zimbabwe. Several psychological benefits were mentioned by the study participants, for example, increase in sense of satisfaction and achievement, distraction from war thoughts, land provided sense of security and helped to connect with other veterans thereby improving social support. Such benefits go a long way in indirectly resolving war related trauma. Findings from this study are consistent with outcomes from other structured programs that utilise nature in healing war trauma.

Implications of the study

The study points to the therapeutic nature of land ownership and working on the land. It has implications for psychologists working with veterans in Zimbabwe to consider the use of care farming in healing war trauma and other forms of psychological disorders. This work could be done through collaboration with government stakeholders like agricultural extension officers to ensure sustainability of programmes. More studies are needed to modify and enhance farm ownership into trauma healing sites.

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Experiences of Radiographers during the Covid-19 Pandemic at Two Hospitals in Harare, Zimbabwe

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Abstract
During the COVID-19 pandemic, the working patterns and professional practice of radiographers were altered significantly. The purpose of this study was to explore the experiences of radiographers during the COVID-19 pandemic at two hospitals in Harare, Zimbabwe. A qualitative phenomenological study involving radiographers in the diagnostic imaging departments of Zimbabwe's major referral hospital and a private hospital was conducted between mid-March to mid-April 2022. In-depth interviews were used as a method of data collection. The interview data was entered in NVivo 12 (QSR International) and analysed using Giorgi's structured method of analysing phenomenological data. Four themes emerged from the data, which are adherence to strict measures, change in working patterns, feelings and emotions, and adaptation. Radiographers experienced changes in working patterns as well as the implementation of stringent infection control measures and regulations. It was revealed that radiographers needed to adapt quickly to the constantly changing new ways of working including organisation of workload. Local pandemic response strategies must be developed from standard protocols in readiness for safe practice during emergencies.

Keywords: COVID-19, adaptability, radiography practice, pandemic, personal protective equipment

Introduction
Coronavirus (COVID-19) is a communicable disease produced by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus. There have been at least 636,440,663 confirmed cases of COVID-19, including 6,606,624 deaths worldwide (WHO, 2022). Infection occurs easily, mostly by droplets, and contact is required for transmission of the virus. This is why in every health department, preventative planning and management methods for the spread of the virus to patients and department personnel are essential, and the radiology department is no exception. Many countries implemented lockdowns, restricted travel, and urged social distancing to contain the spread of this extremely contagious sickness while addressing the symptoms of the infected, causing healthcare systems to be disrupted. The COVID-19

Prevention, Containment, and Treatment Order of Zimbabwe (2020), proclaimed a twenty-one-day lockdown, except for critical services and exempted cases and, as the pandemic spread over the world, the lockdown was extended.

The pandemic of the novel COVID-19 swept the globe, affecting the provision of radiological services and care (AJMC Staff, 2021). Radiographers are vital patient-facing healthcare professionals who are involved in the patient care giving chain in healthcare (Akudjedu *et al.*, 2020). The COVID-19 outbreak caused a significant decrease in ambulatory (outpatient) imaging volumes, and elective imaging services were temporarily suspended. Several policies in hospitals and radiology departments had to be amended, including COVID-19 testing, PPE availability, and training how to successfully handle the new scenario (Narwani, 2020). In reaction to the COVID-19 outbreak, studies and experiences show that diagnostic imaging and radiotherapy departments around the world have undergone substantial reorganisation (Devi, Smith, and Subramaniam, 2021).

The radiology department workflow was modified to limit actual presence at work, eliminating in-person case evaluation and training sessions because of the physical distancing requirements and safety precautions. Although many countries explored alternative strategies to aid with care continuity, it remains unknown what effect these initiatives had on patient care (WHO, 2020). One such attempt is the global study titled, *COVID-19 Response in Radiology*, which sought to investigate the global impact of the COVID-19 outbreak on the radiography workforce and practice (Akudjedu, 2021).

The purpose of this study was to explore the experiences of radiographers during the COVID-19 pandemic at two hospitals in Harare, Zimbabwe. The findings of this study ought to help in gaining an understanding of the pandemic's effect on radiography practice, as well as to discussing solutions and mitigating measures that address these effects.

Methods

Study design

This qualitative phenomenological study design involving radiographers in the diagnostic imaging departments of one of Zimbabwe's major referral hospital and a private hospital was conducted between mid-March to mid-April 2022. The design of this study allowed radiographers to share their experiences and thoughts about their practice during the COVID-19 pandemic.

Population and sampling

The population comprised all radiographers in both departments who were working during the COVID-19 pandemic. The researchers used a non-random convenience sampling technique to select the two imaging departments in Harare for adequate representation. The participants were also selected by convenience sampling. In this study, data saturation was reached by the twelfth interview; therefore, a sample of 12 was used for data analysis. The study included willing radiographers (both male and female) who gave consent to participate in the research, and had at least 3 years of working experience in a radiography department.

Research instrument

Personal interviews were conducted using a semi-structured interview schedule that was informed by literature (Naylor, Booth, Strudwick, 2022). The interview guide was adapted for this study. The interview guide was divided into two sections. Section A solicited the demographic information of the participants. Section B consisted of open-ended questions that explored the experiences of radiographers during the COVID-19 pandemic. Some of the questions asked included:

i) *How did the experience of work during the COVID-19 pandemic affect you?*
ii) *What changes to your routine radiography practice do you associate with the experience?*
iii) *How did the experience affect your colleagues and your loved ones?*
iv) *What lessons were generated by the experience of work during the COVID-19 pandemic?*

Data collection

The researcher administered an information letter that briefly described the research and its purpose and a consent form to help participants to make an informed decision whether to participate. Face-to-face interviews were conducted at each centre while observing the COVID-19 regulations like social distancing and wearing face masks. Researchers recorded interviews using an android application, Voice Recorder© and transcribed manually.

Data analysis

The interview data was entered into the NVivo 12 (QSR International) for analysis. The data was analysed using Giorgi's (1975) structured method of analysing phenomenological data. Below are the five main stages that were followed step by step:

i) Put aside preconceived ideas

ii) Review the interview transcripts

iii) Group the transcripts into units (such as chunks of relevant information).

iv) Create themes based on the relevant units created

v) With the phenomenon of study, the purpose of the study and research, and question(s) in mind, present descriptions of the themes.

Trustworthiness and integrity of the study

This study employed Lincoln and Guba's (1985), four criteria for developing the trustworthiness of a qualitative inquiry: credibility, dependability, confirmability, and transferability. To increase credibility, the transcribed interviews were sent to the radiographers for their reactions (member checking) (Adu, 2019). The aim was to use their feedback to improve authenticity of the data and accuracy of the findings. Space triangulation was done also to further enhance credibility of the findings (data was collected from radiographers in both the private and public sectors). Secondly, to ensure reliability of the themes, the researchers did inter-coder agreement. The difference between the codes was discussed and resolved by consensus (Creswell, 2016). Thirdly, the study endeavoured to provide a detailed description of the research setting and the sample of study participants (thick description). Fourthly, to ensure confirmability verbatim, this study presents quotes from the participants' voices in the results section. Lastly, researchers recognised that they were professionally socialised in the same environment, and hence a journal was kept about every decision made during the study (Adu, 2029).

Ethical considerations

Ethical approval for the research was granted by the Medical Research Council of Zimbabwe (MRCZ/B/2271), as did the respective centres. For involvement in the study, all respondents supplied written informed consent. Confidentiality was maintained by protecting the participants' identities. Participants were advised of the option to leave the study should the need arise. The data required proper and efficient safekeeping according to regulations of the institution. The researcher secured data storage by use of passwords to gain access to recordings and stored the transcripts in a file kept in the supervisor's lockable office. These measures ensured confidentiality at all costs.

Results

Demographics

A total of 12 practising radiographers consented to personal interviews, and indicated the number of years of work experience. Of these 12 radiographers, 6 were females and 6 were males. Also, 5 of the radiographers worked in a private work setting, and 7 were in a public service. The working experience ranged from 4 to 14 years. Table 1 summarises the demographic information of the participants.

Table 1: Demographic information of the participants

Participant	Age (Years)	Gender		Title/Rank	Work experience (Years)	Setting	
		M	F			Public	Private
R1	28	X		Radiographer	4		X
R2	30	X		Chief Radiographer	6	X	
R3	29		X	Radiographer	5		X
R4	40	X		Radiographer	14	X	
R5	27	X		Radiographer	3	X	
R6	27		X	Radiographer	4		X
R7	32		X	Senior Radiographer	8	X	
R8	34	X		Chief Radiographer	10	X	
R9	32		X	Principal Radiographer	8		X
R10	28		X	Radiographer	4	X	
R11	33	X		Senior Radiographer	9		X
R12	29		X	Radiographer	5	X	

Experiences of radiographers

Four themes emerged from the data on experiences of radiographers (Figure 1-4)

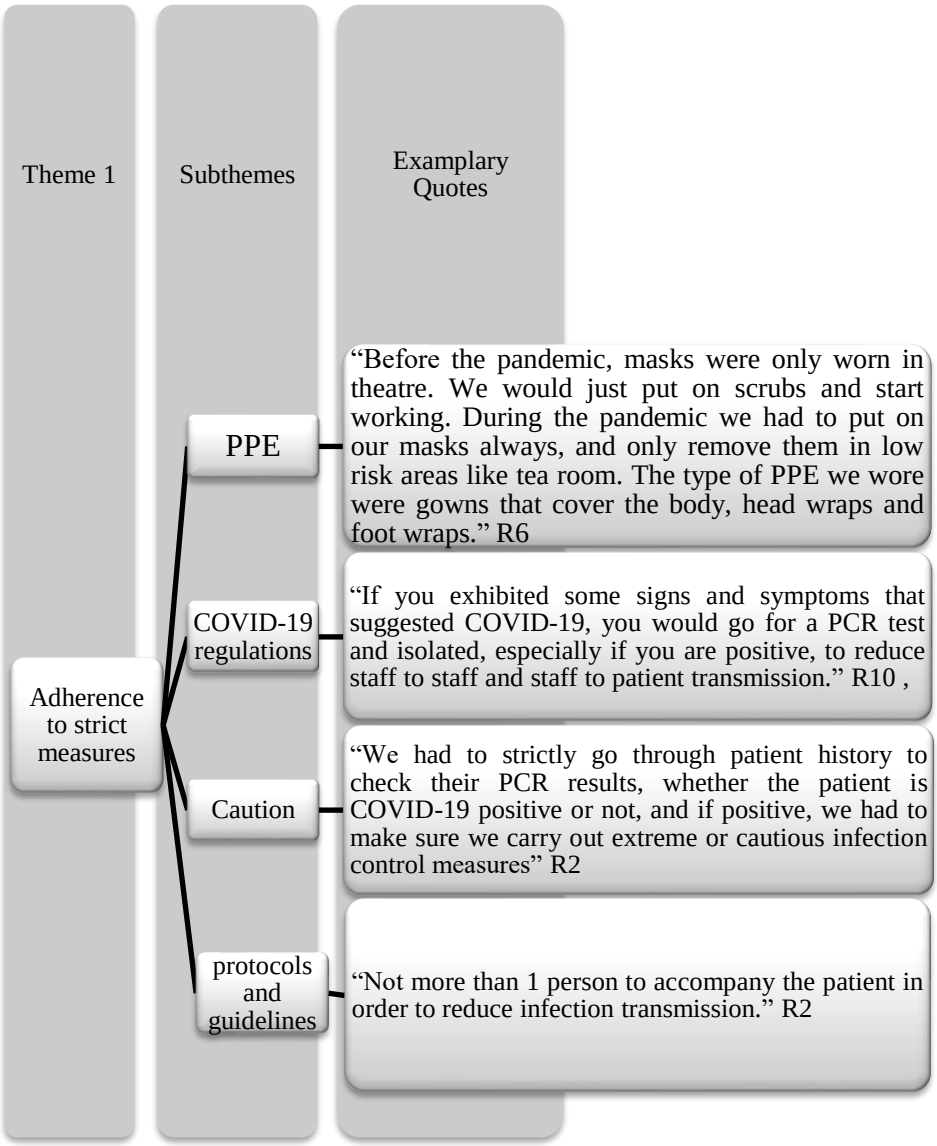

Figure 1: The first theme and corresponding subthemes and examples of quotes from participants

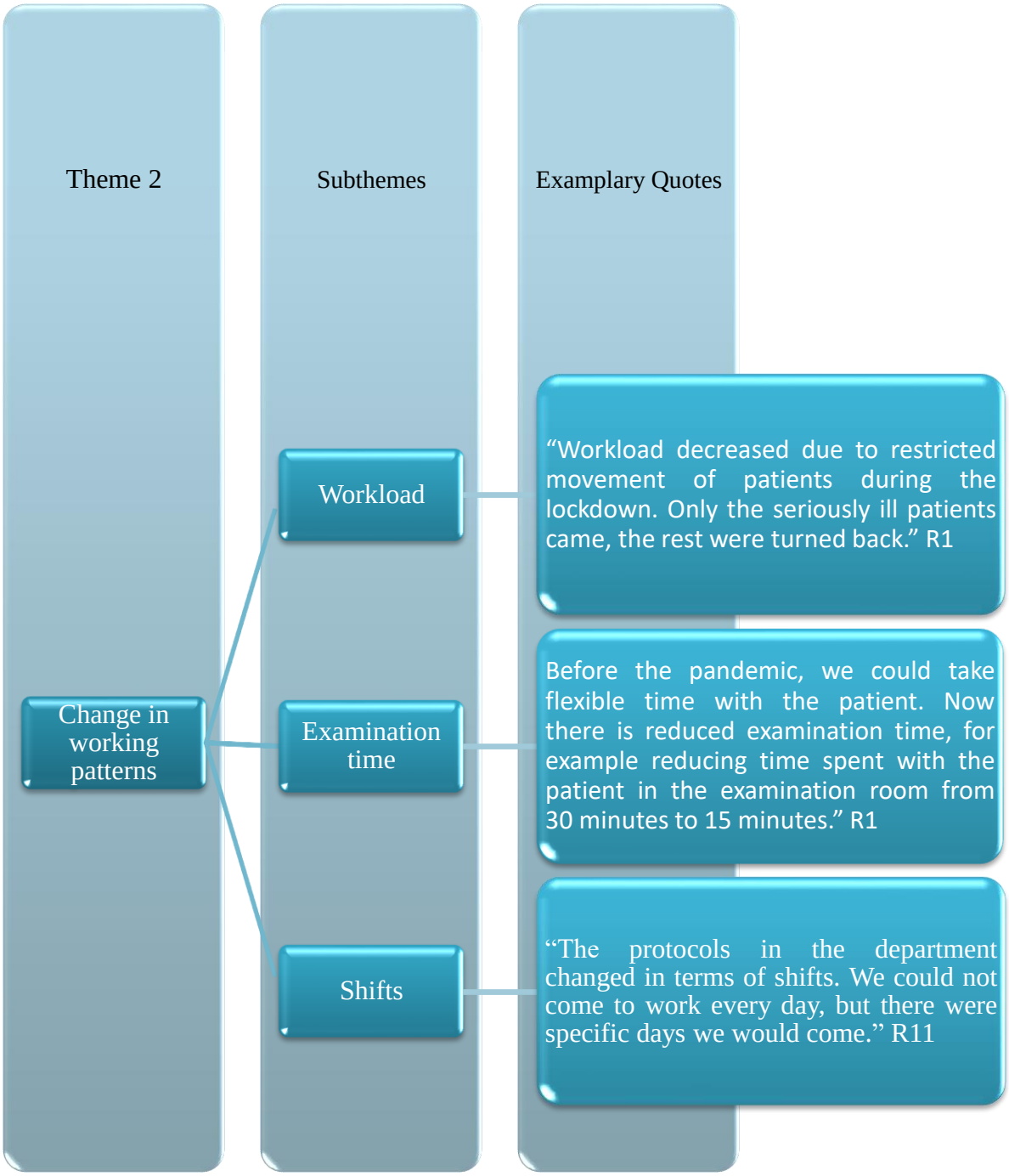

Figure 2: The second theme and corresponding subthemes and examples of quotes from participants

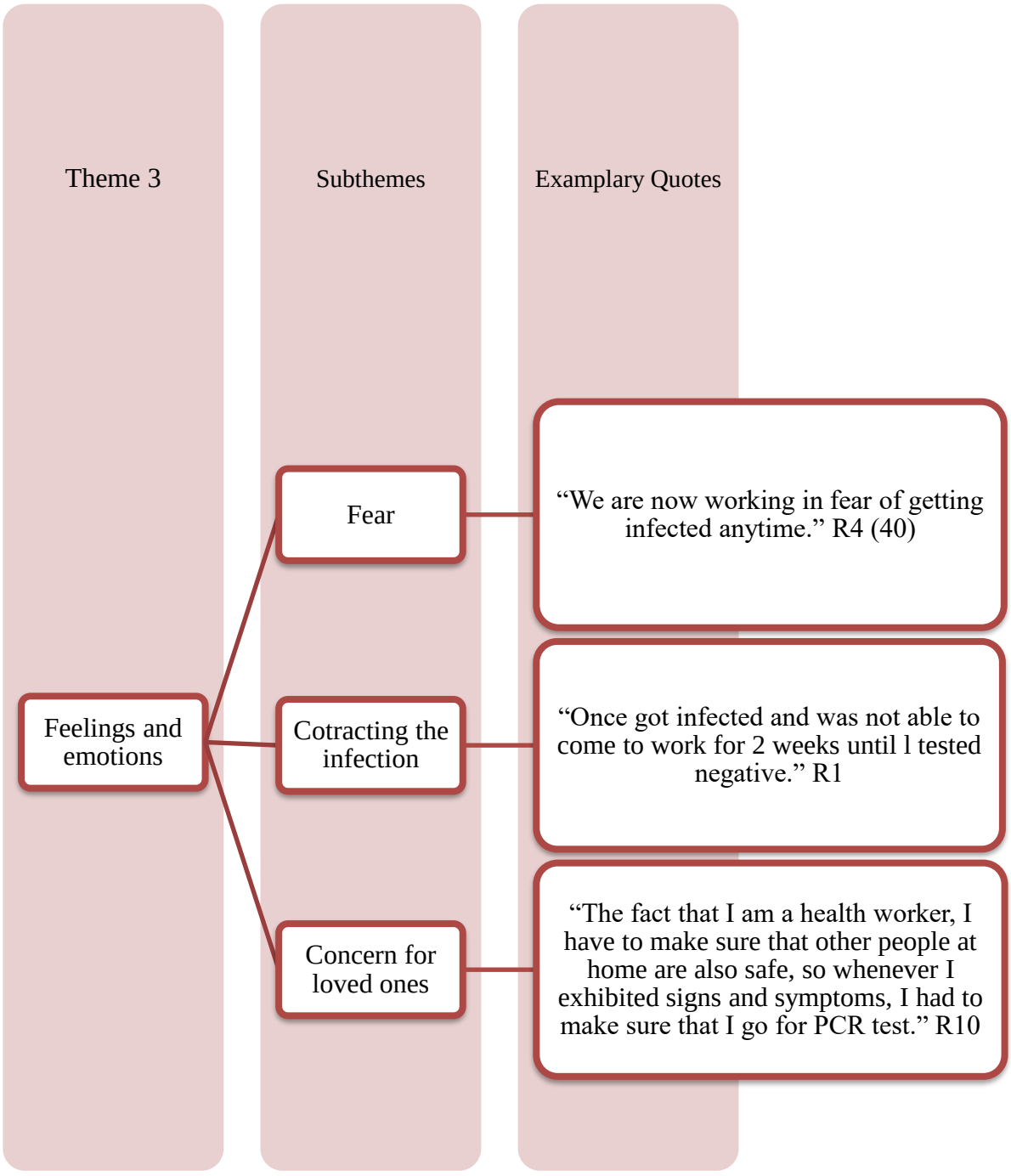

Figure 3: The third theme and corresponding subthemes and examples of quotes from participants

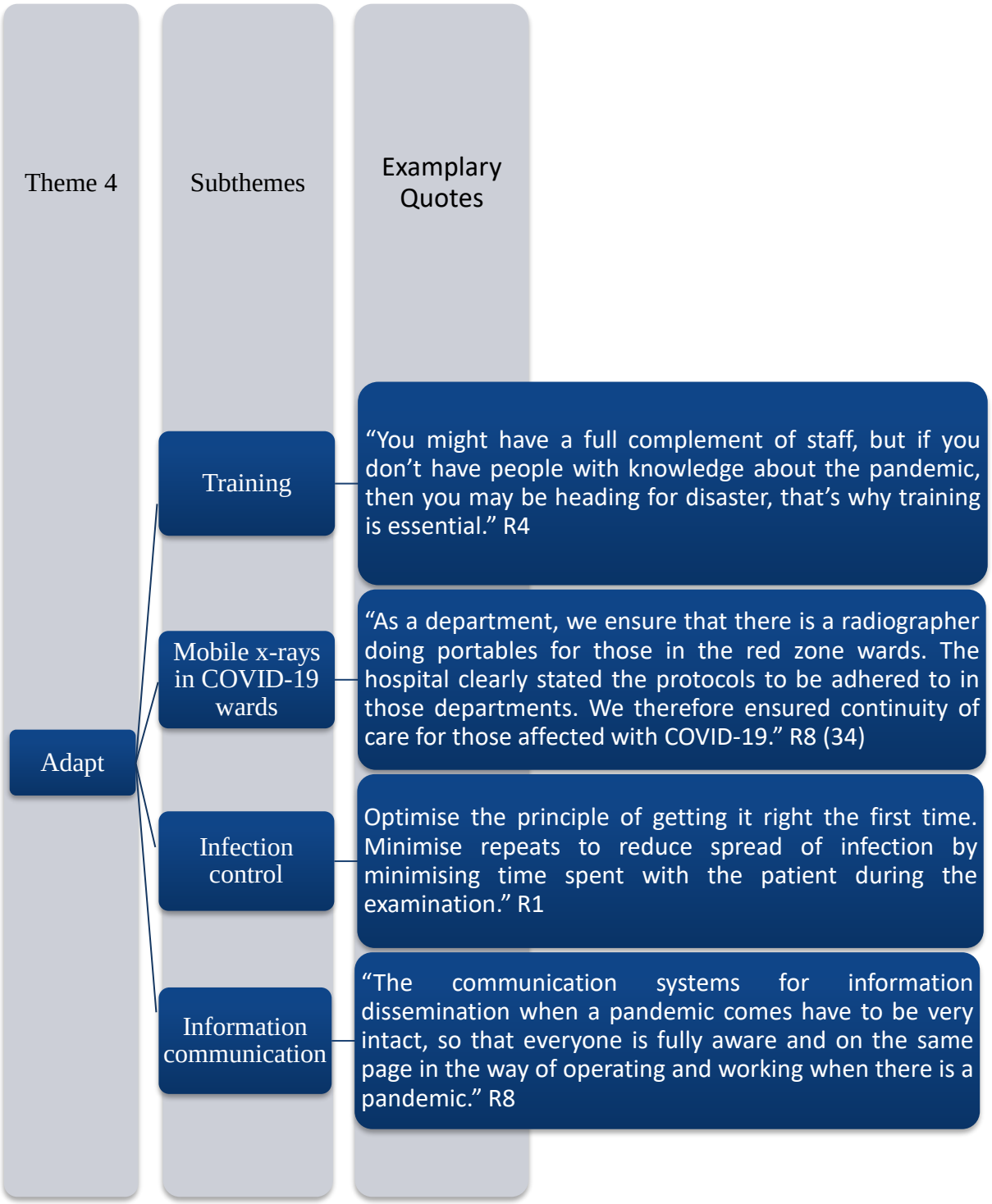

Figure 4: Fourth theme and corresponding subthemes and examples of quotes from participants

Changes in clinical radiography practice

To identify any changes in clinical radiography practice brought by the COVID-19 pandemic, *adherence to strict measures* emerged as a theme. It has four subthemes, which are *personal protective equipment (PPE), COVID-19 regulations, caution,* and *protocols and guidelines*.

Some participants described a change from the basic to stricter measures because of the COVID-19 pandemic, as shown by the following quotation:

> "Before the pandemic, we adhered to the basic infection control we do in a standard radiology department but with the coming in of the COVID-19 infection, we had to adhere to strict measures." R7

Some participants described a change in the use of PPE from the beginning of the COVID-19 pandemic, as exemplified by both radiographers and patients wearing face masks during the examination. Participants acknowledged that supplies of PPE had improved, as shown by the following quotations:

> "Before the pandemic masks were only worn in theatre. We would just put on scrubs and start working. During the pandemic we had to put on our masks always, and only remove them in low-risk areas like tea rooms. The type of PPE we wore were gowns that cover the body, head wraps and foot wraps." R6

> "Before the pandemic, gloves were not worn for every patient, but only in cases where exposure to patient's fluids is possible. During the pandemic, l would wear gloves before touching anything in the x-ray room." R1

> "We emphasised that patients should were face masks, to minimise cross infection." R8

Participants expressed that the COVID-19 pandemic caused the infection control department to be more aware of the importance of infection control in the radiology department, as shown by the following quotation:

> "Because of COVID-19 other departments also saw the importance of infection control for us. That's why we would also receive PPE. Before the pandemic, we would just look out for ourselves, go to the CSSD, take a scrub and put it on. Now there are gowns that come particularly for our department and if they are finished, they are replenished." R4

Participants explained that there was the introduction of COVID-19 regulations to be adhered to in the department, and hospital at large. These included testing of both patients and radiographers, isolation, vaccination and hand hygiene, as shown by the following quotations:

> "If you exhibited some signs and symptoms that pointed towards COVID-19, you would go transmission." R10

> "For the patient to even enter the hospital, they had to undergo a vetting process." R8

> "We were advised to get vaccinated against COVID-19" R5

> "We received hand sanitizers. We had to strictly adhere to hand hygiene, that is sanitising or hand washing after every patient." R12

Participants mentioned that the COVID-19 pandemic required them to be cautious in their work, as shown by the following quotations:

> "We were told to be a bit cautious with the patients. Patients should be tested first before examination." R11

> "We had to strictly go through patient history to check their PCR results, whether the patient is COVID-19 positive or not, and if positive, we had to make sure we carry out cautious infection control measures" R2

Participants described protocols and guidelines changing in the department, as shown by the following quotation:

> "COVID-19 pandemic has given me the chance to change protocols that were redundant." R3

Infection control protocols improved as shown by the following quotations:

> "Infection control measures were improved." R11

> "The room should be cleaned after every patient." R1

> "Before the pandemic, only cleaners would clean the floors. Now there are structured times the department gets fumigated." R6

Patient care protocols also changed as shown by the following quotations.

> "Not more than 1 person to accompany the patient in order to reduce infection transmission." R2

> "Patient should not stay in the department for long." R9

> "Damp dusting and changing linen after every patient." R4

Extent and nature of the changes

To determine the extent and nature of these changes in clinical radiography practice during the Covid-19 pandemic, there are two emerging themes, namely *changes in working patterns*, and *feelings and emotions*. The first theme has three subthemes, *namely workload, shifts*, and

examination time. The second theme has three subthemes, namely *fear*, *contracting the infection*, and *concern for loved ones*.

Some participants reported a reduction in workload as shown by the following quotations:

> "Workload decreased due to restricted movement of patients during the lockdown. Only the seriously ill patients were accepted on screening, the rest were turned back." R1

> "Workload was minimal as patients were scared to come because of the outbreak." R12

> "Number of patients seen per day reduced due to strict admission of patients into the hospital." R8

However, a few participants stated that workload increased as shown by the following quotations:

> "Workload increased due to increase in chest x-rays to monitor COVID-19 in infected patients." R2

> "Patient throughput increased, and there is understaffing as we are getting a lot of patients." R3

Some participants also noted the reduced number of working days, as shown by the following quotations:

> "The protocols in the department changed in terms of shifts. We could not come to work every day, but on a rotational basis." R11

> "Number of working days changed to coming fewer days." R5

Participants described a reduction in examination time as shown by the following quotations:

> Before the pandemic, we could take flexible time with the patient. Now there is reduced examination time, for example reducing time spent with the patient in the examination room from 30 minutes to 15 minutes." R1

> "Reduce patient practitioner contact time." R3

> "Time spent with the patient in the examination room was limited, for example trying to perform a chest x-ray in 5 minutes." R11

Many participants expressed a variety of feelings, including fear, anxiety, and stress. Some of the worry was linked to the concern of catching the virus or spreading it to other people.

> "We are now working in fear of getting infected anytime." R4

> "We are now working in fear and have to be more careful and vigilant about infection control." R2

Some participants reported that they had been infected, as shown by the following quotations:

> "Once got infected and was not able to come to work for 2 weeks until l tested negative." R1

> "At times we are getting infected and not coming to work for more than 3 weeks consecutively." R7

Participants felt that safeguarding themselves and others was necessary.

> "The fact that I am a health worker, I have to make sure that other people at home are also safe, so whenever I exhibited signs and symptoms, I had to make sure that I go for a PCR test." R10

> "Personally, how I took infection control before the pandemic was just not at this level. Sometimes I wouldn't wash my hands after an examination, its common, here, especially with the numbers here. Now being conscientious about COVID-19, I now knew what was at stake, so l had to try to make sure that l am safe myself, and also on a secondary level, to avoid infecting others." R6

Most participants mentioned a rise in work-related stress, as shown by the following quotations:

> "There was an increase in work-related stress as we feared catching the disease." R7

> "What l would consider as a major stressor is being exposed to a COVID-19 positive patient." R5

> "The major stressor was death of a colleague" R2

Alternative strategies

To identify the alternative strategies that were used to mitigate the effects of the COVID-19 pandemic on clinical radiography practice in order to promote continuity of care, the emerging theme was *adaptation*. The theme has four subthemes, which are *training*, *mobile X-rays in COVID-19 wards*, *infection control*, and *information communication*. Participants discussed how their departments had adapted to new working practices to promote continuity of care during the pandemic. Mobile X-rays were carried out to allow continuity of care for COVID-19-positive patients in isolation, as shown by the following quotations:

> "As a department, we ensure that there is a radiographer doing portables for those in the red zone wards. The hospital clearly stated protocols to be adhered to in those departments. We, therefore, ensured continuity of care for those affected with COVID-19." R8

> "Mobile x-rays were done in the red zones with adherence to hospital COVID-19 protocols." R5

Some of the participants had training on different aspects concerning COVID-19, as shown by the following quotations:

> "We had short courses on infection control." R2

> "We underwent training to help us identify the signs and symptoms of covid-19 and be able to interpret some of the findings on x-ray." R7

> "There was specific training for those who were doing portables in red zones, and in their selection, they took the most experienced people so that if they know the information, it is easier to disseminate to juniors." R10

However, some participants did not have any training and highly recommended it in preparation for future pandemics.

> "You might have a full complement of staff, but if you don't have people with knowledge about the pandemic, then you may be heading for disaster, that's why training is essential." R4

> "Training on how to deal with infected patients could have reduced the work-related stress." R1

Departments took steps to help workers manage their workload as shown by the following quotations:

> "Observing breaks like tea time and lunch time helped me cope." R5

> "Use of booking system to manage large numbers of patients." R3

Participants emphasised the importance of infection control in the COVID-19 pandemic, as shown by the following quotation:

> "I cannot emphasise more on infection control, and radiation protection, especially in ward radiography." R10

> "Infection control is a serious part of radiography." R12

They described infection control in the context of technique, protocols and guidelines, and advocated it to newly qualified radiographers, as shown by the following testimonies.

> "Optimise the principle of getting it right the first time. Minimize repeats to reduce spread of infection by minimizing time spent with the patient during the examination." R1

> "Be careful, wear masks and gowns, sanitise after every patient, minimize contact and time with infected patient." R2

> "You have to adhere to all rules and protocols on COVID-19 infection control." R7

Participants went on further to suggest infection control measures that could be implemented to ensure the department was better prepared for current or future pandemics. Most of the participants suggested stocking PPE, as shown by the following quotations:

> "After knowing the nature of the pandemic, we also need to know the physical needs be it PPE, or other devices that can be used in the department, since we also work with accessories in radiography. The department should be intellectually prepared in terms of stocks and equipment." R7

> "Stock PPE to avoid shortages. Continuous restocking should be done to minimize cross infection." R2

> "PPE should be made routine. You never know when the pandemic is back so always stay safe." R5

Other infection control measures were suggested as shown by the following quotations:

> "There should be an infection control supervisor in the department who oversees implementation of infection control." R2

> "The department should have a capacity of disinfecting examination rooms after every suspicious case." R8

> "There should be dedicated COVID-19 centres that deal with these cases where people are specifically trained for this." R4

> "Need for adequate universal screening of COVID-19 for everyone that enters the hospital to avoid infected people spreading infection in the department." R9

Participants described the importance of information communication and knowledge in a pandemic, as shown by the following quotations:

> "The communication systems for information dissemination when a pandemic comes have to be intact, so that everyone is fully aware of the standard of operating and working when there is a pandemic." R8

> "The department should keep records of any statistics on the pandemic." R3

> "Know what COVID-19 is, so you don't have to worry much but to just observe all the regulations." R6

Participants recognised the need to be versatile and advised undergraduate students, as shown by the following quotation:

> "COVID-19 is just a disease that came out in an aggressive manner and it changed perceptions and affected performance of some, who became sceptical. If you have that way of thinking, it can affect you in terms of gaining new experience. Be people who adapt to changes brought by pandemics or natural disasters, and not be rigid people. Be versatile and able to adjust to any changes that come." R2

Discussion

This study explored the experiences of radiographers during the COVID-19 pandemic at two hospitals in Harare, Zimbabwe. Ideally, clinical radiography practice involves in-person interaction and physical contact with the patient, for example, during patient positioning and lifting. However, the emergence of the COVID-19 pandemic caused the introduction of several health policies and practices, for example, observing physical social distancing, which discouraged close interaction and physical contact with patients. These COVID-19-imposed measures caused unprecedented changes to clinical radiography practice, effects of which were investigated in this research. The findings of this research ought to help healthcare leaders in the radiography field understand what went well in the COVID-19 response at a local level, identify what could have been done better, and mitigate systemic weaknesses so that all critical components of the system are better prepared for the future, not just for medical emergencies, but for any type of disaster that may impact healthcare systems.

Participants admitted that the supply of PPE improved since the start of the pandemic. A scoping assessment of research on the level of health system readiness, impacts, and reactions to COVID-19 in Africa showed that tools to manage COVID-19, including PPE, were insufficient or non-existent (Bajaria & Abdul, 2020; Desalegn *et al.*, 2021; Semaan *et al.*, 2020). The findings in this current study could be due to donations of PPE by non-governmental organisations in Zimbabwe (Maiden, 2020; Steward Bank, 2020; Tome, 2021). Participants described that the COVID-19 pandemic caused the infection control department to be more aware of the importance of infection control in the radiology department and; consequently, they were provided with PPE. Diagnostic radiographers were not formerly thought to be frontline personnel, especially in terms of getting and using PPE, and the pandemic rendered professional recognition (Lewis & Mulla, 2021; Naylor *et al.*, 2022). Fleischner Society's worldwide consensus statement highlighted that, in the management of

COVID-19 patients, the radiographer is an important member of the frontline response staff (Rubin *et al.*, 2020).

Participants explained that COVID-19 regulations were introduced, and were supposed to be adhered to in the department, including testing of both patients and radiographers, isolation, vaccination, and hand hygiene. These were in response to WHO recommendations of hand cleaning, social distancing, wearing face masks, and covering the mouth and nose when coughing or sneezing to minimise virus transference (WHO, 2020). These were also in response to a task force formed by the African Centres for Disease Control and Prevention with six major practice areas: laboratory diagnosis, surveillance, including screening at points of entry, infection prevention, and control, clinical treatment of patients with severe COVID-19, risk communication, and supply chain management (Mankoula, 2020; Paintsil, 2020). However, there was dissatisfaction regarding screening, as participants in this research suggested adequate universal screening for everyone that enters the hospital. Similarly, other research revealed that there was no regular staff screening at the gate and that testing and results were delayed (British Institute of Radiology, 2020; Lewis & Mulla, 2021).

Some participants in this study reported a reduction in workload due to restricted movement of patients during the lockdown, fear of contracting the infection at hospitals, and strict admission criteria for patients into the hospital. The reduction in imaging referrals at the start of the lockdown impacted the operations of diagnostic imaging departments (Cavallo & Forman, 2020; Lewis & Mulla, 2021). A few participants however described an increase in workload due to a larger number of chest x-rays done to monitor COVID-19 patients. With rising COVID-19 cases in Zimbabwe (Figure 1), the number of chest x-rays done increased, as it was used in monitoring COVID-19 patients. Similarly, studies done on the experiences of radiographers in Ireland and Queensland, reported an increase in workload, particularly chest x-rays and CT, as COVID-19 patients increased (Foley & Creedon, 2020; Eastgate *et al.*, 2020).

During the pandemic, fear of getting infected and transferring it to members of the family was a significant source of anxiety among healthcare professionals (Lewis & Mulla, 2021; Mahajan & Sharma, 202; Nyashanu *et al.*, 2020; Ruiz et al., 2021). Similarly, participants in this study expressed diverse feelings, including fear, anxiety, and stress. Most participants mentioned an increase in work related-stress, with the apprehension of becoming infected, exposure to a COVID-19-positive patient, and death of a colleague as major stressors. This is similar to

findings from other studies which found that alterations in clinical practice during the pandemic linked to occupational stress (Akudjedu, 2020; Akudjedu *et al.*, 2021). To see co-workers become ill, and some die, has a negative impact on radiographers' mental well-being (Lewis & Mulla, 2021).

The adaptability of departments was highlighted in this study as recognised by others (Akudjedu, 2022). Other departments have implemented new modes of working in response to the increasing burden, such as modifying staff rosters to include rest intervals (Lewis & Mulla, 2021; Naylor *et al.*, 2022). Similarly, participants in this study described that observing breaks and the incorporation of rotational shifts helped them cope with the workload. In other studies, participants described how departments increased the number of people working night shifts as a way to manage the workload (Naylor *et al.*, 2022; Ooi, Lee & Chee, 2020). However, participants in this research did not report on increase of staff working night shifts, but elaborated on use of booking system to manage the workload. This could be due to countrywide scarcity of radiographers in Zimbabwe (Maboreke *et al.*, 2019; Nyamukondiwa & Chinhoyi, 2016), making it impossible for the departments to raise the number of staff working night shifts as developed countries did. Instead, the departments would manage the workload by managing the number of patients that visited the department by using a booking system, as a way of supporting staff to manage the workload.

Participants described understaffing as they were getting a lot of patients. This could be because, in addition to being short-staffed, some of the radiographers were getting isolated for a minimum of two weeks prior to contracting the infection as reported by some participants. This was meant to observe the COVID-19 regulations. Loss of healthcare workers from illness and quarantine severely strained hospital operations (Alvin, 2020; Billings, 2021). This is because infection control necessitates the isolation of symptomatic workers as well as social distancing from asymptomatic carriers in order to prevent transmission from asymptomatic carriers (WHO, 2022).

While some of the participants described that they had trained to address different aspects of the COVID-19 pandemic, some did not have any training at all. At the time of the pandemic, reports from various contexts showed that there was no or minimal training in radiology and radiotherapy departments on COVID-19 infection prevention and control, and patient management measures (Akpaniwo *et al.*, 2020; Akudjedu *et al.*, 2020; Foley *et al.*, 2020). In

part, the quick and unanticipated evolution of the global pandemic contributed to the lack of training (Akudjedu *et al.*, 2020; Cavallo & Forman, 2020; Hasford *et al.*, 2020). COVID-19 was a unique coronavirus strain, thus it took time for scientists to figure out how it spread and prescribe universal pandemic procedures to prevent it (Ruiz *et al.*, 2021). Fear and worry among radiography personnel from various contexts are associated with a lack of information on proper infection control methods during the outbreak (Elshami *et al.*, 2021; Foley *et al.*, 2020; Ruiz *et al.*, 2020). Similar to this, participants in this study explained that training could have reduced work related stress. Once WHO and associated health authorities were explicit in their guidance, fast and effective communication and distribution concerning the procedure for infection control and emergency reaction protocol were important for restoring power to the healthcare professional (Akudjedu, 2021). In this study, participants suggested that information communication systems ought to be prepared for current or future pandemics. Not only is clear communication necessary to inform healthcare professionals about new procedures, but it is also necessary to ensure understanding and, as a result, proper implementation (Foley & Creedon, 2020).

Strengths and weaknesses

In this research, qualitative research allowed participants to freely reflect on their experiences without limitations, which is particularly important as it embraces the notion that everyone has a unique voice, therefore this research gives in-depth information. The focus of this research was to delve into the details of participants' experiences and how they interpreted them. As a result, the findings are inextricably bound to this specific setting, limiting their applicability. The experiences recounted, however, may be shared by others in the profession.

Recommendations

In consideration of the pandemic's lessons, it is necessary to change existing protocols and/or develop new ones. All radiology departments should explore methods for future pandemic reaction or other types of crisis occurrences. Standard protocols should be employed to develop localised pandemic reaction strategies in order to promote safe practice in crises. Simulated pandemic case scenarios in regard to infection prevention and control, effective communication and information sharing strategies during emergency situations, and other issues pertaining to effective management and/or adjustment of diagnostic imaging protocols should all be part of ongoing professional development. It is critical to provide intervention mechanisms at both the system and organisational level to enhance radiographer wellness and worker resilience, as

well as to resolve mental health concerns. At departmental level, a reliable distribution network must be in place for resource procurement, including adequate PPE as well as other clinical commodities. More research is needed to determine the effect of the COVID-19 pandemic on clinical radiography practice in Zimbabwe as a whole. Furthermore, because the dynamics of a group can often make people bolder in expressing their thoughts, focus group discussions bring to the surface issues that might not have been identified otherwise, and can be carried out as they provide an in-depth understanding of the participants.

Conclusion

Chest radiography and chest CT scans were used extensively in the diagnosis and treatment of patients. Radiographers have to quickly adapt to ever-changing new modes of operation, including workload management. There have been modifications in working practices, as well as the establishment of strict infection control procedures and regulations. Fear of getting infected or spreading it on to members of the family triggered a rollercoaster of powerful emotions during the pandemic. This research emphasised the importance of region-specific guidelines or recommendations in the context of global pandemics, especially in low-resource settings, for safe and easy implementation. In the event of future pandemics, radiology departments must recognize the importance of protecting all workers, including radiographers, in order to ensure safety of patients. This includes providing sufficient training, adequate PPE, and strengthening institutional arrangements for the management of occupational stress and anxiety.

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The Contemporary Strategies of Curbing Indiscipline in Public Schools in Zimbabwe

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Abstract
Globally, indiscipline is a ubiquitous topical threat to learning in educational institutions and peaceful existence in society in general. The contemporary behaviours exhibited by young learners both in the community and at school are so complex and shocking. Communities are enlightened through education and the young learners are the passport and insurance of success. The behaviour of youth in the community determines social development since the youth constitutes the greater population in most countries. Discipline is the fulcrum of education at all learning institutions and in any society. In this study, the causes of indiscipline among young learners are traced from interconnected environmental systems which are the microsystem, the meso-system, the exo-system, and the macro system. This study was conducted in Mbare and Highfields high density suburbs of Harare, the capital city of Zimbabwe. The main objective of this study was to find the causes and alternative strategies of curbing indiscipline in learners at school and in the community. The study found that indiscipline is mainly caused by drugs and substance abuse, peer pressure, teacher-pupil relationship, parenting style, influence of social media, economic challenges and human rights. The strategies of curbing indiscipline are determined by its causation. The bio-ecological theory was used to anchor the study and descriptive research design was used in this study to describe forms of indiscipline. Some of the strategies found in this research include ensuring the use of integrated social structure, providing accessible comprehensive counselling, and using behavioural gateway, sanctioning all indiscipline behaviours, rewarding positive behaviours and offering education.

Keywords: behaviour, contemporary, indiscipline, contemporary, strategies

Introduction
Worldwide, general indiscipline is one of the ubiquitous topical threats to human development in this 21st century. Biblically, discipline was proclaimed by the Creator during creation and there is nothing amiss with putting in place disciplinary measures in the community. Both in the community and at school, the misbehaviour exhibited by learners paralyse the learning and

social environment. Education is a strong force of enlightenment in any community and the discipline of young people is regarded as the passport to success. This view regards education as an investment in the young generation. This is supported by Ali, Dada, Isiaka and Salmon (2014) who opine that young people are both the wealth and pride of a nation. They are the critical resource that ensures community development through inheriting and maintaining community beliefs and values. According to Schlebusch, Makola and Ndlovu (2022), an uneducated society has slow developmental milestones and ultimately lacks developmental brand and vision. This present study acknowledges that discipline is the fulcrum of education at all learning levels and in any society. It teaches an individual to be self-control and to be responsible. Indiscipline affects the academic performance of learners as well as the bio-psychosocial setting.

Background to the problem

Indiscipline behaviour is a topical pandemic among the young people. There are so many theories on the causes of indiscipline among the young learners both in the community and at school. Technological development, for example, has caused more harm than good since young learners tend to abuse social media. In addition, the prevalence of drug abuse has increased highlighting accentuating general indiscipline. Research predicts that 40% of youth indiscipline in Africa is due to drug and substance abuse (UNODC, 2021). The World Health Organization (WHO, 2020) states that more than 42 million of healthy life was lost due to drug use in 2017, that is, about 1.3% of the global burden of disease. Zimbabwe has not been spared from the plaque of drug related discipline. Globalisation has proved to have negative significant impact to the behaviour of young people. The wave of using complex drugs in the world over is so alarming. This actually means the use of complex drugs has become a virus which turned the behaviours of young people upside. The spine of indiscipline is the abuse of drugs and chemicals. There emerging use of complex drugs has caused unprecedented complex behaviours among the young learners. For instance, there is a new wave of abusing animal tranquilisers called "T*RANQ*" which is causing skin infections and amputations. When an individual takes this drug, one would start to behave like an animal.

In this study young learners refer to all learners from ten (10) years to twenty (20) years. According to Ofori et al, (2018), there is no single day which passes without the media reporting incidence of indiscipline among the youth in Africa. In Zimbabwe, Wayne Ndlovu, a form four pupil at Founders High school was stabbed to death in a suspected inter-school war

turf (*The Chronicle*, 2023, 15 February). This incident illustrated the level of indiscipline in schools as learners carry dangerous weapons to schools. is the case triggered this current research.

Indiscipline exhibited in schools has affected the quality of education, especially in public schools. This view concurs with Simuforosa and Rosemary (2014) who posit that the period of teaching and learning is reduced as more time is devoted to managing misbehaviour of learners. Education facilitators (teachers) are faced with a mammoth task of trying to control complex deviant behaviours from the learners.

Indiscipline is best defined with three Ds which are disruptions, deviance and disrespectful. The concept of indiscipline has serious consequences on the geo-economics and bio-psychosocial development in the environments. The World Bank (2018) concurs with this view as it concluded that insufficient skills stemming from weak educational outcomes are the key constraints to economic progress and growth. There are so many factors that are causing learners to exhibit complex misbehaviours ranging from environmental, technological, economic and globalisation issues. Indiscipline behaviour is a worldwide canker, which is a threat to the lives of young individuals. Indiscipline is an act of deviating from the norms and values of the society and a school is a miniature society as well. This means that there is no universal definition of indiscipline. Indiscipline is the opposite of discipline and the two are socially constructed entities. Each society has a different perspective and meanings of indiscipline due to different norms and values.

The wave of indiscipline is increasing at an unprecedented speed making it a pandemic that threatens the moral fibre of communities in Zimbabwe. The country is currently grappling with complex cases of indiscipline in schools. Some of the causes of indiscipline are aggravated by lack of parental monitoring and support. According to Kaiser et al. (2017), economic difficulties have forced parents to focus on present financial needs and parents have no time to nurture their children causing children to behave astray. The Zimbabwean economic situation has pushed parents between the rock and the hard surface. Most parents spend their time and effort trying to make ends meet thereby paying less attention to the welfare of their children. Some parents the diaspora have precipitated indiscipline among their young children as they delegate the custody of their children to *would-be indiscipline care givers.*

This study was carried out in the high density suburbs of Mbare and Highfields in the capital city of Harare, Zimbabwe. Some Zimbabweans regard life in Harare to be fast and deviant behaviours as the order of the day. Mbare and Highfield high density suburbs are the oldest residential areas of Harare characterised with hive of illegal and legal activities as source of income. Wolhuter and Van der Walt (2020) insist that disrespectful, indiscipline, criminal and violent society nurture children alike. In same respect, we cannot expect to find disciplined learners from crime infested and drug ridden density suburbs such as Mbare and Highfields. In that case, schools become the manifestation of community activities leading to complex deviant behaviours such as beating teachers and bullying others, among others. This was confirmed by Mkhize and Shembe (2022) when they narrate that teachers in some schools were threatened, physically harmed, verbally abused, and emotionally and psychologically traumatised by intoxicated learners. The teachers therefore suffer in silence and there is no policy to protect them from hooves of indiscipline.

The learners are becoming more violent and dangerous at school as well as in the community. Community leaders are astonished by the behaviours of the young people. Education facilitators in schools become vulnerable and disheartened by the complex behaviours exhibited by learners (Pretorius, 2014). This further compromises the effectiveness of teaching and learning in schools.

Complex behaviours exhibited by learners clearly indicate that the current education system cannot match the challenges it faces. The indecorous behaviour of learners is a current generational pandemic that needs collective effort.

Children are born without any culture. Culture is then transmitted through primary socialisation and the family is the primary source of culture transmission. Every culture has its own approaches, informed by norms and beliefs crafted by a people of that culture. Discipline is first taught and nurtured at home by primary care-givers. In this regard, Mkhize (2016) and Mbiti (1988) concur that discipline is enshrined within the philosophy of *unhu/ ubuntu* "I am therefore we are" "*munhu nekuda kwevanhu*". The concept of discipline is therefore a collective picture of the whole community. Indiscipline is a manifestation of the marginalisation of the indigenous culture.

In the Zimbabwean worldview indiscipline among the young people has a great impact to the developmental aspirations of the country. The pockets of cultural resistance are an influx in the

current school environment and this is transferred into the general communities. According to Garagea (2008), if children are not properly taught moral issues, they would graduate into criminal gangs instead of educated citizens who could develop the socio-economic sectors of the country.

There is now a dilemma of coming out with effective ways of curbing learner indiscipline in schools and at home as well as honouring children's rights. The United Nations conventions on the rights of children is clear; therefore, the legal requirements of protecting children's rights has to be respected. Many learners with disruptive behaviour come from troubled homes where there is erosion of a nurturing family structure (Bosman, 2022). Indiscipline in schools affects the learner more than anybody else. Section 53 of the constitution of Zimbabwe concurs with the United Nation conventions and the African Charter on Human Rights. The Zimbabwean government adopted the Education Amendment Act of (2020) which outlaws corporal punishment. In schools, the school head or deputy are authorised to administer moderate corporal punishment to learners. The worrisome level of indiscipline triggered the researcher to carry out this study.

Causal factors of indiscipline in schools

It is generally believed that learners are currently more unruly and less respectful than they used to be during the time when corporal punishment was permitted in schools. Globally, corporal punishment has been outlawed by legislation. Various international organisations have ruled that corporal punishment was not an effective measure of curbing learners' indiscipline in schools and in the community. It was also noted that corporal punishment was a serious human rights abuse. This created controversy among the researchers as they expressed concern about viable alternatives of curbing indiscipline other than resorting to corporal punishment (Meier & Marais, 2010). In other countries like South Africa, cases of indiscipline in schools are at climax as there is high rise incidence of learners being injured and killed within the confines of schools (Nene, 2013). According to Jeloudar, Yunus and Roslan (2011), schools in Malaysia have some disciplinary problems such as petty crimes, bullying, drugs abuse, immoral conduct, dressing, truancy, disrespect for others and maladjustments with the school environment. Discipline in schools is an essential element in the socialisation of children. The level of indiscipline among the youth both at school and out of school has generally disturbed, demoralised and exhausted the caregivers in the community. Nene (2013) indicates that most education facilitators are now vulnerable as they feel incapacitated and helpless in addressing

learners' indiscipline in schools. There is a dyadic influence of indiscipline in schools and communities.

Indiscipline as both internal and external locus of control

Indiscipline amongst the youth is attributed to so many factors which can be grouped as both external and internal locus of control. The literature from various contexts connects the causes of indiscipline to society-based factors, parental style, technological influence, hormonal issues. The school is an institution that inherits and shapes the personalities of learners from home environment. This was supported by Jinot (2018) who argues that the root causes of learners' misbehaviour at school emanate from home. The behaviour of learners at school is therefore a clear reflection of community behaviour. In this regard, the family is the primary socialisation agent for the learner where manners, norms and values of society are inculcated through reward and punishment mechanisms at its disposal. The behaviour and the relationships between learners and adults at home/community tend to spill over to the school. For instance learners, who bully their parents at home, are not moved when the school informs them that it will report them to the parents. Kiwale (2017) asserts that the home environment plays a very big role in influencing the learner's behaviour at school. The school is a miniature community. It reflects the characteristics of the wider community to which it belongs. Criminal activities occurring in the community tend to manifest themselves in learner behaviour at school. Personality and developmental changes at puberty stood out as the main internal factor which triggers indiscipline among the young people. Learners with attention seeking personalities commit offences so that they can receive attention in the process.

Adolescence is a critical transition period between childhood and adulthood, where there is rapid growth and significant changes in the physical, psychological, emotional, intellectual and social domains (Lau & Yuen 2013; Bolu-Steve & Esere, 2017). Peer pressure is very strong and some adolescents may start to engage in activities that are perceived to be contrary to the norms and values of the societies, or what may be considered as normal or typical for society (Bolu-Steve & Esere, 2017; Herington & van de Fliert, 2018).

In America, studies revealed that young people are involved in criminal activities and use of dangerous substances that have a significant impact on their health (Boyd, 2015; Parks, 2013). Studies in China also show that adolescents are engaging in risky behaviour such as substance abuse, vandalism, gang violence, and theft (Lu et al., 2013; Pyrooz & Decker 2012; Cheung, 2014; Chui & Chan, 2013). A study conducted in Kenya indicated deviance of adolescents in

high school in the form of dropping out of school, the destruction of property, injury, and poor academic performance (Aute, 2019). Stressful life circumstances, including exposure to violence, mental and physical health problems, substance abuse, poor housing conditions, and crime, can diminish parental self-efficacy and capacity (Crnic & Ross, 2017). Socio-economic conditions and high levels of toxic stress within a family may influence parenting through their effects on mental health and differential access to resources, and ensuring children's survival in such circumstances becomes a major challenge for parents (Roubinov & Boyce, 2017).

Schlebusch, Makola, and Ndlovu (2022) lament the reality that learners are now out of control and disrespectful to themselves, teachers, school administrators, parents, and society at large. According to Kourkoutas and Wolhuter (2013), the largest obstacle in dealing with learner indiscipline concerns in developing countries such as Zimbabwe, is centring on how to control the unexpected behaviours. In some case schools in the high density of Mbare and Highfield, there was a critical worrisome level of indiscipline.

Theoretical framework

The bioecological theory was used to anchor the study. The chief proponent of this theory is Bronfenbrenner (2006). The complex indiscipline behaviour exhibited by learners within school premises and in the community was dissected with an intention of coming up with the alternative of curbing such behaviours. This theory opines that behaviour is as a result of complex process involving a system of dyadic interactions between the individual and the surrounding environmental. According to Schlebusch, Makola and Ndlovu (2022), the theory of Bronfenbrenner's bioecological has four interconnected environmental systems which are the microsystem, the mesosystem, the exosystem, and the macrosystem. The microsystem is the immediate environment which directly influences an individual to exhibit complex indiscipline behaviour. A microsystem is characterised with the learners' primary socialisation membrane such as the family, peers, teachers or caregivers. The mesosystem consists of the dynamic interactions between the different elements of a person's microsystem. The exosystem consists of the factors beyond the person that have an impact on the person such as the parent's employment status and the environment. The macrosystem is the wider system of society which embodies a set of ideological beliefs, values, and norms, as reflected in the cultural, religious, and socioeconomic organisation of society (Ettekal & Mahoney, 2017). The use of Bronfenbrenner's theory helps to connect the factors which spike learners to be undisciplined and the causal factors can then guide the study towards effective strategies of curbing

indiscipline among the learners. Mkhize and Shembe (2022) posit that the environment surround the learners has an impact to learners and the solution of indiscipline comes from same environment.

Aim of the Study

To find the causes and alternative strategies of curbing indiscipline in learners in schools and in communities of Mbare and Highfield in Harare, Zimbabwe.

Methodology

The descriptive research design was used in this study to describe forms of indiscipline exhibited by learners both in public schools and in the community. According to McCombes (2022), descriptive research design aims to describe a population in the study or the phenomenon accurately and systematically. It can be used to answer the what, where, when and the how questions. Teachers, ancillary school staff, guardians and learners were used as target population of the study. Data was analysed using the thematic analysis in which data was transcribed into themes.

Population and setting

This study included teachers, guardians, learners and significant leaders in the community in Highfield and Mbare high density suburbs. The convenience and purposive sampling technique was used to select the participants who reside in Mbare and Highfield high suburbs. The principle of data saturation was used in gathering the data from the participants

Research findings and discussions

The causes help to come up with best strategies of curbing indiscipline among the learners both in school and the community. The causes of indiscipline are interlinked. The research came up with the following themes extracted from the data presented as the causes of indiscipline.

i) Influence of social media
ii) Economic challenges
iii) Human rights
iv) Drug and substance abuse
v) Parenting style
vi) Experimentation
vii) Environmental and peer pressure
viii) Teacher –learner relationship

The strategy of curbing indiscipline among the learners at school and in the community is best determined with the causal factor of indiscipline. In this study, indiscipline is precipitated by the micro (individual and immediate stimuli), meso (communal), macro (societal, environment and spiritual systems.

Influence of social media and peer pressure

The participants indicated the causes of indiscipline among the young learners in schools. This was shown by their verbatim statements below:

> Participant 1: "Social media is determining and influences the behaviour of young people."
>
> Participant 2: "Technology has brought more harm than good to our culture and the abuse of technological gargets such as mobile phones is seen as the fashion among the young people in public schools."
>
> Participant 3: "Young people imitate the behaviour which they saw on the social media."

Indiscipline cases, in which young people view themselves as best decision makers, are as a result of peer pressure

The study found that social media is wreaking havoc on the moral values of learners. It was noted that young learners emulate the behaviours of individuals such as actors on the social media. The study found that, when the young learners are misbehaving, they would be viewing their actions as being legendary. This means some learners behave unknowingly. Social media is a subset of technology hence younger learners both at school and in the community observe the behaviour of characters on the social media. These young learners tend to emulate the behaviour of characters they see on social media. For instance learners might watch violent behaviour or pornographic movies. This influence misbehaviours such as bullying and prostitution or committing sexual crimes such as rape. The behaviour learnt from the social media is so complex which warrant complex behavioural approaches.

Economic challenges, parenting and environmental influence

The study found that the current hard economic challenges faced by the youth in their daily experiences are forcing them to initiate counter economic behavioural strategies such as vandalism, stealing and abusing drugs. It was established that learners sell items which they had vandalised to raise money to buy drugs. This concurs with WHO (2020) which explains that most young learners are key players of drug and substance abuse. The current study established that young learners abuse drugs as a counter quick relief to the hard economy. Drug

abuse is against the accepted moral code since the behaviour exhibited by an individual who is intoxicated with drugs can negatively affect the psychological nature of an individual thereby delaying and destroying development.

The study also found that high unemployment rate has caused almost everyone to venture into hustling behaviours and young learners are exposed to immoral behaviours such as child prostitution, sexual abuse behaviours, glorified suicides, and serious crimes such as robbery, among others, as people hustle to make ends meet in their communities. On the parental side, unemployment has forced some parents to go to neighbouring countries looking for greener pastures (employment opportunities) leaving their children alone or with strangers. This could expose younger learners to unrestricted environments leading them to behave against the norms and values of the community. Parents who leave their children with strangers have no direct guidance in the upbringing of their children and leave total responsibility to the school.

The following extracts from the participants are in support for the above views:

> Participant 4:"Lack of adequate food has precipitated young learners to engage in criminal activities such as vandalism".
>
> Participant 5:"Unemployment in the communities has caused most individuals to survive on illegal activities which young learners emulate and later exhibit at school".
>
> Participant 6: 'Lack of guidance due to parental exodus to neighbouring countries to look for employment leaving their children under the care of strangers'
>
> Participant 7:'The collaboration between young learners and the community youth committing crimes is a product of drugs and substance abuse'
>
> Participant 8: 'Corruption is the main cause of indiscipline in schools'

The research established that some parents tend to spend little or no time with their children hence there is a lack of guidance and monitoring of behaviours. Ultimately, lack of parental guidance led to complex behavioural problems such as bullying, truancy and *blue toothing*, among others. In this research *blue toothing* is extracting blood of an intoxicated peer and inject other peers so that they also get drugged. This act is very dangerous as it exposes young learners to diseases such as HIV/AIDS.

The indiscipline of younger learners is the collective indiscipline of the whole community. This concurs with Mkhize et al. (2016) who state that behaviour is a product of the *ubuntu* philosophy which articulates that *I'm because of others.* This concurs with the theory of

Bronfenbrenner in which all the surrounding system can be affected by the behaviour of an individual. Lack of proper parenting, therefore, has a strong influence on the behaviour of learners. It was found that some negative labels given to young learners at school and in the community led to self-fulfilling prophecy which later attracted them to join criminal gangsters in their communities. Greer and Reiner (2014) argue that labelling is the process of normalising a deviant act.

The other notable causes of indiscipline by young learners include the issues of broken homes due to death, divorce, violence and infidelity. These issues could lead to unexpected behaviours as young learner may lack control and copy some of the behaviours of the adults affected by such issues. The learners would therefore be influenced to develop bad morals in the community.

Psychologically, it is known that the environment shapes behaviour. In this case, communities in Mbare and Highfields are associated with undisciplined characters of all ages. Corruption and poor moral values as displayed in Mbare and Highfields may influence the learners to misbehave. This means indiscipline of learners who resides in these areas is precipitated by a lack of proper role models who could influence them to emulate good behaviour. Young learners who grow in such environments are therefore prone to learn criminal behaviour, which is an element of indiscipline.

Human rights

The issue of children's rights has brought more harm than good in schools and communities. The issue of labelling sanctions given to young learners who misbehave as child abuse has caused high indiscipline both at school and in the community. The study found that children in school currently have all the rights yet teachers have none. Learners are becoming boastful while teachers are now vulnerable. This has caused young leaners to bully teachers, propose love to teachers, sexually harass teacher and carry dangerous weapons to school. It is therefore difficult to discipline learners since any measure that could inflict pain on learners is against the law and regarded as child abuse (Constitution of Zimbabwe, 2013). The complex behaviours exhibited by learners clearly reflect that they do not fear anything since they are overprotected by the law. The study established that learners are becoming boastful of their rights to an extent of directly telling education facilitators and the community elders of these rights. This has caused education facilitators to be vulnerable hence they opt to ignore and do not offer behavioural remedy to learners. The above supposition indicates that young learners

misbehave because they know their rights more than their responsibilities. The following statement was echoed by one of the participants:

> Participant 3: "The over-elaboration of children's rights without responsibility has led young learners to misbehave".

Drug and substance abuse

Drug and substance abuse is a topical threat to human behaviour especially the youth. This study found that abusing drugs and substance is regarded as a 21st century fashion among young learners. Makumbe and Dzingirayi (2022) also established that the abuse of drugs and chemicals has always exposed the youth to deviant behaviours such as unhealthy sexual acts, cyber-bullying, cyber-porno, suicidal behaviour, experimentation, parental bullying and even murder. It is therefore understood that most young learners misbehave under the influence of drugs. In agreement with the above views, one of the participants expressed that:

> Participant 6: "The abuse of drugs is the key cause of indiscipline amongst the learners in public schools"

Teacher–learner relationships

The study found that some teachers' behaviours triggered indiscipline amongst learners. In this case, teachers behaved in a way which compromised their profession. It was noted that most teachers in public schools were no longer motivated to do their work due to very low remuneration. This supposition indicate that teachers were no longer committed to do their work due to hard economic challenges. This ultimately led teachers to go to work unprepared and when learners realise that they may counter react leading to indiscipline. This means learners' indiscipline may be due to doubting the competence of their teachers. A less motivated teacher uses teaching methods which lead to boredom among learners.

Imposing school rules without the involvement of learners could also lead to indiscipline behaviour such as bullying, vandalism, gang fights, assaults, extortion, truancy and drug abuse. The economic challenges have also made some teachers to be vulnerable to conniving learners who then make illicit deals that compromise teachers' control over leaners. The study further found that there were so many teacher related factors which could trigger learners to misbehave some of these were unprofessional dressing of teachers, large teacher-pupil ratio, absenteeism, use of abusive language on learners and having negative attitudes towards learners.

Strategies of curbing indiscipline in schools

It is hard to come out with finest strategies of curbing indiscipline among young learners due to factors such as technological development worldwide. Technology has created a superhighway of communication leading to the globalisation and destruction of physical boundaries. This study found that young learners were mostly influenced to misbehave due to emulating behaviours on the social media. Therefore, in order to control the behaviour of young learners both at school and in the community, there is a need to have supportive disciplinary measures which are embraced by the community leadership as well as enshrined in the law. Communities cannot ignore indiscipline exhibited by young learners because the youth are the light and hope of the future in each and every community. There are many causes of indiscipline and dealing with such behaviour poses many challenges. The following are some of the strategies that can be employed by communities and schools to control the behaviour of young learners:

i) Using the integrated social structure of curbing discipline. The social structure should involve teachers, community leaders, law enforcement agencies, religious leaders, mental health experts such psychologists, counsellors and other significant others in the community. This strategy is in line with the Afrocentric philosophy of collectivism which entails that the child belongs to the community not to an individual. The spirit of *ubuntu* is noble in controlling the behaviours of the youth in the community. A well cultured community is a disciplined community. The supportive-preventive structure should be comprehensive, proactive, systematic, nurturing, and liberating. This indicates that there is a need to have participation and complete involvement of all partners in the community.

ii) The other strategy involves rewarding positive behaviour exhibited by other youth. Young learners who behave well should be rewarded periodically. This would foster competition of behaving well and ultimately it is a way of grooming the youth towards good behaviours.

iii) To restore discipline in the community, there is a need to have accessible comprehensive counselling centres in the community. These counselling centres should offer services freely without any monetary restrictions.

iv) Creation of cultural globalisation in which youth collaborate and compare cultural systems taking advantage of technological advancement.

v) Using behavioural gateway that involves tracking the behaviour of young learners on the internet and make use of internet restrictions such as use of age appropriate internet. For instance, parents and the school could make use of passwords so that learners cannot abuse the internet.

vi) Adding mental health education as part of emotional guidance since technology is bringing emotional damage to young learners due to what they see on the internet.

vii) Empowering learners by keeping them busy so that they find it difficult to purchase some drugs from the drug lords.

viii) Reprimanding learners who misbehave in a respectful way.

ix) Holding regular parent-teacher association (PTA) meetings in which matters around the behaviour of learners can be discussed using learner-centred approach.

x) Sanctioning all indiscipline behaviours. There is an alarming level of misbehaviour globally. This means there is a need to be flexible in the interpretation of the law.

xi) Establishing clear guidelines and rules on indiscipline in schools.

xii) Using guidance and counselling intervention strategies.

xiii) Teachers should vary their style of teaching to cater for diverse needs

xiv) Motivating and encouraging young learners by creating an environment conducive to learning in schools.

xv) Encouraging psychosocial support to communities and schools. In this case, teachers must avoid labelling learners at all cost. They must ensure they cater for individual differences in schools. Teachers should fine tune their attitudes towards their learners and this can help to shape the behaviour of learners.

xvi) Creating a collaborative discussion of relevant everyday issues.

xvii) Learners found in possession of drugs must be referred to counselling and or rehabilitation centres.

Conclusions

In an attempt to address the causes and impact of indiscipline among the youth and learners both at school and in the community, this study established that drug and substance abuse are the chief causes of indiscipline in Mbare and Highfields suburbs of Harare, Zimbabwe. The causes of indiscipline have been explained by the bio-ecological theories such as the micro-systems, meso, exo-system and the macro-system. The research found that these bio-ecological systems determine the best strategies used to curb the contemporary misbehaviour by learners.

Some of the strategies include initiation of behavioural gateway, rewarding well behaved learners, involving young learners in community decision-making, motivating and empowering the learners. The study recommends an inter-ministerial task model that can put in place a recipe of strict policies to curb indiscipline. The study predicts that, if the issue of indiscipline is not addressed properly, the youth may revolt against the elders and leaders at macro levels. The young people may end up taking dangerous drugs that can precipitate into cultural conflict.

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Commonly Abused Substances by Youths in Sakubva Suburb: Towards a Community-Based Model for Substance Abuse Prevention

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Abstract
This qualitative study was carried out to investigate substances commonly abused by youths in Sakubva suburb of Mutare, Zimbabwe. The aim of the study was to establish the effects of substance abuse and come up with a model that can be used to prevent such behaviour at community level. Twenty participants were conveniently sampled using linear snowballing techniques. Data was collected through a questionnaire with qualitative questions and focus group discussions conducted with participants residing in the suburb within the period of the past two years prior to this research. The research presented the symptoms, causes and effects of substance abuse in the study area. The symptoms of substance abuse in Sakubva youths included presenting bloodshot eyes; changes in appetite and sleep patterns; sudden weight loss or gain; deterioration of physical appearance; unusual body smells and bad breath; decline in school or work performance; impaired coordination; behavioural problems as well as sudden changes in friends or associates. The causes of substance abuse among Sakubva youths included peer pressure, unemployment and burdens of life. The main categories of substances that were abused by respondents included stimulants, depressants and hallucinogens. The study presented a model which could be used to assist youths prevent substance abuse in their communities. The study recommends that youths should be empowered to resist peer influences as these play a significant role in substance abuse. The youths also need employment opportunities in order to gainfully occupy themselves and keep off drugs. The family and caregivers should execute their roles effectively in child upbringing in order to keep youths out of drugs.

Keywords: commonly abused substances, youths, Sakubva suburb

Introduction
The upsurge of substance abuse has serious ramifications on people's physical and mental health. Substance abuse increase is noted in many population groups and parts of the world (Tavarez, Beria & Lima, 2003, 2004) alongside concurrent drug and mental health problems in young people (WHO, 2010, 2014; Ferrari, Whiteford & Degenhardt, 2015, 2016). Comer (2014) also notes that substance abuse is still rampant today as in the past and is responsible for a wide range of psychological disorders. Substance use and abuse has contributed to mental health complications (Jane-Llops & Matytsina, 2006; Lee, Humphreys, Flory, Liu, & Glass, 2011; Urcelay & Dalley, 2011) and many researchers have also established that people who ingest drugs suffer substance intoxication together with substance use disorders (The Diagnostic and Statistical Manual of Mental Disorders DSM-5, 2013). The global burden of

disease study of year 2013 shows that the burden attributable to substance use has increased substantially in adolescents more than in the general population (Degenhardt & Hall, 2016). It is postulated that half of all mental illnesses begin at the age of 14 and most cases go undetected and untreated. In giving credence to this disturbing phenomenon, the United Nations Office on Drugs and Crime (UNODC) puts an estimated 7% of the 15-64 age bracket as having abused substances, which corresponds to 183 000 drug related deaths in a 2012 report (The World Drug Report, 2013; 2014).

Substance abuse among teens and young people has also become part of a pattern of unsafe behaviours. Considered in some places as a rite of passage to adulthood, substance abuse among teenagers is a prominent health problem even in the United States (Peterson, 2010; Comer, 2014). The World Drug Report (2014) also puts Western Europe, Southeast Asian countries, Australia, Spain, Afghanistan and Pakistan as the hardest hit nations by illicit substance use. Past studies unanimously agree that drug and substance abuse are global concerns (Babaola, Ogunwale & Akinhanmi, 2013; UNODC, 2013). This disturbing occurrence is also prevalent in most African nations as reported by a Kenyan study (Simatwa, Odhong, Juma & Choka, 2014) and in another Nigerian study (Adje, Oyita & Eniojukan, 2015). Not to be outdone, adolescent substance abuse is reported as high in Ramotswa region of Botswana at 17.4% in the 13 to 19 year bracket (Gotsang, Mashalla & Seloilwe, 2017). Substance and drug misuse prevalence was also investigated among adolescent school children in Zimbabwe (Acuda, Eide & Gudyanga, 1995) noting a high increase in alcohol, tobacco and cannabis in both rural and urban schools studied. Very minimal variations were also noted across sexes and ages. In South Africa, the substance abuse problem is also reported to be twice that of the entire world (CDA Report to Parliament 06 September, 2011). In 2010, it was reported that 12% of South African learners had used illicit drugs (Reddy, Panday, Swart & Sewpaul, 2010).

Dangerous drugs are finding their way into Zimbabwe. A wide variety of licit and illicit drugs and substances are being abused. Harmful drugs and substances such as broncleer, *"brongo"* glue, ZED, Histalix D, *"whoonga"* (which contains anti-retroviral drugs, cannabis or heroine), *"skunk"* (a potent form of cannabis plant), *"musambodhiya"* (diluted ethanol or methanol), heroine, *"kirango"* and anti-psychotic drugs are widely being abused by the youths. According to research, methanol is poisonous to the central nervous system and may cause blindness, coma and death if taken in large amounts (Yikoniko, 2016). Other widely abused drugs are the

pills meant for the sedation of mentally ill patients such as chlorpromazine and diazepam which are supposed to be bought with a prescription.

Risk factors associated with substance abuse among adolescents have been widely researched but not much is known on the methods used or resources that could be utilised to manage it. Anti-psychotic drugs used to manage substance abuse problems like delusions, hallucinations or disordered thought among drug abusers are scarce in public hospitals in Zimbabwe. Addiction treatment centres in Zimbabwe are also few and the cost is prohibitively expensive at US$40 a day in some cases. There are few centres for drug rehabilitation which include Highlands Halfway, Ruwa Rehabilitation, Serenity Mind Centre, Tirivanhu Rehabilitation, Beatrice Rehabilitation, Tariro Rehabilitation centre, Sally Mugabe Psychiatric Unit, Parirenyatwa Annex Psychiatric Unit, all in Harare. Only Ingutsheni Psychiatric Hospital in Bulawayo and Ngomahuru Hospital and Half-way House in Masvingo are centres outside Harare, which makes most centres inaccessible for many who might need them. The Zimbabwe United Nations Association, as cited by Yikoniko (2016), reveals that about 65 per cent of Zimbabwean youths suffer from mental problems due to drug and substance use. The Zimbabwe Republic Police also revealed that 5445 people were arrested on various drug related crimes between January and December 2015 with ages between 15 and 35 being among the major users and abusers of drugs (Yikoniko, 2016). It is against this background that the present study examined the substances that the Sakubva youths abuse, their effects and causes with a view of coming up with a model to assist them.

Research questions

The present study, therefore, sought to answer the following research questions:

i) What are the specific substances abused by Sakubva suburb youths and what are the effects of such substances?
ii) What model can be used to prevent substance use among youths?

Methodology

Research design

To delve more deeply into the commonly abused substances by youths in Sakubva suburb, the research was conducted using the qualitative approach to capture detailed data. Creswell and Creswell (2018) specifically define qualitative research as "…..an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem." The writer subscribes to this view because, in a qualitative study, the

researcher builds a complex, holistic picture; analyses words and reports detailed views of informants and conducts the study in a natural setting. The qualitative methodology would therefore allow the researcher to capture the meanings of the lived experiences of participants as far as commonly abused drugs and their effect is concerned.

Study population

The population of interest for this study was all youths who had been living in Sakubva suburb in Mutare in the previous two years prior to this research. Youths in Zimbabwe are defined as persons between 15 and 35 years of age. It was assumed that the youths would have been involved and witnessed substance abuse during the same period. These respondents had to be mature enough in order to give informed assessments of the substance abuse problem in the area.

Sampling

The researcher chose twenty participants as the study required a small but focused sample. The researcher used snowball sampling, which is a widely employed method in qualitative research, specifically when studying hard-to-reach populations (Gray, 2014). Linear snowball sampling relied on one referral per participant. The researcher recruited only one participant, and this participant, in turn, recruited another. This process went on until there were enough participants included in the sample. Linear snowball sampling was preferred because it works best when there are few restrictions (called inclusion and exclusion criteria) as to who is included in the sample.

The study participants were asked to highlight their age ranges as it was felt that many could have been uneasy at releasing their ages to unfamiliar persons. The ages of the respondents are presented below:

Table 1: Age distribution of the participants

Responses	Frequency	Percentage
Below 20 years	3	15
20-25 years	5	25
25-30 years	9	45
30-35 years	3	15
Total	**20**	**100**

From Table 1 above, 3 (15%) of the respondents were below 20 years of age; 5 (25%) showed that they were between 20-25 years of age; 9 (45%) indicated that they were in the 25-30 year bracket. Another 15% of the respondents were between 30 to 35 years of age. The table results

show that the respondents were mature enough to give informed answers on the phenomenon under investigation.

Data collection

The tool used for data collection in this study was the questionnaire which comprised qualitative questions. The questionnaire was used to obtain information about current conditions and practices in substance abuse in the suburb and to make inquiries concerning attitude and opinions of youths in quick and precise forms (Kombo, 2006; Chiromo, 2006).

A focus group discussion (FGD) was utilised as a way to gather together youths in Sakubva suburb who were from similar backgrounds or experiences and encourage them to discuss a specific topic of interest (causes and effects of substance abuse) (Stewart & Shamdasani, 1990). The group of youths was guided by a moderator (researcher) who introduced the discussion of the causes and effects of substance abuse. The moderator helped the youths to participate in a lively and natural discussion amongst themselves.

Data analysis and interpretation

The study utilised various methods used in analysing qualitative data. Thus, data analysis took the form of content analysis which involved breaking up the data into manageable themes, patterns and trends. The aim of this analysis method was to determine whether any pattern or trends could be identified or isolated into established themes in the data (Creswell, 2012). For the thematic analysis, the researcher also utilised the techniques suggested by Braun and Clarke (2013). The authors used flexible qualitative methods which include familiarising oneself with the data, generating initial codes, reading through each transcript to immerse in the data, reviewing themes, defining and naming themes and producing the final report.

Ethical considerations

The purpose of the study was disclosed to twenty participants four weeks before undertaking focus group discussions and administering the questionnaire. The investigator explained the aim of the study (Chetty, 2016), and other pertinent and important information about the research to the participants so that they could make an informed decision as to whether to become involved or not (Singh, 2019; Gray, 2014). The investigator observed some ethical considerations like informed consent, privacy, respect and anonymity of the subjects (Makore-Rukuni, 2004) and confidentiality (Creswell, 2012).

Results

Signs and symptoms of substance abuse in youths

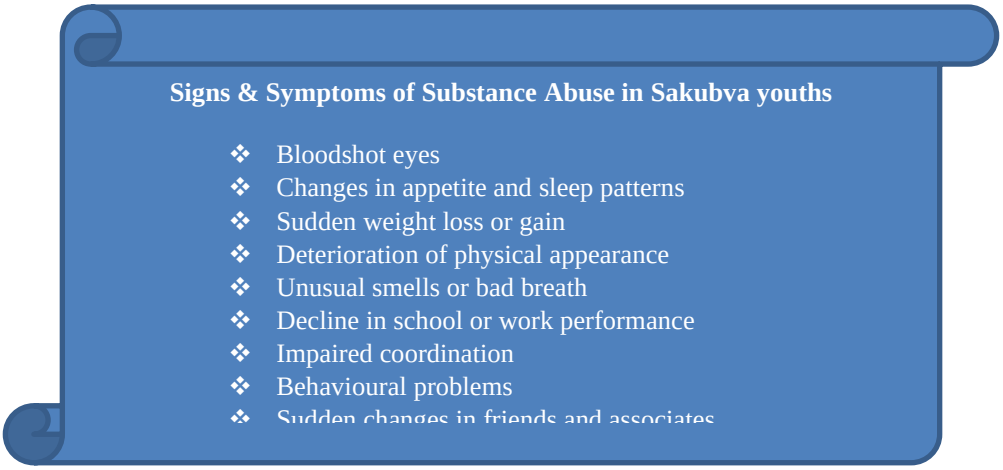

Figure 1: Signs and symptoms of substance abuse in youths
(Source: Mashamba, 2023)

The symptoms of substance abuse in Sakubva youths as presented on Figure 1 above include bloodshot eyes; changes in appetite and sleep patterns; sudden weight loss or gain; deterioration of physical appearance; unusual smells or bad breath; decline in school or work performance; impaired coordination; behavioural problems as well as sudden changes in friends and associates. From these symptoms presented it was noted that alcohol can also be the cause of bloodshot eyes because it increases blood circulation. With increased blood circulation, the blood vessels in the eyes dilate, which was why the eyes became red after drinking. Sleeping problems and decreased appetite often reflect abuse of illicit drugs like methamphetamines. Illegal drugs cause weight loss as they disrupt the body's metabolism. This is because the metabolic process is distorted by the unnatural chemicals present in the body following drug or alcohol use.

Causes of substance abuse in Sakubva suburb

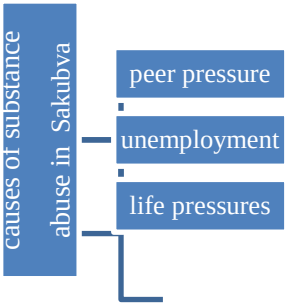

Figure 2: Causes of substance abuse in Sakubva suburb
(Source: Mashamba, 2023)

The causes of substance abuse among Sakubva youths include peer pressure, unemployment and life pressures. On peer influences, these results show that no one likes to be left out, and youths find themselves doing things they normally would not do just to fit in. Those youths not working were unhappy about their lives and they ended up doing drugs to while the hours away. Because of many social pressures, these youths became overwhelmed and needed to find other ways to handle stress.

Categories of commonly abused drugs by Sakubva youths

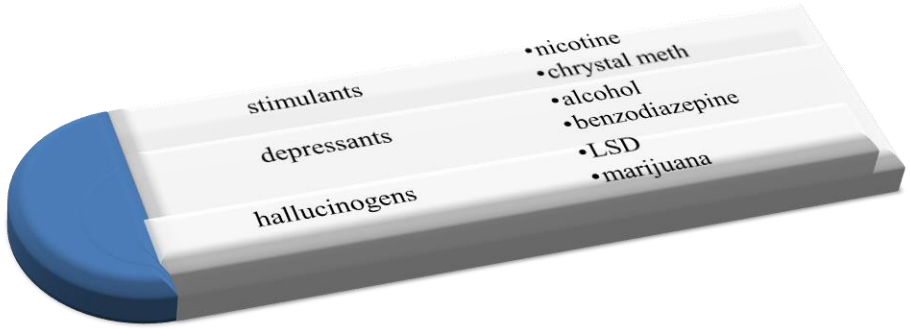

Figure 3: Categories of commonly abused drugs by youths
(Source: Mashamba, 2023)

The results from Figure 3 above show that the categories of substances that were abused by respondents included stimulants, depressants and hallucinogens. The stimulants which the respondents highlighted (nicotine and crystal meth) are habit-forming, and can lead to addiction as they affect the way the body and brain functions. The information from the data collection instrument shows that the effects of depressants on the central nervous system are the main reason why respondents abuse them. However, the longer a person abuses drugs, the more tolerant they become of their side effects. These youths then may begin taking higher doses to experience the same high. On hallucinogens, respondents reported that their senses peaked, and perceived everything as interesting. On a negative note, these hallucinogens inflict significant distress or functional impairment in one's life.

Results from focus group discussions

The researcher conducted two focus group discussions with the participants in order to gain a deeper insight into the commonly abused substances by youths in Sakubva suburb. The participants reiterated the influence of peer pressure in fuelling substance abuse as one such participant indicated:

> "We, as youths, feel anxious in social situations. Using alcohol and other drugs is a way to bond with a group of other kids, and be a shortcut to developing an identity for youths who aren't sure where they fit in. Substances help us get over shyness." [Participant]

In keeping with the influence of the peer group in exacerbating substance abuse, this respondent showed that they had problems turning down invitations to booze:

> "Receiving an invitation from a friend to come and party with drugs or alcohol is very difficult to turn down." [Participant]

There were some respondents who enjoyed taking drugs just for the fun of it, as this respondent explained:

> "Drugs, including alcohol, work quickly and can make me feel good in the shortest possible time. I sometimes use drugs to enhance other types of fun, like music festivals and dance parties." [Participant]

Another issue noted on taking drugs by youths was that there were some who did it out of failing to find employment, as this participant explained:

> "Many of us who have no employment end up abusing drugs because we need to survive and or keep on pressing in this stressful life. When we are growing from being children to adults, we have a lot of hopes and aspirations, which fade off as time goes by. As a result we get involved in drug as a way of forgetting our troubles unemployment status." [Participant]

There were other participants who emulated their caregivers and significant others, as this respondent emphasised:

> "Exposure to family members who reach for a substance to cure every pain of ailment caused me to do the same." [Participant]

Thus, results gleaned from the focus group discussions suggest that peer pressure, lack of employment as well as failure of the family to perform parental roles contributed to substance abuse in the study area.

Discussion

The study revealed the commonly abused drugs in the study to include stimulants, depressants and hallucinogens. It was also identified that the most influential factors in the abuse of substances in Sakubva area included peer associations, unemployment and social pressures. The symptoms of substance abuse in Sakubva youths included bloodshot eyes; changes in appetite and sleep patterns; sudden weight loss or gain; deterioration of physical appearance; unusual smells or bad breath among others. From the literature, peer pressure and curiosity among youths also contribute significantly as major causes of substance abuse in communities.

This finding agrees with Oketch (2008) who observed that the period of adolescence and youth is characterized by many challenges which they believe are experienced by their peers as many youths try alcohol, cigarettes and cannabis. This is also supported by Chikoko (2013) and Ngesu, Ndiku and Masese (2008) who report that peer pressure accounts for 21 – 42% influence in all types of drugs and substances consumed.

The youths usually strive to be accepted by the peer group and want to fit in and be part of the peer group and it is important for the youth to conform to the peer group. The peer subculture also facilitated the behaviour by making the substances available and by providing an appropriate social setting and instructions. This finding dovetails with results from another school-based study. In support of this finding, according to teachers studied in a past research, peer pressure is the largest contributing factor to drug abuse (Mpofu, 2013). Chikovo (2011) reports other factors including curiosity, drugs being available and the belief among students that drugs are a silver bullet to passing their exams. In many cases, students are drawn into consuming drugs by virtue of enticement and then introduced to drugs by their friends. They are convinced that they will feel high or would gain a sense of belonging.

Results also show that youths abuse drugs because of lack of employment. Zimbabwe is said to have the highest youth unemployment in southern Africa, according to the International Council Committee (Mpofu, 2013). Consequently, youths have the highest unemployment rate among all age groups in Zimbabwe. In year 2008, only 480 000 youths were formally employed, down from 3.6 million in 2003. Mpofu (2013) also reports that the majority of youths are turning to drugs to while away the hour. Statistics from the Anti-Drug Abuse Association of Zimbabwe also reveal that drug abuse in local schools has reached alarming proportions with 43 per cent of students interviewed in Mpofu's study indicating that they know of schoolmates who smoke cigarettes (Mpofu, 2013).

Although the Zimbabwean law prohibits possession, dealing in and taking illicit drugs, very little is being done to stem drug abuse in communities by the country's army of unemployed youths. Youths who use alcohol and other drugs persistently face an array of possible consequences as they may be alienated from and stigmatised by their peers. They often disengage from community activities because of their substance abuse, depriving their peers and communities of the positive contributions they might otherwise make. Substance abuse also jeopardises many aspects of family life and may result in dysfunctional families. Monetary

resources spent on alcohol and emotional distress due to drug-related crimes by youths affect many others in the community. Often there is an additional burden for the support of adolescents and young adults who are not able to support themselves as a result of abusing substances.

Some models have been proffered to assist people recover from substance use but their efficacy tends to be context specific. Examples of promising intervention for youths include Fast Track; All Stars; Life Skills Training (LST) Program; Narconon as well as Truth about Drugs Video Program, although these are school-based programmes (Substance Abuse and Mental Health Services Administration, 2022). Other examples of community-based programmes include Strong African American Families (SAAF), which is a seven-week program targeting rural African American families with children from 10 to 14 years old. It is a parental training program that works to strengthen attachments between parents and children, ultimately reducing alcohol and drug use (SAMHSA, 2022). Guiding Good Choices is a universal, parent-focused intervention (formerly Preparing for the Drug-Free Years) consisting of five two-hour sessions that teach parents about setting clear expectations, monitoring children, teaching children how to cope with peer pressure, adopting positive conflict management strategies, and enhancing family bonding. To be more effective, these interventions ought to be multi-dimensional, cross-cultural, responsive, inclusive and tailored to the needs of particular groups of people.

Community-based substance abuse prevention model

In view of the research findings, the following model (Sakubva Youth Substance Abuse Prevention Model- SYSSPM) is proposed to help youths prevent substance abuse in the community studied:

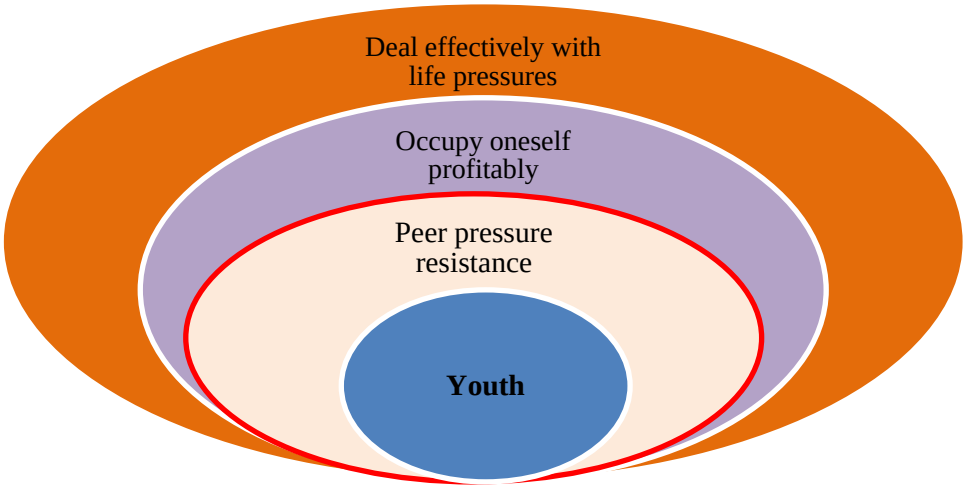

Figure 4: The SYSSPM model for community-based substance abuse prevention
(Source, Mashamba Tarashika. 2023)

At the centre of the substance abuse model is the youth who lives in a community with peers. There are also problems like unemployment and many other life pressures. To effectively prevent substance abuse, the youth should:

Resist peer pressure. The biggest reason why youths start using illicit drugs from the study is because their friends consume them and they fall victim to peer pressure. No one likes to be left out, and youths find themselves fitting in a peer group. In these cases, one needs to either find a better group of friends that would not pressure them into doing harmful things, or one needs assertiveness skills or to find a good way to say no. Youths need to keep from giving into tempting situations.

Occupy themselves profitably. Zimbabwe is said to have the highest youth unemployment in southern Africa. Youths have the highest unemployment rate among all age groups in Zimbabwe. Because they cannot find jobs, the majority of youths are turning to drugs to while away the hour. To escape the drug abuse problems youths should engage in more profitable ventures in groups or as individuals.

Deal effectively with life challenges. Youths today seem to be overwhelmed with life pressures. However, drugs only make life more stressful and many youths all too often fail to recognise this in the first instance. They ought to prevent using drugs and venture into profitable businesses or find other ways to handle stress. They ought to take up exercising, read a good book, volunteering to work with the needy or creating something to ensure that they are gainfully occupied. It is envisaged that anything positive and relaxing helps take the mind off

using drugs to relieve stress. To effectively manage themselves, youths must be aware of the biological, environmental and physical risk factors in their community which militate against living a more balanced life. This model is suggested as a prevention measure and caregivers or significant others may always use available referral centres who deal with drug rehabilitation.

Conclusion

The research presented the symptoms, causes and effects of substance abuse in the study area. The symptoms of substance abuse in Sakubva youths included bloodshot eyes; changes in appetite and sleep patterns; sudden weight loss or gain; deterioration of physical appearance; unusual smells or bad breath; decline in school or work performance; impaired coordination; behavioural problems as well as sudden changes in friends and associates. The causes of substance abuse among Sakubva youths included peer pressure, unemployment and life pressures. The categories of substances that were abused by respondents included stimulants, depressants and hallucinogens. The study presented a model which could be used to assist youths prevent substance abuse in their communities.

Recommendations

i) Youths should be empowered to resist peer influences as these play a significant role in substance abuse
ii) Youths need employment in order to gainfully occupy themselves and keep off drugs
iii) Family and caregivers should play their roles effectively in child upbringing in order to keep youths out of drugs.

Area for further research

The present study is limited to substances abused by youths in the selected urban suburb of Sakubva in Mutare, Zimbabwe. Future studies can examine the psychological disorders which young people may suffer after ingesting drugs and proffer interventions to curb such situations.

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Development of a Real-Time Integrated Electrocardiogram (ECG) and Reflectance-Based Pulse Oximetry System

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Abstract

Cardiovascular disease (CVD) is one of the primary causes of sudden cardiac death in Africa. Cardiac anomalies can be detected using an electrocardiogram (ECG), but the most difficult aspect of CVD is detection during its early stages. In addition to monitoring the heart using ECG, heart rate and blood oxygen saturation (SpO_2) are also important indicators related to the heart-pulmonary system since the two variables provide an indication of the overall functionality of the heart. Insufficient technologies for monitoring these parameters have been documented (especially in LMIC regions and rural areas) leading to late detection. The objective of this study was to create a low-cost 3-lead ECG signal detecting system and a pulse oximeter that could detect the likelihood of CVD in real time. The design of the device with LCD and DSO138 oscilloscope output is described in this study. Five units were used to create the device: ECG electrodes attached to an AD8232 ECG sensor module; ECG filter system; DSO138; MAX30100 heart rate and oxygen saturation sensor, and a power source. The results revealed that the portable device interprets the ECG signal from the 3-lead ECG system satisfactorily. The pulse oximeter system is made from a MAX30100 sensor which displays patient heart rate and oxygen saturation levels on an alphanumeric LCD screen. The designed system was successfully compared against a standard 3-lead ECG system and an internationally approved Oxiline Pulse 7 Pro pulse oximeter. The system developed in this study was able to function according to the design, measuring heart rate, and blood oxygen saturation, and displaying ECG waveforms. According to the test findings using the designed pulse oximeter system, heart rate measurements resulted in an error value of -0.70% and -0.21% in males and females, respectively, as well as 1.28% and 0.10% for SpO_2 results in males and females, respectively after comparison. For a much better assessment of CVD, there is a need to integrate the system with a GSM module to allow for the transmission of ECG

signals, heart rate, and SpO_2 patient data through mobile phones and the internet for remote and automated monitoring.

Keywords: electrocardiogram, heart rate, SpO_2, pulse oximetry system, automation, CVD

ACRONYMS

ECG	Electrocardiogram
CVD	Cardiovascular disease
LMIC	Low to medium income country
GSM	Global system for mobile communication
LCD	Liquid crystal display
NCD	Non communicable disease
CMD	Cardiometabolic disorders
HR	Heart rate
BPM	Beats per minute
WHO	World Health Organization
PAD	Peripheral artery disease

Introduction and background

Cardiovascular disease (CVD) has long been one of the primary causes of sudden death in many nations, both developed and developing. In the United Kingdom, cardiovascular disease has been a significant and ever-growing problem, and it has been responsible for almost one-third of all deaths, leading to significant morbidity (Stewart, Manmathan & Wilkinson, 2017). In developing countries, more cases of CVD have been attributed to a change in lifestyle which introduces novel risk factors for the disease (Stewart, Manmathan & Wilkinson, 2017). According to Ruan et al. (2018) approximately 17.9 million people died from CVD in 2015 in the entire world. By 2030, it is anticipated that at least 22.2 million people will die from cardiovascular diseases each year, with low and middle-income countries (LMICs) accounting for over 75% of CVD deaths (Ruan et al., 2018).

The term "cardiovascular disease" refers to a group of diseases that include cerebrovascular disease and rheumatic heart disease among others (Stewart, Manmathan & Wilkinson, 2017). Cardiovascular diseases were identified as the top cause of death among non-communicable diseases (NCDs) in 2021 (Made, Nonterah,

Tlotleng, Ntlebi, 2021). Poor diets have contributed to an increase in CVD cases in Zimbabwe, and the World Health Organization (WHO) cites these factors as the top worldwide health hazards, especially for CVD (Morera, Marchiori, Medrano & Defagó, 2019). In a study conducted by (Mutowo, 2015), the data gathered illustrated that cardiometabolic disorders (CMDs) and accompanying mortality are on the rise in Zimbabwe. The authors underlined the urgent need for cost-effective preventative interventions to lessen the burden of CMDs and backed the realignment of health policy decisions. In the quest to reduce the burden of CVD, insufficient primary care, including access to physicians, technologies, and treatments, have been cited as major causes of cardiovascular diseases related deaths (Ertola, Figueira, Carlsen, Palaniappan & Rondini, 2016).

Matiashe (2019) noted that, an ECG test in Zimbabwe was pegged at US$240, and this was not accessible to many people, especially those who live in rural areas. In the article, Matiashe (2019) pointed out that cardiac tests, which include ECG tests in Zimbabwean public hospitals, were only done at Parirenyatwa, Harare Central and Mpilo Central hospitals due to insufficient portable technologies, forcing many patients to seek services in private institutions and out of the country, making ECG tests inaccessible to most remote and rural parts of Zimbabwe. Heart rate and blood oxygen saturation measurements are also critical in cardiovascular monitoring. Currently these measurements are not being done frequently due to inaccessibility of equipment in rural Zimbabwe. Ramachandran and Bashyam (2017) developed a real time ECG signal monitoring system for telemedicine application, with the only drawbacks being portability and cost as it was integrated with a laptop. Another study conducted by Fezari, Bousbia-Salah and Bedda (2008) , examined an embedded system based on a microcontroller for real-time interpretation of ECG data, which was built and tested on various heart diseases. The system was made for telemedicine and the main goal was to reduce hospitalisation and assistance cost through early monitoring of patients. Hence, the aim of this study is to develop a simple system that is suitable for ECG signal monitoring.

Problem statement and justification

Insufficient technologies for monitoring heart signals, heart rate and blood oxygen saturation have been mentioned among reasons for lack of early diagnosis of CVDs

leading to increased number of deaths in LMICs especially in rural areas. Reasons behind lack of these technologies have been prohibitive cost, inaccessibility, and unavailability. The development of this affordable machine will go a long way to improving cardiovascular disease monitoring, especially in rural areas where these services are inaccessible because of cost and lack of infrastructural technologies. ECG tests would now be accessible in small clinics at cheap prices affordable to people living in LMIC's. This would improve early detection of cardiovascular diseases and improved patient care, thereby improving the quality of life of the population. The system would offer an advantage of ECG monitoring, measurement of blood oxygen saturation and heart rate at the same time.

Aim

The aim was to develop a cheap real time integrated electrocardiogram (ECG) and pulse oximeter system to be easily used in the villages, clinics, or houses, due to the small size and ease of use of the device.

Objectives

i) To design and develop a portable 3-lead ECG monitoring system.

ii) To design and develop a heart rate and blood oxygen saturation measuring system.

iii) To integrate the two systems into one device.

Literature review

Cardiovascular diseases are currently diagnosed using a variety of technologies, such as the electrocardiogram (ECG), also known as the electrocardiogram (EKG in German), among other methods. The electrocardiogram is an old technology but still widely used because its quick, painless, non-invasive, can spot abnormal heart rhythms and does not use ionising radiation (Ehnesh, Abatis & Schlindwein, 2020). An electrocardiogram (ECG) is a medical test that tracks the electrical activity produced by the heart while it contracts in to identify cardiac issues and anomalies. The electrical activity of the heart is supported by excitable muscle tissue's capacity to quickly alter its membrane permeability to sodium (Na^+) and potassium (K^-) ions. These ions move across the cell membrane and produce a fluctuating electric field that resembles the electrical activity of the heart. When these ions migrate across the cell membrane, they create a changing electric field that mimics the heart's electrical activity. The

electrical signals are picked up using electrodes linked to the patient, which are then amplified and shown on a cathode ray oscilloscope (CRO) to assess the patient's heart rate and other health information (Shakhreet, 2015). Figures 1 (a and b) illustrate the general anatomy of the heart in 3-D and cross-sectional view, respectively.

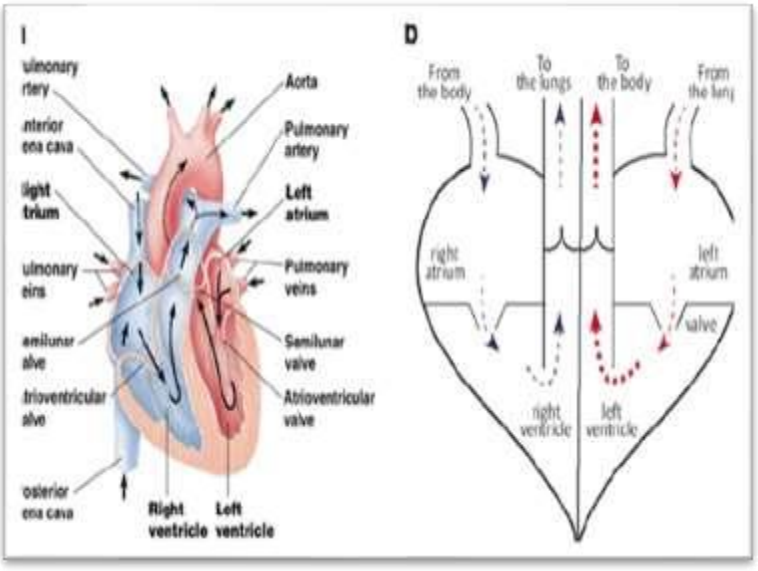

Figure 1: (a) 3D anatomy of the heart (b) cross-section of the heart

(Source: Heart anatomy, 2020)

Cardiovascular disorders can be identified using ECG testing (Electrocardiogram & Cardiovascular, 2021). A typical ECG wave as shown in Figure 2 is formed by the cyclical changes in the polarisation of the heart cell (Price, Cardiologist, Mary & Wight, 2016).

Table 1: Sections of an ECG trace

Section of Electrocardiogram	Section
P - Wave	Atrial Excitation
QRS - Complex	Atria Repolarisation + Ventricle Depolarisation
T - Wave	Ventricle Repolarisation
P - Q Interval	Excitation Timing Delay

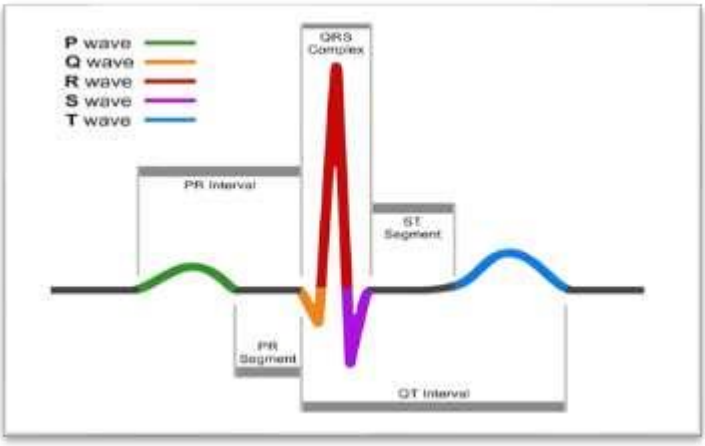

Figure 2: Standard normal ECG Waveform
(Source: David Hudon, 2021)

From an ECG graph, a clinician can detect enlargement of the heart, clogging up of heart blood supply, previous heart attacks, and heart failure (Sunehra & Siddireddygari, 2020).

Contractions in the heart walls produce electrical currents and create various potentials throughout the body, resulting in heart electrical signals. By putting electrodes on the skin, this electrical activity can be detected and recorded in an ECG. The electrical signal originates in the right atrium's sinoatrial node and travels to the right and left atria, causing contraction and subsequent blood pumping into the ventricles. The ECG records this electrical output as the P wave. Figure 2 shows a standard ECG trace for a normal human heart. P, QRS, and T waves are three vertical waves that show the depolarisation (atria contracting as a P wave, followed by the ventricles contracting as a QRS wave), and repolarisation, respectively, of the ventricle. In a typical ECG trace, a vertical P wave appears first, followed by the QRS complex and then a T wave. Atria repolarisation (relaxation) is weak and covered by QRS on the ECG trace, which has a straight line at zero voltage that represents the baseline known as the isoelectric line (Electrocardiogram & Cardiovascular, 2021).

Pulse oximetry

Heart rate (HR) and blood oxygen saturation (SpO_2) are crucial markers that are directly connected to the heart-pulmonary system in addition to heart health monitoring utilising the ECG approach. The two variables give an indication of the overall functionality of the heart especially in old people and pregnant women hence their

importance. A pulse oximeter is a medical device that can be used to noninvasively detect heart rate and indirectly monitor the patient's oxygen saturation level in the blood (Tso, Currie, Gilmore & Kiat, 2015). In pulse oximeters, 660 nm (red) and 940 nm (blue) light wavelengths are used to illuminate the skin and detect variations in the amount of light that is absorbed by oxygenated and deoxygenated (reduced haemoglobin) blood (Jubran, 2015). Several researchers have looked into designs of pulse oximeters; however, low-cost pulse oximeter designs for LMICs that provide unfiltered photo-plethysmograms (PPGs) are still unavailable (Fu & Liu, 2015) hence the motivation to carry out this research and to integrate the pulse oximetry system together with an ECG system for quick, convenient patient monitoring.

Reflective-mode pulse oximetry has been steadily rising in popularity as a means of monitoring oxygen saturation in blood since it can be used on the forehead, feet, chest, and wrists, and it does not need a thin measuring site. Despite current research into reflectance-based pulse oximeters, transmittance-based oximeters remain popular due to their high accuracy and stability, ease of signal processing and use (Lee, Ko & Lee, 2016). The main drawback with transmittance-based pulse oximetry system is the limited areas of the body where the sensor can be placed (Abedalmoniam & Fadul, 2017). This type of oximeter is normally paced on the ear or the finger.

Heart rate

According to Diaz, Casas, and Pallas-Areny (2010), heart rate provides information on the condition of the heart and assists in the diagnosis and evaluation of cardiovascular system problems (Díaz, Casas & Pallas-Areny, 2010). In a clinical environment, heart rate is observed in conjunction with other controlled parameters such as blood pressure, heart rate, and electrocardiogram (ECG). The heart beats to carry cell waste away from the muscles and to provide them with oxygen-rich blood. The heart needs to work harder to conduct these functions as more muscles are employed, which makes it pump blood more quickly. In order to use the data to check for heart problems, heart rate (cardiac rate) monitors are used to record heartbeats and determine the number of beats per minute (BPM). In order to use the data to check for cardiac abnormalities, monitors are used to capture heartbeats and determine the number of beats per minute (BPM). Electrical and optical heart rate monitors are the two types of heart rate monitors available (Hashem, Shams, Kader & Sayed, 2010).

On average, adult males have a resting heart rate of 70 to 72 beats per minute and adult females, 75 to 82 beats per minute (Ciklacandir, 2017). Depending on one's level of fitness, age, and heredity, individual heart rates vary significantly. By taking one's pulse, which may be done with sophisticated medical equipment or just by putting one's fingertips against an artery (usually on the wrist or neck), one can measure their heart rate (Ciklacandir, 2017). Although there are other well-known and established ways to measure heart rates, such as the phonocardiogram (PCG), electrocardiogram (ECG), blood pressure wave form, and pulse meters, it is generally agreed that auscultation-listening to heartbeats with a stethoscope-is a more precise and accurate method (Tai & Chien, 2005). The main disadvantage of other techniques being used is the issue of cost as they are expensive. Other cost-effective approaches for measuring heart rate using wearable sensors include an acoustic sensor encased in an air pillow and another technique is finger modelling (Rhee, Yang & Asada, 1999) however both methods are prone to noise and movement of subject and arteries.

Complications arising from cardiovascular diseases

The most feared side effect of CVD is death and, despite significant advances in recent years, CVD still ranks among the world's top causes of death as a result of the disease's increased prevalence in the population (Dunbar et al., 2018). Other challenges include the need for prolonged hospital stays, physical impairment, and growing healthcare costs, which are crucial and will be a priority for health-care policymakers as they are anticipated to rise in the coming decades (Dunbar et al., 2018). When a person has heart failure with a blood ejection fraction that is less than 35%, they are at a substantial risk of developing life-threatening arrhythmias. The implantation of an implanted cardioverter defibrillator (ICD) is advised by current recommendations for patients with symptoms that are comparable to a New York Heart Association (NYHA) Class II-IV, despite the use of maximally tolerated pharmaceutical treatment (Yancy et al., 2017). Strokes can have long-lasting or transitory effects that are very debilitating, such as dysarthria or aphasia, dysphagia, localised or widespread muscular weakness, or paresis. Due to hemiplegia, they can leave a person completely bedridden, with extra negative effects such an elevated risk of thromboembolic events and/or urinary tract infections (Carvalho-Pinto & Faria, 2016; Bovim, Askim, Lydersen, Fjærtoft & Indredavik, 2016). People with PAD have an increased risk of dying from any cause when compared to individuals without signs of peripheral disease (IJsselmuiden & Faden, 1992). Physical

restrictions, persistent wounds, and limb ischemia are additional side effects of PAD (Ponikowski et al., 2016; Ruan et al., 2018).

Methodology

A circuit diagram of the ECG system developed is shown in Figure 3. The circuit was drawn and simulated in microcap software. The output signal was fed to the AD8232 sensor module for further processing before the signal was displayed on the CRO screen.

The bio signal conditioning techniques and sequences described below are developed to successfully reduce unnecessary noise while maintaining the valuable components of ECG signals:

i) An instrumentation amplifier is used to amplify the raw ECG signal in order to increase the signal voltage level.
ii) The DC offset those forms between electrodes is removed using a high-pass filter.
iii) A low-pass filter is employed to filter out high-frequency background noise.
iv) A notch filter is used to get rid of power line interference.

The filtered analogue ECG signal is then digitalised for computer display and/or further digital signal processing and analysis.

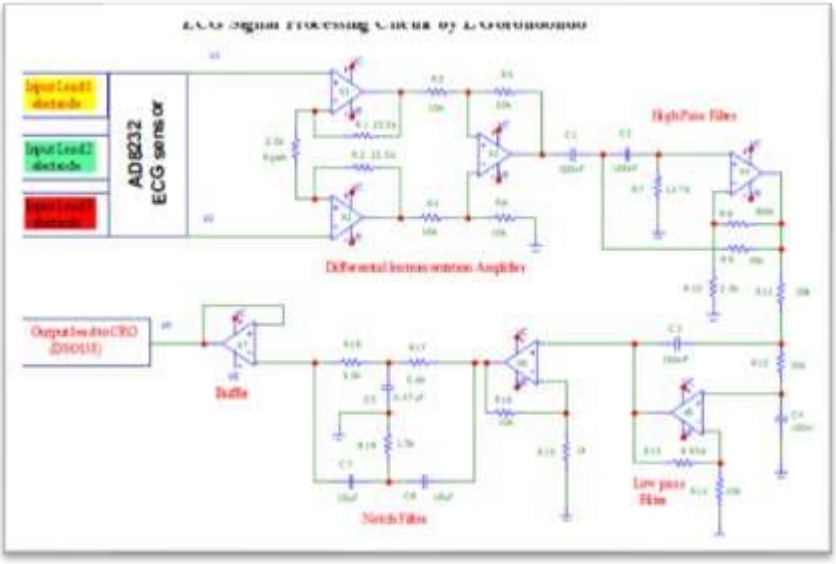

Figure 3: ECG Signal processing circuit without electrodes

ECG simulation in microcap

Figure 4 shows the ECG signal obtained from microcap software during simulation using a 1.5 mV signal.

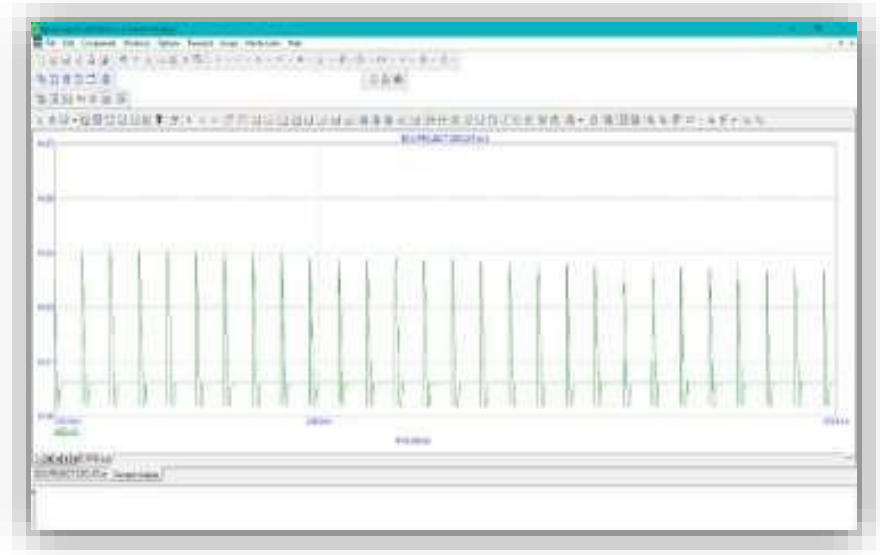

Figure 4: ECG signal simulation in microcap

Pulse oximeter system design

The pulse oximeter system was designed using a MAX30100 sensor. Since the MAX30100 is a sensor solution that combines pulse oximetry and a heart rate monitor, it was chosen as the main sensor. The pulse oximeter has light sensors incorporated in two LEDs (red and infrared) and a photodiode part of the MAX30100 sensor, which is positioned between a patient's body parts, such as a finger or earlobes. The two LEDs are coupled and positioned so that the photodiode receives the light and, depending on the type of oximeter probe, they alternately transmit or reflect light through the anatomy. The photodiode transforms the incoming light that has not been absorbed or dispersed by the body into an analogue electrical signal that is delivered to the analogue pin of the Arduino Uno module. The Arduino module contains an AT Mega 328p microcontroller that performs computations and displays the heart rate and blood oxygen saturation readings on the liquid crystal display (LCD) module. The LCD contrast is adjusted using a potentiometer.

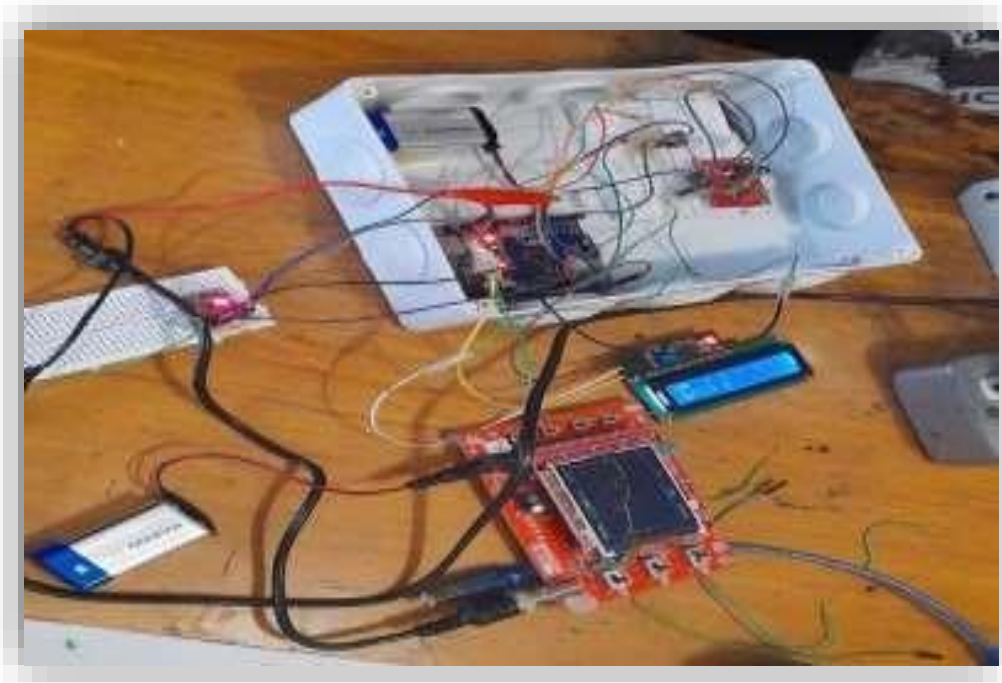

Figure 5: Fabrication of the ECG system

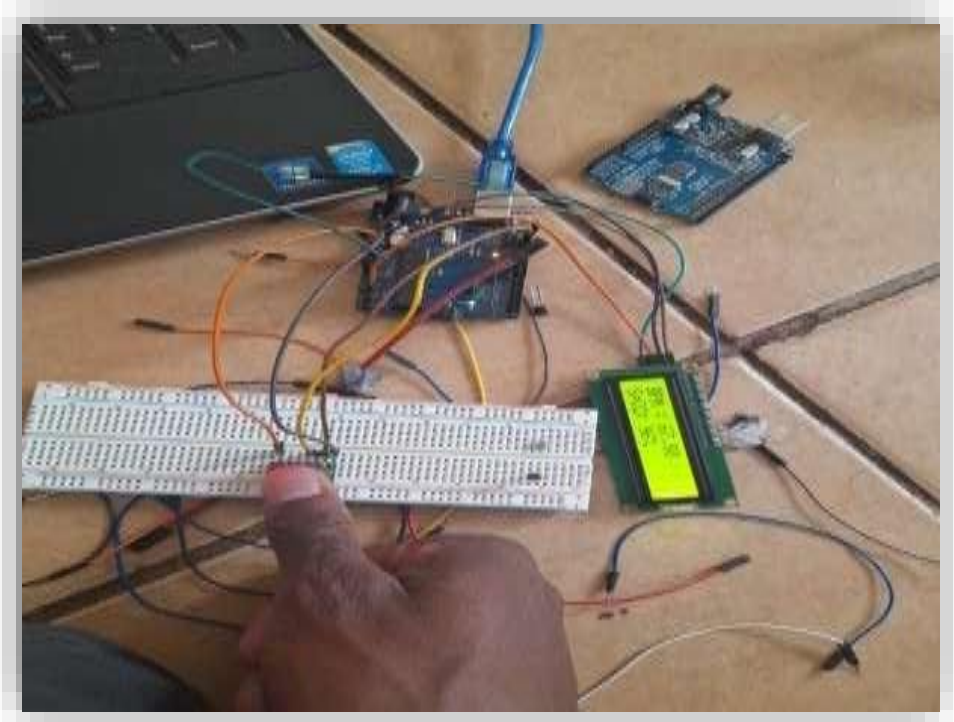

Figure 6: Fabrication of the pulse oximeter system

Figure 7: Integration of the ECG and pulse oximeter systems

Heart rate and SpO_2

A sample of twenty people was chosen for heart rate and oxygen saturation data collection and analysis. Ten males and ten females were chosen randomly. Males are said to have a heart rate between 70 and 72 while that of females is between 75 to 82 (Ciklacandir, 2017). People without any history of heart diseases were chosen to measure their heart rate and blood oxygen saturations. The selected people in the sample were given code names from A to J without any specific order followed for anonymity. The sample was divided into two groups: group A (males) and group B (females). The two groups were then compared independently. Each person's heart rate and blood oxygen saturation values were obtained from the designed pulse oximeter system and also from a standard FDA international pulse oximeter (Oxiline Pulse 7 Pro pulse oximeter) currently in use in many hospitals in Zimbabwe (Ciklacandir, 2017). T-tests were used to statistically analyse the data to determine if there was a significant difference between the means of data collected using the designed pulse oximeter system and the Oxiline Pulse 7 Pro pulse oximeter. A t-test was chosen for analysis because the data was independent, approximately normally distributed and the sample size was sample. Two tailed t-tests were carried out at 95% level of confidence ($\alpha = 0.05$).

Sample 1 size (n_1) = 10

Sample 2 size (n_2) = 10

Degrees of freedom ($n_1 + n_2 - 2$) = 18

Level of confidence = 95%

The t-test value and standard error were calculated according to statistical formulars in equations 1 and 2 respectively.

$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{s_p^2 (\frac{1}{n_1} + \frac{1}{n_2}}}$ ……	Eq 1

$S_p^2 = \frac{(n_1 - 1)\, s_1^2 + (n_2 - 1)\, s_2^2}{n_1 + n_2 - 2}$ … … … … … …	Eq 2

Where:

$\bar{x}_1$ is the mean for sample 1

x_2 is the mean for sample 2.

S_p^2 is the pooled standard deviation.

s_1 is the standard deviation for sample 1

s_2 is the standard deviation for sample 2.

n_1 is the size of sample 1.

n_2 is the size of sample 2.

Results

ECG results

The ECG system was tested on the researcher and the ECG trace obtained and displayed on a DSO138 oscilloscope is shown in Figure 8 below.

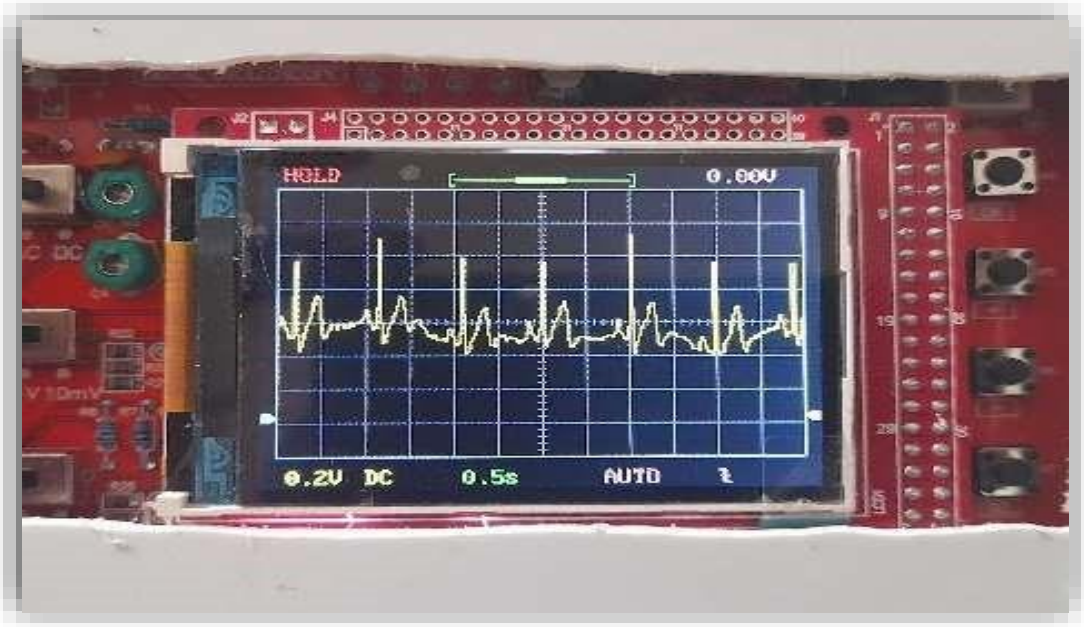

Figure 8: ECG trace obtained using the designed system

Heart rate and SpO_2 results

Table 2: Heart rate data for ten randomly selected male persons

Males	Designed pulse oximeter prototype	Oxiline Pulse 7 Pro pulse oximeter	% Difference
Person	**Heart Rate**	**Heart rate**	
A	69	70	1.43
B	71	72	1.39
C	71	72	1.39
D	73	70	-4.29
E	75	71	-5.63
F	70	70	0.00
G	70	68	-2.94
H	72	73	1.37
I	76	73	-4.11
J	68	71	4.23
Average	**71.5**	**71.0**	**-0.70**
Standard deviation	**2.55**	**1.56**	**3.27**

$t_{calculated}$ = 0.53

$t_{0.025,18}$ = 2.10

$t_{calculated} < t_{critical}$, therefore, we fail to reject the null hypothesis.

Table 3: Heart rate data for ten randomly selected female persons

Females	Designed pulse oximeter prototype	Oxiline Pulse 7 Pro pulse oximeter	% Difference
Person	**Heart Rate**	**Heart rate**	
A	76	78	2.56
B	75	78	3.85
C	74	76	2.63
D	73	75	2.67
E	79	78	-1.28
F	80	80	0.00
G	81	78	-3.85
H	82	83	1.20
I	76	79	3.80
J	75	76	1.32
Average	**77.1**	**78.1**	**1.28**
Standard deviation	**3.14**	**2.28**	**2.42**

$t_{calculated}$ = -0.81

$t_{0.025,18}$ = -2.10

$t_{calculated} > t_{critical}$, therefore, we fail to reject the null hypothesis.

There is no significant difference in heart rates measured by the two instruments for both males and females., therefore the null hypothesis was taken as true.

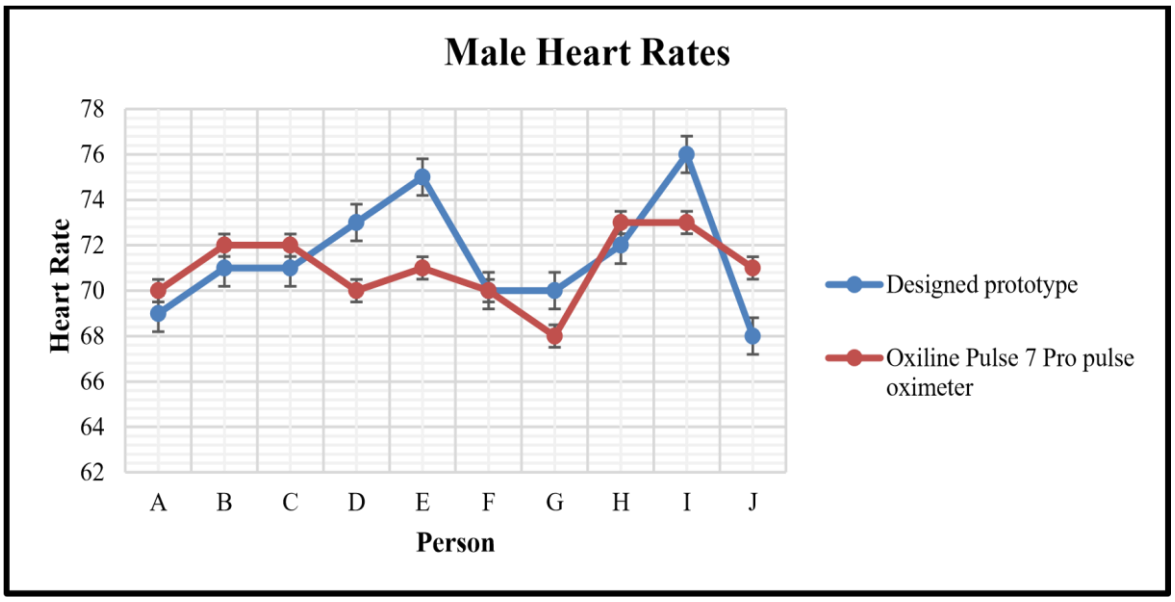

Figure 9: Graphical comparison of male heart rates as measured by the designed prototype and a Oxiline Pulse 7 Pro pulse oximeter

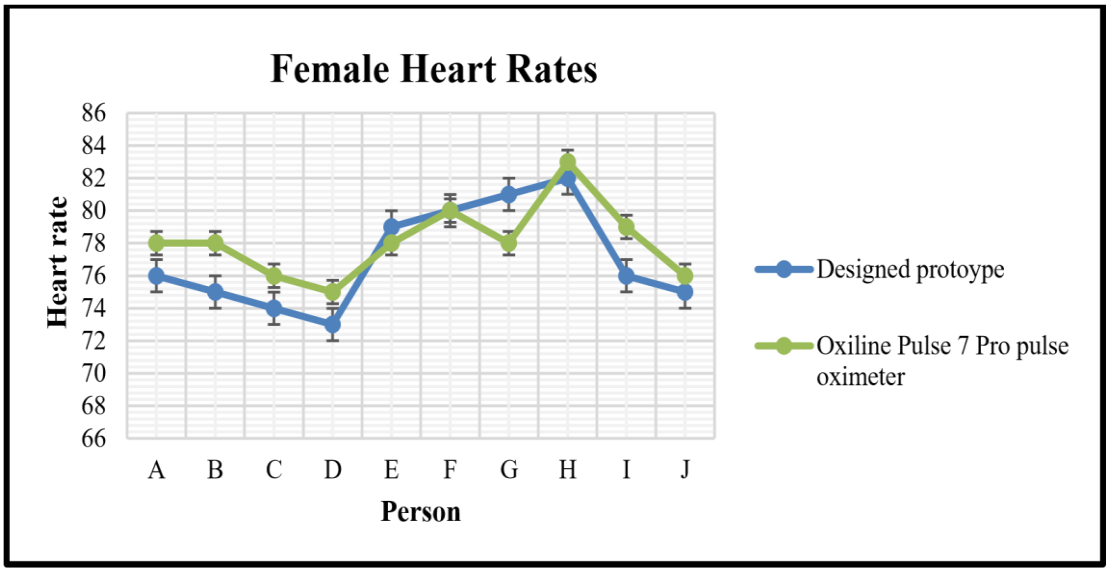

Figure 10: Graphical comparison of female heart rates as measured by the designed prototype and a Oxiline Pulse 7 Pro pulse oximeter

Two-sided t-test workings for SpO_2

Degrees of freedom = $(n_1 + n_2 - 2) = 18$

Level of confidence = 95%

Table 4: Oxygen saturation data for ten randomly selected male persons

Males	Designed pulse oximeter prototype	Oxiline Pulse 7 Pro pulse oximeter	% Difference
Person	**SpO_2**	**SpO_2**	
A	95	95	0.00
B	96	96	0.00
C	96	95	-1.05
D	97	98	1.02
E	99	98	-1.02
F	98	98	0.00
G	99	96	-3.13
H	96	97	1.03
I	95	97	2.06
J	99	98	-1.02
Average	**97.0**	**96.8**	**-0.21**
Standard deviation	**1.63**	**1.23**	**1.45**

$t_{calculated}$ = 0.31

$t0.025,18 = 2.10$

$t_{calculated} < t_{critical}$, therefore, the null hypothesis was not rejected.

Table 5: Oxygen saturation data for ten randomly selected female persons

Females	Designed pulse oximeter prototype	Oxiline Pulse 7 Pro pulse oximeter	Percentage difference
Person	**SpO2**	**SpO2**	
A	98	95	-3.16
B	98	96	-2.08
C	97	98	1.02
D	97	97	0.00
E	96	95	-1.05
F	98	98	0.00
G	96	99	3.03
H	96	96	0.00
I	94	96	2.08
J	97	98	1.02
Average	**96.7**	**96.8**	**0.10**
Standard deviation	**1.25**	**1.40**	**1.85**

$t_{calculated}$ = -0.28

t0.025,18 = -2.10

$t_{calculated} > t_{critical}$, therefore, the null hypothesis was not rejected.

There is no significant difference in blood oxygen saturations measured by the two instruments for both males and females.

Blood oxygen saturation graphical analysis

Figures 11 and 12 show a graphical comparison of percentage of oxygen in blood as measured by the designed prototype and an Oxiline Pulse 7 Pro pulse oximeter for both male and female samples, respectively.

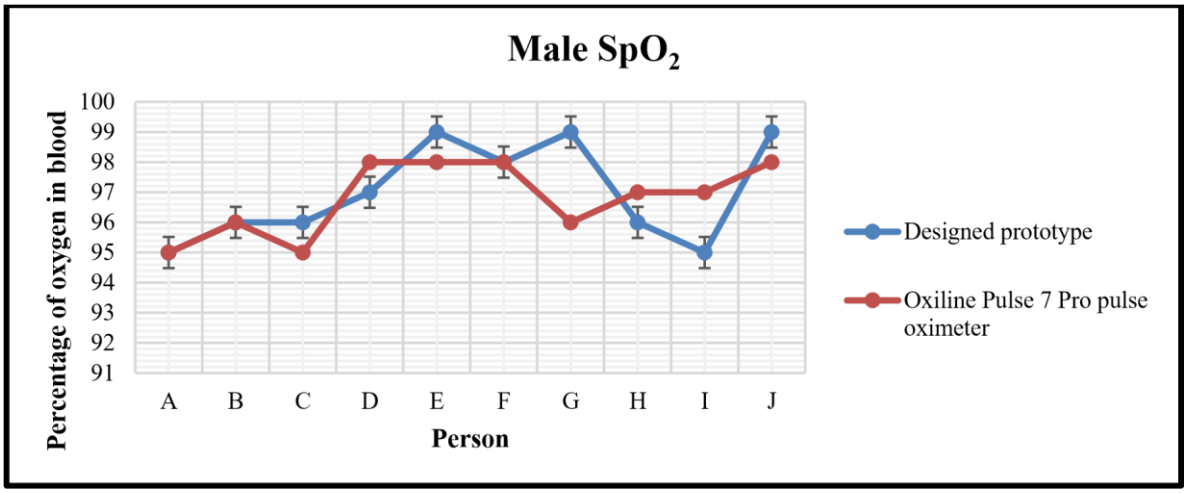

Figure 11: Graphical comparison of male percentages of oxygen in blood as measured by the designed prototype and an Oxiline Pulse 7 Pro pulse oximeter

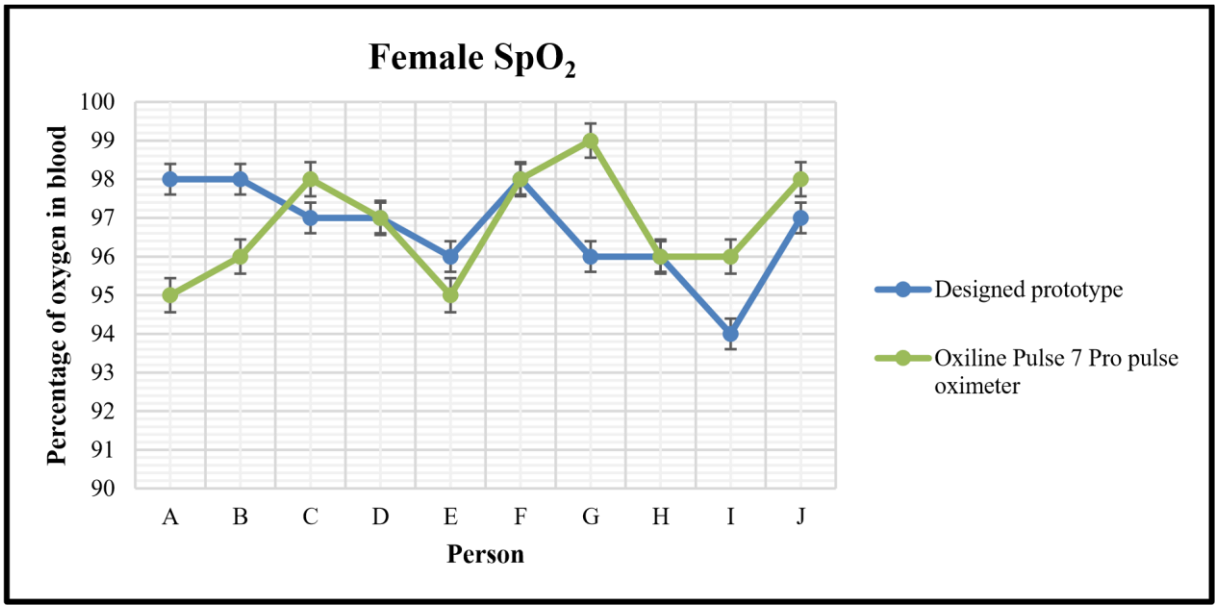

Figure 12: Graphical comparison of female percentages of oxygen in blood as measured by the designed prototype and an Oxiline Pulse 7 Pro pulse oximeter

There are no significant differences for the data of heart oxygen saturation in blood collected for males and females using the two devices.

Discussions

ECG signals from electrodes have millivolt-level amplitudes, hence they need to be amplified. Instrumentation amplifiers are used by amplifier circuits to transform the difference between signals to an output voltage. The proposed device's analogue front-end circuitry is made up of three integrated circuits: a low noise operational amplifier (OPA134), a low offset operational amplifier (TL082), and an instrumentation amplifier (AD8220). The instrumentation amplifier AD8220 with a gain of 20 dB increased the difference between two signals obtained from the electrodes. By placing a 2.5 k resistance across the AD8220's gain resistor pin, a gain of 20 dB was attained. A high-pass filter with a cut-off frequency of 0.033 Hz was created to eliminate extraneous noise below the frequency of the ECG. The signal's 20-dB gain was insufficient for the DSO138 oscilloscope to display the signal; thus, a low noise amplifier was employed to boost the overall gain by 20-dB. A low-pass filter with a cut-off frequency of 150 Hz was created to only allow the frequency of the ECG in order to avoid high-frequency noise from interfering with the data gathering process. TL082 JFET operational amplifier was used to create a second high-pass filter with a

20-dB gain to increase the amplification and noise filtering. Because it has a limited frequency bandwidth (0-200 kHz) and is inexpensive (about US$15) compared to TFT displays, a DSO138 cathode ray oscilloscope was used for this portable ECG. As a result, a DSO138 is appropriate for affordable ECG monitoring devices. Although the ECG analogue front end also amplifies the circuit noise and 50-Hz noise interference, the results of the ECG signals were amplified to have a peak-to-peak value of 500 mV, which could be seen on the oscilloscope. A 50-Hz filter is necessary for the system to be further improved so that the ECG signal reading is not dominated by power supply noise interference.

The device built in this study worked as intended, measuring heart rate and blood oxygen saturation and displaying ECG waveforms. According to the test findings using the designed pulse oximeter system, heart rate measurements resulted in an error value of -0.70% and -0.21% in males and females, respectively, as well as 1.28% and 0.10% for SpO_2 results in males and females, respectively after comparison. For a much better assessment of CVD, there is a need to integrate the system with a GSM module, to allow for the transmission of ECG signals, heart rate, and SpO_2 patient data through mobile phones and the internet for remote and automated monitoring.

Recommendations

A low-cost electrocardiogram and pulse oximeter system was designed successfully and compared against standard 3-lead ECG system and an internationally approved transmittance-based pulse oximeter (Oxiline Pulse 7 Pro pulse oximeter). For better and more accurate results, the system must be thoroughly documented and tested on a large sample size. This project met its aims, yet there are certain areas where some aspects might be improved. To begin with, the connections that connected the ECG-sensor and the amplification circuit were not the best. It is advised that insulated cables be used to reduce interference from electromagnetic radiation, and that the cables be flexible to make the patient more comfortable. Because the ECG electrodes used in this experiment were not the best, it is advised that salty gel be placed between the electrodes and the skin to minimise resistance between them. Using better ECG electrodes, it is feasible to generate a crisper ECG trace than the one acquired in the project.

Instead of utilising body-worn ECG electrodes, capacitive electrodes that can be placed inside clothing rather than clinging to the body with gel are recommended. The following recommendations are also made to improve the design prototype:

a) To conserve energy and extend battery life, ultra-low power systems may be constructed using low power wireless protocols.
b) Solar-powered ECG electrodes are recommended for usage in the future.
c) Compact electrodes with all necessary electronics must be used to eliminate the need for extra electronics to be carried.
d) For a much better assessment of CVD, there is a need to integrate the system with a GSM module, to allow for the transmission of ECG signals, heart rate, and SpO_2 patient data through mobile phones and the internet for remote and automated monitoring.

Conclusions

The research was carried out to develop a real time integrated electrocardiogram (ECG) and reflectance-based pulse oximetry system. The design and development of a heart rate monitoring tool that monitors the heart rate accurately, swiftly, and cheaply without the need of time-consuming and expensive clinical pulse detection equipment is given. It was successful in designing and building a prototype for a single channel, three-lead electrocardiograph that properly analysed differential potentials and produced the ECG recordings. The results demonstrate that the portable ECG correctly detects the electrode signal; however, a 50Hz filter is needed to ensure that power supply noise interference does not significantly impede the reading of the ECG signal in order to improve the system. On DSO138, graphic data from digital ECG data were finally created. Because of its compact size and simplicity of use, this portable ECG equipment may be used in villages, clinics, or homes. The findings section demonstrates how the designed pulse oximeter system provided heart rate and blood oxygen saturation measurements consistent with international devices. The device was designed to be simple, and to effectively reduce signal disruption using both antilog and digital signal processing techniques.

The device is able to ergonomically detect, filter, digitise, and display an ECG trace, heart rate and blood oxygen saturation of a user. After a process of designing, experimenting, testing, and data collecting, the author concludes that the ECG and

pulse oximeter system works properly according to the experimental results on several volunteers as the results were compared with standard international medical devices approved by the FDA. The device's minimum system circuit works properly as it controls and displays all parameters listed in the objectives of the research.

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Endorsement of Traditional Masculinity Ideology among Students at a State University in Zimbabwe

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Abstract

Traditional masculinity ideology has shaped the way men think and behave over the years. This study sought to examine masculine norms and assess traditional masculinity ideology among university students. The male role norms inventory (short form) (MRNI-SF) was administered to 190 students online. Participants had a mean (±SD) age of 34.61 (±9.98) years, of which 55.79% were male. The researchers used descriptive statistics. Male students in the MRNI-SF had a total mean total score (±SD) of 4.05 (±1.18) scoring above the midpoint of the 7-point scale. Female's total mean score (±SD) of 2.91 (±0.92) scoring way below the midpoint. Male more than female students significantly, ($p<0.001$) endorsed traditional masculinity ideology. The study established that males generally conformed to the norms in the dimensions of "avoidance of femininity", "negativity towards sexual minorities", "self-reliance through mechanical skills", "toughness" and "importance of sex". The research also established that females conformed to "negativity towards sexual minorities" and "self-reliance through mechanical skills". Based on these findings, the researchers recommend a multi-sectorial approach to redefining masculine norms, and an increased access to psychological services as well as further research on masculinity.

Keywords: masculine norms, traditional masculine ideology, endorsement, dimensions

Introduction

"*Boys don't cry! Men do not shed tears! Boys are strong*!" are popular phrases which are meant to express how males are expected to behave by society, especially in challenging situations where they are expected to remain tough (Ezeugwu & Ojedokun, 2020). This kind of socialisation of men has led to a debate in the field of health with some arguing against the dangers of such beliefs on the mental health and well-being of men. This debate has revealed that conformity to traditional masculine norms results in many men battling with mental illnesses in silence. On the other hand, some have observed that traditional masculine norms have resulted in men frequently negotiating social status and power with their health behaviours which can promote health within this scope of negotiation (Courtenay, 2010). To back this argument, statistics show that women are consistently at greater risk of mental illnesses such as depression (Albert, 2015). However, this argument is also based on biased statistics since men, in conformity to the traditional masculine norms, are less likely to seek treatment; thus, the burden of depression among men is likely underestimated (Albert, 2015). Interestingly, statistics show that the prevalence of depression among women is about twice that in men, however, suicide rates among men are significantly higher (Bachmann, 2018). The American

Psychology Association (2019) has noted that men are 3.5 times more likely to die by suicide than women. This shows that men are affected by depression but may regard their symptoms as incompatible with their masculine self-image and they are therefore reluctant to seek help which in turn increases the risk of suicide (Kilian et al., 2020).

Generally, masculine norms are often similar across cultures the world over, with common masculine norms including heterosexual presentation, risk taking, emotional restraint, power over women, dominance, self-reliance, and winning (Iwamoto et al., 2012). It is these norms that have been associated with adverse mental health occurrences in men with several studies having proved this to be true globally (Iwamoto et al., 2012). Studies of college students in the United States of America showed an association of traditional masculinity and suicidal ideation (Coleman, 2015). Psychological evaluations done on young men who had died by suicide in Norway indicated that unattainable masculine ideals were the biggest risk factor in these suicides and death by suicide was theorised to show an act of masculinity that would compensate for the supposed failure to attain the ideal masculine standards (King et al., 2020).

In Africa, a study by Fast et al. (2020) in Tanzania and Kenya showed that men are often overwhelmed by their thoughts and expectations of masculinity. These expectations cause psychological warfare as economic, political, and social uncertainty hinder their ability to fulfil them. Fast et al. (2020) further stated that, when men are unable to fulfil their expected fantasies designed by the society such as provide for the family and pay all the bills including but not limited to rents and fees, the sense of failure overwhelms them, and they may resort to drug and alcohol use and abuse which bolster their depressive symptoms and suicidal ideation.

In South Africa, Gibbs et al. (2019) examined the associations between traumatic experiences and HIV-risk taking behaviours among young men in South Africa. They found that the structural system of poverty and gender inequalities that supports gender role culminates in traumatic experiences that eventually predispose young men to engage in HIV-risk taking behaviour. Gibbs et al. (2019) then advocated for "the eradication of poverty as a way to reduce risky behaviour and mental health challenges among men." The study however noted that this strategy would significantly reduce mental health challenges, "only if there is a conscious effort to transform gender norms which place too much burden on men." Furthermore, the study indicated the extent to which men suffer both cognitive and behavioural dysfunctions that most

times go unreported due to masculine norms that stigmatise them as weak when they seek mental health support (Gibbs et al., 2019).

Traditional masculinity is a Western concept of manliness that relies or over relies on stoicism, dominance, aggression, and competitiveness. From an African perspective, there are multiple definitions of traditional masculinity that are culturally specific and are socially constructed (Everitt-Penhale & Ratele, 2015). Males and females both play an important role in socially constructing masculinity. Masculinity in modern Zimbabwe is used to describe a socio-cultural model that is passed from generation to generation (Mtutu, 2005). Similar to the Western traditional masculine norms, masculinity in modern Zimbabwe dictates attitudes, values, and behaviour that men should have in order to be considered a "man". It is built on the premise that men are naturally superior (dominant) physically, intellectually, and sexually and this has been inculcated in both men and women (Mtutu, 2005).

There is therefore strong evidence to support the association of strong traditional masculinity beliefs and negative outcomes (Stephanie, 2019). The more men cling to the rigid views of masculinity, the more likely they are to be lonely and depressed (Stephanie, 2019). Negative outcomes such as the rise in male suicide has been linked to a high level of traditional masculinity ideology. Despite evidence showing that some masculine behaviours have been associated with detrimental effects on physical and mental health of men, few studies have been done to assess the levels of conformity to traditional masculine norms globally (King et al., 2020). Because we are living in an era where traditional gender norms are being challenged, the researchers found it to be of great importance to investigate these traditional norms among university students. Prior to this study, the researchers did not find any studies assessing the endorsement of traditional masculinity ideology among males and females in Zimbabwe. Knowing how much people conform to traditional masculine norms could help to accurately inform awareness programs.

Objectives

i) To measure the dimensions of traditional masculine norms among university students
ii) To compare conformity to traditional masculine norms in different dimensions between male and female students
iii) To determine the endorsement of traditional masculinity ideology among male and female students.

Conceptualising traditional masculine norms

Conceptualisations of masculinity have shifted away from the notion of a singular masculinity, toward recognition of a multiplicity of masculinities (Connell, 2005). Among these multiple masculinities, there exists an idealised or hegemonic masculinity that represents the currently accepted ideal (Connell, 2005). The norms of masculinity are contestable. This means they are shifting across time, space, and context, as well as relational, that is, hierarchically positioned and performed in relation to femininity and non-hegemonic masculinities (Connell, 2005). Consistent with this, there is evidence that conformity to masculine norms varies by age and that conformity to masculinity is most strongly endorsed by younger males (Rice et al., 2011). The social norms that define appropriate masculine roles and behaviours are assimilated from a young age (Bourgois, 1996). The pressure to conform to masculine ideals can be immense and there are often social penalties for boys and men who deviate from normative masculine roles and behaviours (Connell, 2005). Confinement to the set of behaviours considered to appropriately affirm masculinity can also severely delimit healthy behaviours and emotional responses that might otherwise buffer young males during the often stressful period of adolescence (Rice et al., 2011).

The concept of masculinity must be studied and understood from the perspectives of both males and females. Focusing on men only can lead to implicit essentialism (Whorley & Addis, 2006). Studies to differentiate masculinity ideology in men and women have shown that men tend to endorse masculinity ideology much more than women (Levant & Richmond, 2007)

In countries like Australia where there are many cultural and historical influences shaping masculine identities for adolescent males, the physical practice of masculinity is principally located in two key domains: sexuality and sport (Connell, 2005). Sport provides an arena for ritualised combat, camaraderie, and strength. Heterosexuality is central to normative Australian masculinity, and sport has traditionally been a key setting for the display of hetero-masculinity (Connell, 2005). This is the case with many western countries where physical strength, toughness and competitiveness, and heterosexual prowess are central to adolescent masculine norms (Kågesten et al., 2016). In Africa, such masculinity can be expressed through issues such as male fertility, responsibility to family, dominance over the family and even social status. As noted by Boahene (2013), African society values proverbs as the source of cultural and social wisdom, the basis upon which socially construct gender roles are cognitively fixed.

Methodology

The researchers made use of the descriptive cross sectional study design where data was collected during the months of September and October 2022. The study population was adult male and female students from a state university in Masvingo. These were students registered for either part time or full-time studies during the 2022-2023 academic year. The participants of the study were sampled using cluster random sampling technique. Using a population size of 18036, a 5% margin of error, 95% confidence level and 0.5 measure of variability, a sample size of 385 was calculated using an online sample size calculator.

The MRNI-SF is a validated tool developed in the western society (Levant et al., 2013). The researchers sought permission to use and contextualise the tool. Some questions were therefore modified to fit the setting. After pretesting on 30 students, the modified questionnaire was found to be reliable and valid.

Data analysis

The researchers used descriptive statistics to describe the study subjects. In the research, the means and standard deviations were reported for continuous variables which were normally distributed. In addition, the study used frequencies and proportions to report gender, level of education, residential area, and categorical variables. The researchers calculated mean scores from the MRNI-SF for each of the seven dimensions. Student t-test was used to compare mean scores of male and female students obtained in each dimension. A p-value less than 5% was considered statistically significant. A total mean score was calculated from the means of the different dimensions to get a traditional masculinity ideology factor. The mean scores were categorised to show level of support for traditional masculinity ideology. In this study, researchers used Stata statistical software (Version 16) for data analysis.

Ethical considerations

Ethical approval was sought from the University Research and Postgraduate Office. Participants gave informed consent before proceeding with the online questionnaire. The online questionnaire had a preamble explaining the study outline and purpose, participant rights and time expected to complete the questionnaire.

Results

A total of 190 students participated in the study, providing a response rate of 49%. The greater proportion (55.79%) of participants were male. The mean (±SD) age was 34.61 (±9.98) years.

Postgraduate level students made up the majority (52.63%) of participants. Just over half (56.84%) of participants were married or staying with a partner. The majority (88.95%) lived in urban areas.

Table 1: Socio-demographic details

		(N=190)	
Variable	**Category**	**n**	**%**
Gender	Male	106	55.79
	Female	84	44.21
Age	18 - 25	51	26.84
	26 - 30	17	8.95
	31 -40	72	37.89
	40+	50	26.32
Race	Black	188	98.95
	Coloured	1	0.53
	Asian	1	0.53
Marital Status	Single	70	36.84
	Married	108	56.84
	Widowed/divorced	12	6.32
Religion	Christianity	186	97.89
	Islam	1	O.53
	None	3	1.58
Level of study	Undergraduate	90	47.37
	Postgraduate	100	52.63
Residence	Urban	169	88.95
	Rural	21	11.05

Table 2: Dimensions of masculinity ideology, mean scores among male and female university students

Dimension	**Males Mean (±SD)**	**Females Mean (±SD)**	**P-value**
Avoidance of femininity	3.78 (1.54)	2.77 (1.41)	<0.001
Negativity towards sexual minorities	4.58 (1.85)	3.72 (1.72)	0.0013
Self-reliance through mechanical skills	5.29 (1.41)	4.85 (1.35)	0.03
Toughness	4.38 (1.77)	2.96 (1.65)	<0.001
Dominance	2.78 (1.59)	1.56 (0.80)	<0.001
Importance of sex	3.58 (1.62)	2.67 (1.63)	<0.001
Restrictive emotionality	3.94 (1.27)	1.84 (0.97)	<0.001
TMI			
Masculinity factor	4.05 (1.18)	2.91 (0.92)	<0.001

TMI - Traditional Masculinity Ideology

The researchers calculated the total mean scores (±SD) for the seven dimensions. Students with a total mean score at or above the midpoint of 3.5 endorsed TMI and those who scored below the midpoint rejected TMI. Table 2 shows that male students had an average TMI mean score (±SD) of 4.05 (1.18) and females had 2.91 (0.92). There was a statistically significant ($p<0.001$) difference in the mean scores of TMI between male and female students.

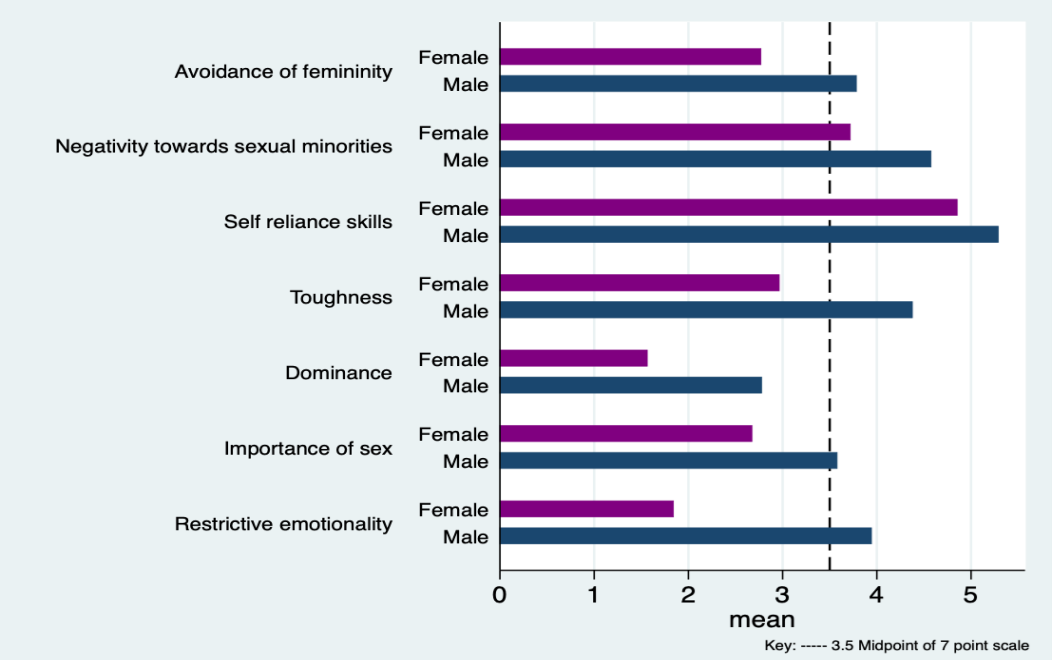

Figure 1: Dimensions of masculinity ideology

Figure 1 shows "self-reliance through mechanical skills" is the dimension most conformed to by both male and females. "Negativity towards sexual minorities" is next with both males and females conforming to the norms in this dimension. The students however scored below the midpoint for the dimensions such as *avoidance of femininity* - 3.34 (±1.56), *dominance* - 2.24 (±1.66), *importance of sex* - 3.18 (±1.69), and *restrictive emotionality* - 3.01 (±1.55). This shows that the students generally disagreed with the traditional norms in these dimensions. The dimension least conformed to by both male and female students is that of "male dominance".

Table 3: Proportions of students who endorse/reject TMI by demographics

	Males N=106		**Females N=84**	
	TMI		TMI	
	Reject	**Endorse**	**Reject**	**Endorse**
Age	**n (%)**	**n (%)**	**n (%)**	**n (%)**
18 - 25	4 (10.53)	25 (36.76)	14 (23.73)	8 (32.0)
26 - 30	5 (13.16)	6 (8.82)	6 (10.17)	0
31 - 40	15 (39.47)	12 (17.66)	33 (55.93)	12 (48.0)
41+	14 (36.84)	25 (36.76)	6 (10.17)	5 (20.0)
Marital status				
Married	27 (71.05)	33 (48.53)	35 (59.32)	13 (52.0)
Single	11 (28.95)	31 (45.59)	19 (32.20)	9 (36.0)
Divorced/widowed	0	4 (5.88)	5 (8.48)	3 (12.0)
Level of study				
Undergraduate	19 (50.0)	32 (47.06)	27 (45.76)	12 (48.0)
Postgraduate	19 (59.0)	36 (52.94)	32 (54.24)	13 (52.0)

Table 3 shows the proportions of the male and female students that endorsed or rejected TMI in relation to demographics. Of the 68 males that endorsed TMI, 25(36.76%) of them were aged 18 to 25 and another 25(36.76%) were aged 41years and above. Just over half 36(52.94%) of the male students that endorsed TMI were postgraduate students. The greater proportion 12 (48.0%) of females who endorsed TMI were aged 31 to 40 years.

Discussion

Dimensions of traditional masculinity ideology

Male students conformed to the norms in the dimension of "*avoidance of femininity*" while females did not. These results are in line with findings from other studies (Levant & Rankin, 2013), and suggest that the males reject being feminised. Men's feminisation was perceived as a threat to masculine gender status quo (Iacoviello et al., 2021). This notion supports the findings that males conform to norms of "avoidance of femininity". Other studies (Martin & Van Wijk, 2020) have however found contrary results where men did not endorse "*avoidance of femininity*". The researchers note with concern how conformity by male students to these norms may pose a risk in their psychological health. Conformity to "*avoidance of femininity*" has been said to hurt the males that mostly believe it (Barber et al., 2019). According to Barbieri et al. (2021), men who adhere to anti-femininity norms are more likely to avoid talking about and seeking help for mental health issues. Avoiding talking about mental health issues leads to depression (Barbieri et al., 2021).

This study further observed conformity to norms in the "*negativity towards sexual minorities*" in both male and female students. Even though both genders conformed, males conformed much more than females. The inability to accept different cultural groups leads to biases which hinder strategies to improving men's mental health. These findings reflect the stigma that exists towards sexual minorities and possibly due to cultural biases that are anchored on masculine norms of heterosexuality in our Zimbabwean culture. Males and females both play an important role in socially constructing masculinity according to the social construction theory and, as such, findings in this study showed both genders to conform to these norms. These findings pose a risk to the mental health of males that are seen to deviate from the norms.

Findings gathered in this study showed both female and males greatly conformed to the norms in the dimension "*self-reliance through mechanical skills*". Males strongly agreed with norms in this dimension when compared to females. Similarly, in their study, Martin and Van Wijk (2020) found that South African navy men conformed greatly to self-reliance norms. Traditional masculinity ideology believes men should be independent and take care of things on their own. Conformance to self-reliance can be viewed as positive as it presents opportunities for growth and self-development. Coleman (2015) however postulates that the problem arises when men only focus on being self-reliant and fail to seek help. The researchers noted with interest that the highest mean scores for both genders were recorded for this dimension. This reflects the importance placed on these norms by participants. The researchers postulate that the norms in this dimension are linked to the male role theory which, according to Kelly (2018), are a set of duties, roles, and behaviours that an individual must exhibit consistently because of socially defined hierarchies. Males and females have societal expectations. As shown in this study, students expect men to be self-reliant, fix their own things, repair things around the home and have home improvement skills. Being a provider for the family can be linked to "*self-reliance*" dimension in a Zimbabwean context. This implies that, in a Zimbabwe context, a man as a provider, is expected to provide under the harsh economic environment where little employment opportunities exist, and inflation rates are high. The challenge with this "role play" assumption is that it does not consider behavioural or emotional exhaustion of men, which exposes them to role conflict and decreased psychological well-being (Ogueji et al., 2020). Role conflict is said to occur when work or social role demands are incongruent with the family anticipated role (Ogueji et al., 2020). It is this strain that can then lead some of the men to commit suicide after prolonged depression, anxiety, and stress

(Fast et al., 2020). The students in this study seemed to rigidly adhere to these masculine norms. The masculine dysfunction strain theory describes how rigid adherence to traditional masculine norms creates dysfunction and may result in negative health consequences such as depression and anxiety. Berm (1979) adds that individuals develop psychological discomfort and more negative feelings about themselves when they are unable to perform roles prescribed by their gender roles.

However, both male and female students did not conform to the "*dominance*" dimension, with females disagreeing more to the norms in these dimensions. Similarly, studies in the United States found low conformity to "*dominance*" among females (Levant & Rankin, 2013). Non-conformity to male dominance norms could be due to higher levels of gender empowerment for women in Zimbabwe. University students are also likely to be empowered and will know gender equality rights and this could be the reason why students did not subscribe to the traditional view of masculine norms that presupposes dominance over women. The findings are contrary to the African masculinity view that presupposes dominance over the family by men (Boahene, 2013).

Males conformed to the dimension of "*importance of sex*". Interestingly, total mean score was just above the midpoint. One would expect the students to have scored high in this dimension. Females did not conform to norms in this dimension. The assumption would be that university students should conform to norms placing importance to sex given that most of them are in their reproductive ages and are young. Other studies also found that males conform more to norms in this dimension when compared with females (Levant & Rankin, 2013).

Male students conformed to the norms in the dimension of "*toughness*" while females did not. These findings are in line with the traditional western view that places an importance on physical strength, toughness, and competitiveness (Kågesten et al., 2016). The study carried out close to Zimbabwe also found South African men conform to the norms that support the "*toughness*" dimension.

The dimension "*restrictive emotionality*" is of great relevance to this study as it has been associated with depression among males (American Psychology Association, 2019). Male students in this study were found to conform to these norms while females did not. Although males conformed to the norms, they did not strongly agree with them. This may mean

psychological intervention programs are likely to succeed. Similar findings were found in other studies (Levant & Rankin, 2013; Martin & Van Wijk 2020, Wong et al., 2012). Adherence to norms of emotional control is more likely to make men avoid talking about and seeking help for mental health issues (Barbieri et al., 2021).

Traditional masculinity ideology

More male participants conformed to traditional norms than women (*masculinity factor*: 4.05 vs 2.91, $p < 0.001$). These findings are consistent with the results of previous studies on the subjects that established that men conform to traditional masculinity ideology more than women (Ezeugwu & Ojedokun, 2020; Levant & Rankin, 2013). In their study, Ezeugwu and Ojedokun (2020) found that some African men often conform to traditional masculine norms; however, the internalisation of these norms among men has been reported to make them more susceptible to mental health problems. The fact that most male students have shown to conform more to the norms measured in this study is a cause for concern. Traditional masculine norms are considered hegemonic, contributing to men's feelings of superiority in the gender hierarchy (Iacoviello et al., 2021). One would think that with an advancement in knowledge and newer and more progressive norms being taught, traditional masculinity would fade away gradually. Research however clearly shows that traditional masculine norms are still prevalent (Duckworth & Trautner, 2019; Messerschmidt, 2019) and this is in line with findings in this study where conformity to traditional masculine norms has been found to be prevalent.

Conclusion

This study found that students conformed to norms such as *dominance, restrictive emotionality, negativity towards sexual minority* and *avoidance of femininity*. These norms tend to perpetuate negative mental health outcomes in men. Male students generally conformed to the norms of traditional masculinity. Females generally rejected the masculine norms; however, they have a significant influence in the social construction of masculinity as observed in some of the dimensions that they conformed to such as *self-reliance* and *negativity towards sexual minorities*. This study therefore brings to light some of the traditional masculine norms that are still strongly embedded in our society.

Recommendations

Having a deeper appreciation and understanding of masculinity itself is a good place to start to promote men's mental health. The researchers therefore call for a shift from some harmful traditional masculine norms to modern forms of masculinities which are culturally specific.

This would allow men to behave congruously with themselves and have better mental health as they are not constantly being forced to conform to ideologies which may be harmful to them.

Engaging both females and males in the deconstruction of harmful masculinities is essential as females have also been shown in the findings to conform to some traditional masculine norms. Psychologists may do this on a multi-sectorial level where different disciplines work together through implementing policies that create an environment conducive to changing norms that promote harmful traditional masculinity.

Mental health workers ought to work on bias reduction through awareness campaigns and mental health education. The study noted high levels of conformity to negativity towards sexual minorities in both genders. This is to create culturally competent citizens who behave accordantly and thus help reduce mental health issues. This study also recommends further research on issues of masculinity specific and relevant to the Zimbabwean context.

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Perceptions and Views of the Elderly on Dirt as Vaccine for Children in Rural Areas During Pandemics: Insights From Dara Community, Gutu District

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Abstract
Dirt cultural rituals have been associated with innumerable positive health outcomes for children including the justification for acts of rubbing or placing clay soil on the tongue and prescription of urine when the child is about to grow his/her first teeth. Understanding the mystery and potential medicinal effects of soil-based microbes on children's immunity is a central health question. It is on this basis that the present research examined the intricate symbiotic relationship that reigns between dirt and immune tolerance. Anchored on a phenomenological case study design, this study interviewed seven participants who were purposively sampled. Thematic analysis was used to analyse the data. The study revealed that: 1). Taking small doses of bacteria or poison either intentionally or unintentionally usually makes one resistant to various disease outbreaks. 2). Children living in urban areas are more susceptible to outbreaks. 3). Local soils contain some medicinal nutrients which minimise the chances of children contracting various types of diseases. The researchers recommended that children should be allowed to freely interact with other children who are not necessarily part of their households and be allowed to play with soil and other various natural components. Children should also be aroused early and allowed to play in the sunshine to develop strong bones and a strong immune system. In addition, parents should follow indigenous and cultural ways of raising their children such as giving them traditional medicines, but more importantly, ensuring that children are vaccinated in health institutions to protect them from various diseases. Traditional medicines are never a substitute for vaccinations, but the two should complement each other.

Keywords: perception, vaccines**,** dirt, immune tolerance, soil-based microbes.

Introduction
The mention of the term 'dirt' has been habitually viewed as absurd, disgraceful and in great disfavour and, at some point, sharply demonised as detrimental to human well-being (Fix et

al., 2020). But, what if dirt is an unclear culprit that conveys some form of hybridised immunity to those exposed to it at the most opportune stage in their lives? The connotations proposed in this view must be meticulously investigated in the realm of both tangible and intangible dirt as an immune fortifier and possibly as a vaccine (Greenwood et al., 2012). It is therefore of paramount importance to understand the meaning of dirt in the framework of this paper. Ideally, the human body's somatic cells are wrinkled with enzymes, collagen, hydroxyapatite, and glycoprotein molecules along their extracellular matrix or surface membrane which function with specificity in the human body (Ruddock & Molinari, 2006). Glycoproteins serve as cell identification markers where they act in cell-to-cell recognition. For instance, they can distinguish a skin cell from a red blood cell, a hair cell from a white blood cell, hence they can detect cells that are foreign to the body (Bian et al., 2022). In this vein, glycoproteins can be classified as immunologic molecules, that is, immunoglobulins and histocompatibility antigens as they can recognise all external substances that enter the body and prompt an immune response to fight off the infection (Robert et al., 2006). To this end, it seems safe to plausibly argue that the body regards foreign substances such as dirt, poisons, mycotoxins and so on as invaders and harmful hence the immune response is an attempt to detoxify.

Upon reflection, however, not all foreign substances are essentially foreign to everyone (Beetz et al., 2018). In a classic example of differences in immune tolerance between children domiciled in a squeaky-clean environment and those in the dusty and unhygienic rural environment, and wearing dirty clothes, the later were seen to resist several diseases (Karimi et al., 2022). To this end, a candid observer might be perplexed by the distinction between rural children who do not fall sick from such exposures to dirt, whereas a person coming from a hygienic home almost gets life-threatening immune responses and diarrhoeas if they get exposed to the same environment (Mosenthal & Martin, 2021). According to Stefanovic et al. (2020) all this boils down to three basic factors, which are individual immune tolerance, the extent of foreign substances to the individual as well as the dose.

To put this into context, families that are deep-rooted in cultural beliefs ordinarily bath their infants in water that is mixed with dirt, not just any dirt but the dirt that has been collected from public spaces such as marketplaces, bus terminus or rank (Alebila, 2019). Of note, emphasis is put on the location of this dirt, because dirt that is found in public spaces contains more bacteria and other foreign substances than dirt collected from a secluded space (Blaustein et al., 2019). The rationale behind bathing infants in dirt-infested water is to achieve early exposure to

foreign substances to children so that they develop a tolerance against foreign substances at a young age and hence they cannot get sick when exposed to the same pathogens later in life (Bee et al., 2018). On one more practical level, children at the "oral stage" barely close their mouth and are very curious, touching and putting every dirty object they can grab in their mouth, from shoes to keys, licking rocks, eating mud and so forth (Sully, 2020). This helps them introduce soil-based microbes (sometimes called soil based organisms) in their body and allow their immune system to register the existence of such pathogens (Brevik et al., 2020). Children develop a higher level of tolerance for the bacteria such that the normal dose would not get them sick and thus conditioning their immune response to ignore fighting some foreign substances which are not harmful and just excrete them without triggering an attack (Marrs & Sim, 2018).

Freedman et al. (2021) opines that most bacteria pathogenic, with only about 1 percent of the different types of bacteria known to man able to make humans sick in their sufficient numbers since different numbers of bacteria are necessary for a reliable infection depending on their species. For instance, the infectious dose or amount of *Escherichia coli* 0157:H7 bacteria that can make one sick is about 100 cells whereas the infectious does of Salmonella typhi is 10 000 cells (MSDS Online) (Liu et al., 2020). This follows a principle explained by dose response curves that different substances have different lethal doses (Zhong, 2021). The toxins produced by each of these bacteria have different potency and hence some bacteria are more potent even in fewer numbers than others.

Since most bacteria is not harmful but helpful in our bodies, you will find that our microbiota is quite populous, with over a thousand species of bacteria occupying the gut in their trillions (Gupta, 2021). In fact, there are ten times more microbial cells than human cells in one's body and there are more bacteria in your mouth than the entire human population (Ogden et al., 2021). Most bacteria are helpful, for example, gut flora such as *Lactobacillus bulgaricus* assists in the digestion of proteins, some even destroy disease-causing cells and provide vitamins for the body (Gao et al., 2019). To understand how these bacteria manage to occupy the human body and not get attacked by the white blood cells, it is important to note that these bacteria appear to the body's immune system as if they are cells of the digestive system and not foreign invaders (Kashimura, 2020). This is because the bacteria cover themselves with glycoprotein molecules removed from actual cells of the digestive system (Lee

et al., 2021). Since glycoproteins are cell identification markers as discussed earlier in this paper, the bacteria are thus disguised and protected from the immune system.

To further understand this principle, reference is made to the Ebers papyrus history about the uses of toxic agents documented around 1500 BCE. Ideally, it is one of the medicinal documents conserved relics and it articulates the utility of various forms of poisons for instance hemlock, aconite arrow poison, opium, lead and copper (Still et al., 2020). Around 399 BCE, passing on by hemlock poisoning was a deep-rooted means of capital penalty in Greece, most conspicuously in the enforced felo-de-se of Socrates (Klaasen, 2008). Hippocrates discoursed bioavailability and over dosage of contaminated agents and planned poisonings used mostly by aristocratic women as a way of eliminating unwanted spouses, a common occurrence in Rome (Naaz et al., 2019). By about 350 BCE, Theophrastus, a protege of Aristotle, made numerous references to poisonous plants in his initial De Historia Plantarum. Around 75 BCE, King Mithridates VI of Pontus (modern Turkey) became fixated with toxins and, from an infantile age, took insignificant quantities of as many as 50 poisons in the expectations of generating resistance to each of them (Velmet, 2020). This practice encouraged substantial conditioning to poisons and the standard poisonous mixture were no longer effective in attempts to kill him by poisoning. The term "mithridatic" comes from the name of this king and it refers to an immunity against the action of a poison produced by minor and progressively snowballing dosages of the poison (Roller, 2020).

Statement of the problem

A bacteria called *Mycobacterium vaccae* exists in soil and helps strengthen the immune system (Brevik et al., 2020). Because this bacterium is everywhere where there is soil, it is hard to avoid and let children play with dirt as it conditions their immune system to understand which foreign substances are best left "ignored" as not all foreign substances are dangerous or fatal (Kuhl et al., 2021). Why is lack of exposure to dirt ordinarily trigger violent immune responses on people who stay in overly sanitised environments.?

Objectives of the study

The objectives of the study were to:

i) Examine the perceptions and views harboured by the elderly on how the immune system is conditioned to bacteria.
ii) To establish traditional systems used to make rural children resist dirt-related diseases.

iii) To examine the utility of dirt on human welfare in the Covid-19 pandemic.

Materials and methods

Research approach

The research was anchored on a qualitative paradigm which ensured the harnessing of the subjective, often impalpable nature of human organisms. This approach was suitable for the study because it revealed the mysteries behind the survival of rural children during pandemics. Mataruse et al. (2022) opine that a qualitative study is a methodology employed by researchers whose conviction demonstrates that any phenomenon is better understood when interrogated as it happened in the context of participants. The study sought to unpack a very crucial and often concealed symbiotic relationship between bacteria and human immunity. Hence, the qualitative methodology was appropriate to explore the intricate qualities related to the phenomenon in question.

Design

Research design refers to the structural plan of the research that is employed to elicit data that speaks to study objectives (Schumacher, 2022). The study utilised a qualitative phenomenological case study in an endeavour to comprehend the perceptions and views of the elderly on medicinal effect in microbes. Al-Ababneh (2020) postulates that one of the pros of a case study strategy is that, ordinarily, it helps the scholars to gain insight of concealed phenomena from respondents' worldview. Therefore, this research design promoted the understanding of dirt as a vaccine from the viewpoint of elderly people in rural areas who have been practising bacterial rituals in boosting children's immunity.

Population

The target population of this research was people with an age range of 60 -100 years domiciled in Dara village, Gutu North, Masvingo, Zimbabwe

Sample and sampling techniques

Mataruse et al. (2022) posit that establishing a suitable sample size in qualitative study is entirely the discretion of the researcher's discernment and experience in assessing the value of the data elicited in relation to the facts under consideration. In view of this, the sample size of this research was determined by data saturation. Purposive sampling technique was used to recruit this study's participants. The study sample had seven (7) participants comprising three (3) males and two (4) females.

Data collection procedure

The researchers sought permission to engage the respondents from the civic leaders. Informed consent was sought from participants. One-on-one in-depth interviews were employed to elicit data from the participants. In-depth interviewing is delineated as a qualitative research strategy that entails the administration of comprehensive individual consultations with a slight number of participants to gain an understanding of a specific phenomenon (Mataruse, 2021). In a similar vein, Brevik (2019) notes that in-depth interviews help in gaining quality information about the respondent's worldview. Interviews were favoured because they are flexible, hence researchers had the latitude to probe for more information. Interviews spanned for roughly an hour or less depending on the expressiveness of the respondents. The interviews were done in participants' mother language, Shona, considering the literacy level of the participants. With participants' consent, interview responses were audio-recorded to prevent loss of important information.,. The interview recordings were transcribed in Shona language and the transcriptions were then transliterated to English.

Data analysis

Data were analysed using thematic analysis technique. Notably, thematic analysis is an algorithm employed to sift data which encompasses skimming through a set of information to establish and evaluate frequent patterns (Matewe et al., 2022). The thematic analysis was used in synthesising data and constructing themes for the research.

Results and discussion

The study revealed that the immune system is heavily conditioned to bacteria. All respondents indicated that bacteria that get into human bodies, especially in small doses, help in conditioning the human body's immune system. People who are unintentionally or intentionally exposed to bacteria have a stronger immune system than those who stay or grow up in total bacteria-free free environments. Adolescents reported psychosomatic disturbances and phobia-related symptoms. Some participants complained of experiencing unexplained physical pain post cyclone Idai disaster. Participants also grappled with rainfall-related phobia. The following quotations are illustrative:

> 'Following the Cyclone Idai and its related impact, I had to be admitted at a hospital for some days as I felt pain all over my body'. (P13)

> 'Because of the losses we experienced, the sight of building clouds makes me shiver. Even up to now, when it starts raining I am not comfortable as I dread the experience of rainfall given the past experiences'. (P6)

> 'Children who grow up taking small doses of bacteria or poison either intentionally or unintentionally are usually resistant to various disease outbreaks such as Covid19, cholera, and others.' Participant 2

> 'Many people in urban areas or living in urban set-up standards who were never exposed to difficult living conditions were the main victims of Covid-19 and cholera outbreaks. Rural children were not affected because of a strong immune system which was conditioned by staying in dirty areas.'

The results show that not all bacteria are harmful to the body since some help improve or harden the body's immune system. The findings are consistent with Gupta (2021) who argued that most bacteria are not detrimental but essentially helpful in human bodies, because the human microbiota is relatively populous, with over a thousand types of bacteria inhabiting in the gut in their trillions.

The study established that children who grow up in rural areas and children in urban areas are exposed to various forms of dirt. The study revealed that the setup in rural areas in Masvingo allows children to do a lot of outdoor activities such as playing traditional games such as *pada*, and soccer outside the houses. In the process, they eat soil and other herbs that are medicinal, which, in turn, harden their immune system. There is a strong cultural belief that local soils contain some medicinal nutrients which minimize the chances of children contracting various types of diseases such as bilharzia, Covid-19, cholera and others. One of the respondents remarked**:**

> We let our children play outside and we have no problems with their health *tsvina hayiurayi* we were raised by farmers we were never sick only the born-born people are always going to the clinic."

Another participant remarked:

> No! our children never suffer from diarrhoea but some adults who move in from new places always need treatment and boil water or use table (I think they mean chlorine tablets) Children who grew up here are never sick but those who settle in from other places struggle with diarrhoea.

A study by Beetz et al. (2018) established that not all foreign substances are fundamentally foreign to every person. Furthermore, Karimi et al. (2022) argues that the differences in immune tolerance between persons domiciled in a clean setting versus the dirty and insanitary environment is that, those who live in dirty places are more resistant to diseases than those who live in clean environments. For example, rural children across the global south live in very dirty

places, put on the same dirty clothes for prolonged periods while feeding from dirt but they still survive the outbreaks of pandemics such as Covid-19. It is perplexing to note that rural children do not easily fall sick from such exposures to dirt, whereas a person coming from a hygienic home almost gets life-threatening various outbreaks such as cholera, Covid1-9 if they get exposed to similar situations. Stefanovic et al. (2020) summarise the issue by arguing that all this boils down to three rudimentary aspects, which are individual immune tolerance, extent of foreign substances to each individual as well as doses.

The study further revealed that families that are entrenched in social and cultural beliefs carry out some traditional activities which they believe strengthen children's immune systems such as bathing babies in water mixed with some doses of dirt that is collected from the local area. Some families rub-clay soil on children's tongues while others make them concoctions such as traditional medicines. Consistent with this view respondent 3 had this to say;

> We rub clay soil on their tongue or put it under the tongue. We also tie a wool string on their waist and *kuvamwisa* their urine if they have a fever/high body temperature. Our first-born children are raised by our mothers after we wean them because our mothers know all the tricks.'

The other participant also remarked:

> 'At 2 months old we start rubbing or place clay soil on the tongue, we administer urine when the child is about to grow his/her first teeth, the wool string is placed 3 weeks after birth (Munyas comment: I think this string harbours bacteria because I once saw a kid *anayo* and it was dirty *haibviswi* so I think the string is just a reservoir for bacteria and since its always on his body the bacteria spreads).'

Participant 7:

> We didn't do anything cultural on our children except praying for them at church, it varies but the child is prayed for, then bathed in water containing sand before his belly button dries because that is the instruction we are told by the elders/ *vakuru*.'

The results are consistent with Alebila (2019) who argued that families bathe infants in water that is mixed with dirt, not just any dirt but dirt that has been collected from public spaces such as marketplace, bus terminus or rank. The elderly argues that dirt that is found in local public places comprise more bacteria and other foreign substances than dirt collected from a secluded space which in turn harden or improve their immune system. The justification for bathing new-borns in dirt-infested water is to realize primary acquaintance to foreign substances to babies so that they develop a resistance to diseases and tolerance to foreign substances at a tender age. This helps them in that if they get exposed to the same pathogens later in life their bodies can

resist them, which consequently protects them from various forms of illnesses. One of the participants remarked:

> Children usually put every dirty object they get such as cow-dung, shoes, licking keys, rugs, sticks and soil in their mouth. Children also play in dirt bacteria-infested water such as pool water.'

The dirt objects contain both bacteria and medicinal elements such as soil-based microbes. The soil-based microbes make children's immune systems register the presence of such pathogens.

It was also established that most people believe that the vaccinations that are given in hospitals should not be viewed as the primary source of boosting children's immune systems but a complimentary to the natural traditional way of hardening the child's immune system. The study revealed that children become conditioned to bacteria not because they are vaccinated but because they have grown up in their natural environment and exposed to various dangers in life. One respondent remarked:

> The child is not vaccinated at the hospital because our religion is enough. We give the child "*midzi*" if it gets serious.

Another respondent:

> 'Our children do not need to go to the hospital and they are never bedridden with any illnesses.

The study also revealed that this category of people strongly feels that their children do not fall victim to local and prevalent bacterial disease outbreaks like cholera. Participant 3 said:

> 'They grow up strong and clever (Munyas comment: I think when she said clever she meant *vanokura* vari active *vasingatyi kurwara netsvina* since *mabasa anowanikwa mu* demographic region *mavo*, i.e., at the fields *achida vanhu vanomhanya mhanya vachipinda pese* without *kusema tsvina*)

Conclusion

The study revealed that initiating children to take small doses of dirt which usual contains some bacteria or poison either intentionally or unintentionally usually makes them resistant to various disease outbreaks during pandemics. Although vaccination of children is mandatory at birth, children living in urban set-up standards are more susceptible to outbreaks than their counterparts in rural areas. There is a long-standing cultural belief that local soils contain some medicinal nutrients which minimalize the chances of children contracting various types of diseases such as bilharzia, Covid-19, cholera and others. It was also noted that not all bacteria are harmful to the body since some help improve or harden the body's immune system. In that

view, the soil-based microbes make children's immune systems register the presence of such pathogens.

Recommendations

The following recommendations were made;

i) It was recommended that children should be allowed to engage in outdoor play with other children and allow them to play with various natural components such as the soil and let them work up early and play in the sunshine. Such activities will make them develop strong bones and a strong immune system.
ii) Traditional medicines are never a substitute for vaccinations but the two should complement each other.

Future studies

Future studies should focus on street children who migrated from rural areas and settled in urban centres. Most street children eat dirt or stale food but they survive various dirt-propelled diseases. There are a number of street children who survived various types of pandemics such as cholera, COVID-19. It is unclear whether the type of dirt exposed to street children also make them resist several hygiene related diseases.

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A Class Solution to Hypo-Fractionated Radiotherapy in High-Risk Localised Prostate Cancer Using 3-D CRT: A Case Study for Parirenyatwa Radiotherapy Centre

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Abstract

Prostate cancer (PCa) is the fourth most common cancer in men worldwide. In Zimbabwe, it is the most prevalent cancer among men leading to high mortality and morbidity. At present, radiation therapy is restricted to external beam as there are no facilities that offer prostatic brachytherapy in the country. Conventional fractionation radiotherapy, where total doses of 78Gy are given in 39 fractions at 2Gy/fraction, five days per week, has been the treatment of choice for patients with localised disease. This regimen has been associated with problems such as long waiting periods as well as increased mortality and morbidity due to undoubtedly long treatment periods. Hypo-fractionation has been associated with better tumour control while offering convenience to patients. This option also increases community accessibility, especially for resource-constrained nations like Zimbabwe with only two public institutions offering radiotherapy. However, hypo-fractionation comes with the demand for greater conformity during treatment planning in order to reduce radiotherapy complications. The aim of the study was to come up with the most appropriate treatment plan that can be adopted when dose escalation is considered in high-risk localised PCa using 3-Dimensional Conformal Radiotherapy (3-D CRT). A quantitative retrospective observational study was done in a sample of ten (n=10) patients with localised high-risk prostate cancer T2b-T4N1M0. Previously acquired pelvic computed tomography (CT) images of patients treated at Parirenyatwa Group of Hospitals Radiotherapy and Oncology Department were used. Nine (9) treatment plans were generated for each patient with different selected gantry angles from a minimum of five fields to a maximum of nine fields. The plans were analysed quantitatively by using cumulative dose volume histograms (DVHs); and qualitatively through slice-by-slice view of the volume. The research revealed that the three best treatment plans that provided good planning target volume (PTV) coverage, organs at risk (OAR) sparing and were considered clinically feasible were, in order of priority, plan 3 (direct anterior, 2 laterals and 2 posterior obliques); plan 8 (direct anterior, 2 laterals and 2 pairs of opposing obliques); and

plan 6 (2 laterals, 2 anterior obliques and 2 posterior obliques). With the employment of the three treatment planning techniques, hypo-fractionation in prostate radiotherapy is a possibility. It was recommended that the findings of the study be used in research studies of biological models to approximate the therapeutic index of hypo-fractionated radiotherapy (HFRT) of PCa on the Zimbabwean population.

Keywords: prostate cancer, radiotherapy, planning target volume (PTV), organs at risk (OAR).

Introduction

The International Agency for Research on Cancer (2016) reported that prostate cancer (PCa) is the fourth most common cancer overall and the second most common cancer in men worldwide. Simeon (2021) and Globocan (2020) indicated that PCa is a leading cancer in terms of incidence and mortality among men of African origin. In Zimbabwe, like most African states, PCa is the third most common cancer after cervix and breast, and the most common cancer among men (Globocan, 2020; Chokunonga, 2013). Of special note is that, in these low and medium-income countries (LMICs) like Zimbabwe, only 5% of patients with PCa have metastatic disease at presentation implying many have localised disease (Yan, 2021). This makes most patients suitable candidates to receive radiation therapy which is considered an effective curative treatment.

Management of PCa in Zimbabwe using radiation is limited to external beam radiation therapy (EBRT) (Mangoni *et al.*, 2014). Like most LMICs, EBRT facilities in Zimbabwe are scarce (Yan, 2021). This is evidenced by the fact that there are only three radiotherapy centres nationwide with two in the public and one in the private sector. Most patients cannot afford private services and; consequently, placing substantial pressure on the scarce public facilities.

In order to achieve normal tissue sparing radiation therapy (RT) is given in fractions which is referred to as fractionated radiotherapy (IAEA, 2022). Conventional fractionation (1.8-2.0 Gy/fraction) is based on the alpha–beta ratio of 10Gy for malignant tumours and 3Gy for normal tissues (IAEA, 2022). However, for the most common PCa type, adenocarcinoma, the alpha-beta ratio is lower than 10Gy (~1.5Gy), making it relatively resistant to lower radiation doses (Runhan, 2008). Thus, greater fractional doses (above 2.0Gy per fraction), also known as hypo-fractionated radiotherapy (HFRT), were seen to offer better tumour control radio-biologically (Yan, 2021). In addition, there are markedly reduced doses and toxicity to OAR particularly the rectum and bladder, offering high conformal doses to the clinical target volume

(Pan, et *al.,* 2018; Zietman *et al.,* 2005; Zelefsky, 2012). With moderate HFRT, the joint guideline state that men with low-risk, intermediate-risk and high-risk PCa can be administered with fractionation schedules of 60-72 Gy over 4-6 weeks, with the bulk of current evidence supporting equivalent results with the use of 60Gy in 20 fractions over 4 weeks (Yan, 2021). The regimen of 60Gy in 20 fractions at 3Gy/fraction is also biologically equivalent to 78Gy given in 39 fractions at 2Gy/fraction which are currently used at the centre of interest.

The goal of hypo-fractionation is to reduce the overall treatment time without compromising the outcome. This has several advantages that include convenience for the patient, improved community accessibility and reduced healthcare costs (Hegemann *et al.,* 2014). HFRT has however been explored in centres with advanced treatment techniques like intensity-modulated radiotherapy (IMRT) and volumetric arc therapy (VMAT) while CFRT has remained the standard in LMICs like Zimbabwe where 3-D CRT is used (Michael, 2021). In addition, Michael (2021) argues that, with a strict margin of about 5-10mm, 3D conformal radiotherapy may be used in hypo-fractionated treatment regimens. Furthermore, Michael (2021) highlights that the bare minimum for HFRT delivery is a CT scanner and a linear accelerator with imaging capability, which is the case with Parirenyatwa radiotherapy centre (Zimfact, 2020).

The purpose of this study was to assess the possibility of adopting moderate HFRT in medium to high-risk PCa using the 3-D CRT technique by coming up with most clinically relevant plan.

Methods

Design

The study was a retrospective, quantitative observational study in which previously acquired CT images of the prostate were used to generate different plans. The scans were done at 5mm intervals as per the departmental pelvic scan protocols.

Study setting

The study was carried out at Parirenyatwa Group of Hospitals (PGH) radiotherapy centre. PGH is the largest and most sophisticated hospital complex in the country with a capacity of about one thousand eight hundred (1800) beds and a staff establishment of more than two thousand (About the Hospital, 2022). The hospital has a radiotherapy and oncology centre (RTC) which provides most of the cancer management services for the northern part of the country (Chokunonga *et al.,* 1999).

Study population
The study subjects were derived from histologically proven PCa patients treated with EBRT in the period January 2021 to February 2022 and logged in the treatment planning logbook at RTC.

Sample and sampling procedure
The researcher used purposive sampling to get a sample size of ten (n=10) patients which was equivalent to other previously reviewed studies (Runham *et al*., 2013; Shawata *et al.*, 2019). Purposive sampling allowed the researchers to get an in-depth focus on the small sample (Nikolopoulou, 2022). This was because there were multiple parameters to be assessed for each patient and each plan.

Inclusion criteria
A group of patients with intermediate and high-risk PCa clinical stage T2b-T4N1M0 (tumour extends into the seminal vesicles), or rectum or bladder, PSA>20, grade group 4/5 Gleason score 8-10, and pelvic nodes involvement. Their age groups ranged from seventy to seventy-five years which is the range associated with good radiotherapy response (Zaorsky, 2020).

Exclusion criteria
Excluded from the study were men who were treated with HFRT regimen for palliation. Patients were ineligible if they had prior radical prostatectomy, prior malignancy, or distant metastasis.

Data collection procedure
Previously acquired CT images of ten (n=10) patients with T2b-T4N1M0 carcinoma of the prostate who had been treated using the four-field (box) technique were used in the study as follows:

a) Treatment planning CT data was collected from ten simulations where a bladder filling and bowel voiding protocol was used and the scans were acquired at 5mm intervals with the patient in the supine position
b) The clinical target volume (CTV) and planning target volume (PTV) were defined according to departmental protocol as follows: The CTV included the prostate gland, pelvic nodes and the proximal 1cm seminal vesicles. The PTV was created by extending

the CTV by 1cm in all directions except posteriorly where 0.7cm was used to minimise dose to the rectum.

c) The OAR, namely the colorectal, urinary bladder and femoral heads were outlined by one oncologist in order to reduce inter-observer variation.
d) Nine treatment plans for each of the ten selected patients (a total of 90 plans) were generated using the Eclipse treatment planning system. This was a forward planning process where the AAA algorithm, 10MV photon beam energies on the Varian (true beam) linear accelerator were used.
e) All plans were shaped at the beam's eye view (BEV) to encompass the PTV using multi-leaf collimators (MLCs).
f) The reference normalisation point for all plans was the isocentre which was also the volumetric centre of the PTV.

Beam arrangements used were as shown in Table 1.

Table 1: Beam Arrangements for prostate irradiation

Plan number	**Number of fields**	**Description or technique**	**Gantry angles (°)**
1	5F	Open equi-spaced	0; 72; 144; 216; 288
2	5F sunrise	Sunrise	0; 45; 90;270,315
3	5F 3	Direct anterior, 2 laterals and 2 posterior obliques	0; 90; 120; 240; 270
4	6F	Open equi-spaced	0; 60; 120; 180; 240; 300
5	6F obliques	2 laterals and 2 directly opposing obliques (oblique 1)	45; 90; 135; 225; 270; 315
6	6F obliques 2	2 laterals, 2 anterior obliques and 2 posterior obliques (oblique 2)	30; 90; 120; 240; 270; 330
7.	7F	Open equi-spaced	0; 52; 104; 156; 208; 260; 312
8	7F2	Direct anterior, 2 laterals and 2 pairs of opposing obliques	0; 60; 90; 120; 220; 270; 300
9	9F	Open equi-spaced	0; 40; 80;120; 160; 200; 240; 280; 320

All plans were normalised to 100% at the isocentre. Of the published recommended moderate HFRT schedules, the researcher used 60Gy in 20 fractions at 3Gy/fraction, as this was the least fractionated schedule and may be considered safe for starters. All plans were then evaluated quantitatively and qualitatively using physical tools and dosimetric concepts. In physical and dosimetric analysis, the aim was to check on the target volume coverage and sparing of OAR

in different plans using DVH data and viewing slice-by-slice dose distribution using isodose curves.

Quantitative data analysis

The collected data were exported to Excel for quantitative analysis. For PTV, graphs of the average parameters of D_{min}, D_{max}, and D_{mean}, homogeneity index (HI) and conformity index (CI) were calculated for each set of beam arrangements using the ten patients. The same concept was also applied for OAR analysis considering the set dose constraints described above. Statistical analysis of dose constraints and PTV were further done for pairwise comparisons (t-test) with a significance level of $p<0.05$, using the Statistical Package for Social Sciences (SPSS).

Ethical considerations

Since the research involved use of patient data, the researchers sought approval from the Clinical Director, Radiotherapy Head of Department and Chief Physicist at PGH. No further ethical approval was sought as it was a virtual dosimetric study.

Results

Analysis of target volume coverage

Analysis of target volume coverage was done by analysing isodose distributions within the PTV, calculations of the homogeneity index as well as the conformity index. The best three plans were plan 8 (7F2), plan 6 (6F oblique 2), and plan 3 (5F3). Their averaged D_{min}, D_{max} and D_{mean}, in that order, were as follows: Plan 8: (95.8±1.08 %; 107.3±2.02%; 100.01±1.09%); Plan 6: (95.56±1.90%; 105.3±1.88%; 100.2±0.888); and plan number 3 (94.89± 1.04; 106.38± 0.886; 100.06±0.488).

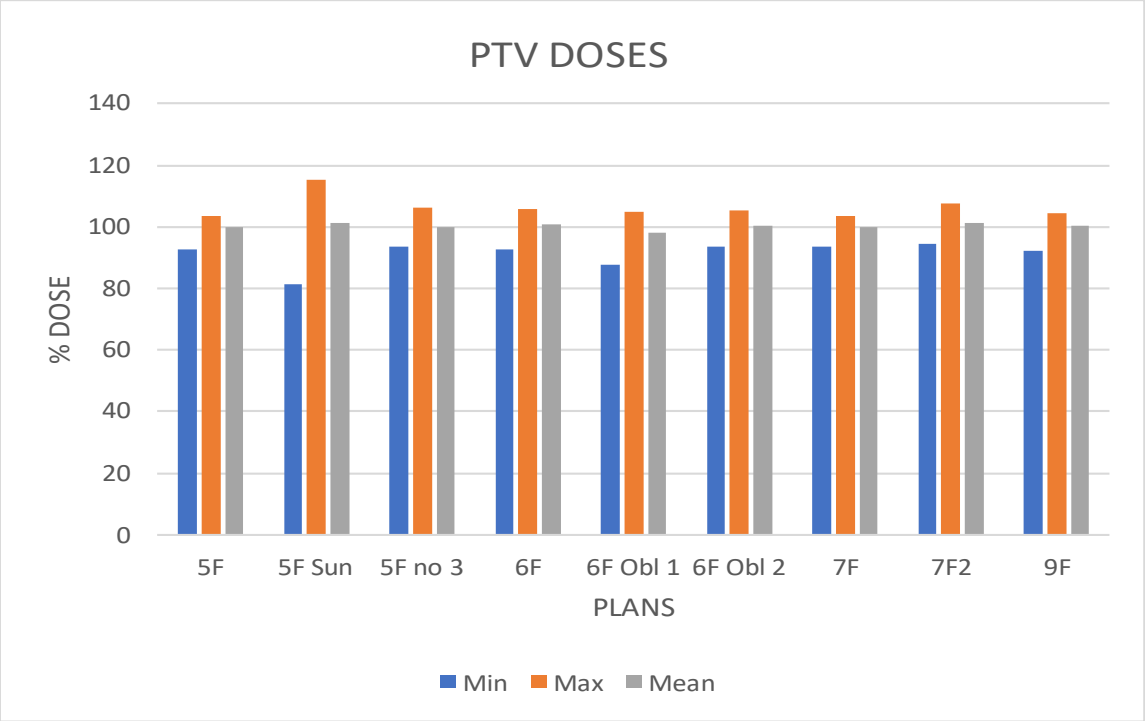

Figure 1*:* The averaged values of D_{min}, D_{max} and D_{mean} of PTV for the nine treatment plans

The worst plan was plan number 2 (5F sunrise) with the following average values D_{min} (82%±6.285), D_{max} (116% ± 2.67) and D_{mean} of 101.09% ± 2.90. The D_{min} and D_{max} were therefore 12% and 8% off the expected values, respectively. In qualitative analysis, it was observed that there was great heterogeneity in the PTV with the 95% isodose line not covering the posterior aspect of the tumour volume in 50% of the plans. This treatment plan was then excluded from further t-test analysis after bearing in mind that there are limited modifications that can be done to a plan to get it to the desired outcome. *T-tests* were done between the top three plans at 95% confidence interval. For plan 8 (7F2) and plan 6 (6F obl2), the significance level was 0.06, while for plan 8 and plan 3 it was 0.07, which were all statistically insignificant.

Tumour coverage was further evaluated using homogeneity index (H.I) and conformity index (CI). The HI was determined using two formulae $HI = \left[\frac{D_2 - D_{98}}{D_{50}}\right] \times 100\%$. Or $HI = \left[\frac{D_2 - D_{98}}{D_{pr}}\right] \times 100\%$, where: D2 – is the minimum dose to 2% of the target volume indicating the maximum dose, D98 - is the minimum dose to the 98% of the target volume, indicating the 'minimum dose', and D50 is the dose received by 50% of the target volume, indicating the 'mean' dose and D_{pr} is the prescribed dose.

In this regard, all the plans had HI values less than 0.1 except for plan 2. Plan 1 was the best followed by plan 7 (7F) and plan 3 (5F3). The HI values were 0.026±0.0013, 0.055± 0.0021 and 0.06±0.0018, respectively. There were no significant differences in HI (1) and HI (2) for all the plans confirming that the prescribed dose was equal to PTV D_{mean} as expected.

A CI value of 1 is ideal and the definition used was $CI = PTV/TV$ where PTV is the planning target volume and TV is the treated volume. Regarding CI, the top three plans were plan 9 (9F) with mean value of 1.9210 ± 0.002, followed by plan 4 (6F) 2.025± 0.0132, and plan 3 (5F3) 2.201±0.0439.

T-tests at 95% CI were done between plan 4 (6F) and plan 9 as well as between plan 6 and plan 3. A *P*-value of 0.131, which was not statistically significant, was obtained for the test between plan 4 and plan 9. For plans 6 and 3, a value 0.003 was calculated, which was statistically significant.

The dose constraints intervals for HFRT schedules of 3Gy/fraction for the rectum, bladder and femoral heads were used. The recommendations were as follows: rectum: V100%<3%, V41%<80%; bladder: V100%<5%, V68%<50%; femoral head V68%<50%.

Analysis of dose to the rectum

Values for averaged V41% and V100% rectum doses per treatment plan are shown in Figure 2 below.

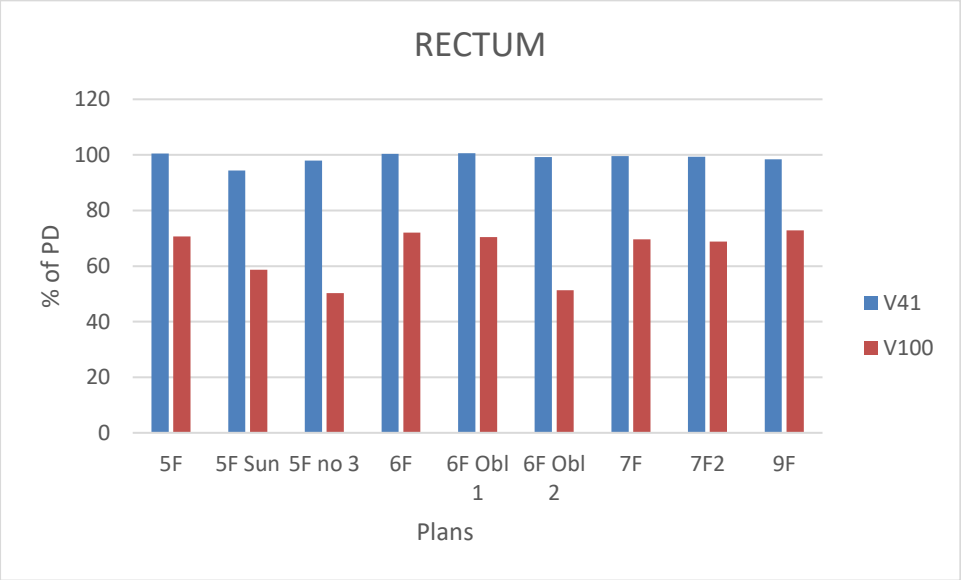

Figure 2: Rectum Dose constraints per treatment plan

There was generally no significant variation in the doses delivered to the rectum as far as V41% and V100% were concerned. However, the following three plans had notable reduced V41% mean values: plan 2 (5F sun): 94.358 ± 1.031%, followed by plan 3 (5F3) with 97.989 ± 0.768, plan 9 (9F) with 98.446± 1.005% and; lastly, plan 6 (6 field oblique 2) which had 99.235 ± 0.432 % of the prescribed dose.

In terms of V100%, the top four techniques were plan number 3 (5F3) with an averaged dose of 50.241±1.328%, plan 6 (6F oblique 2): 51.301± 1.011, plan 2 (5F sun) 58.022± 0.917 and; lastly, plan 8 (7F2) with 68.012 ± 1.002. A statistical analysis at the dose constraint intervals was done as a quantitative review using t-test pairwise comparisons with a significance level of $P<0.05$ considered to be significant.

Analysis of radiation dose to the bladder

Radiation dose to the bladder was also considered and values of dose constraints per treatment plan are shown in Figure 3.

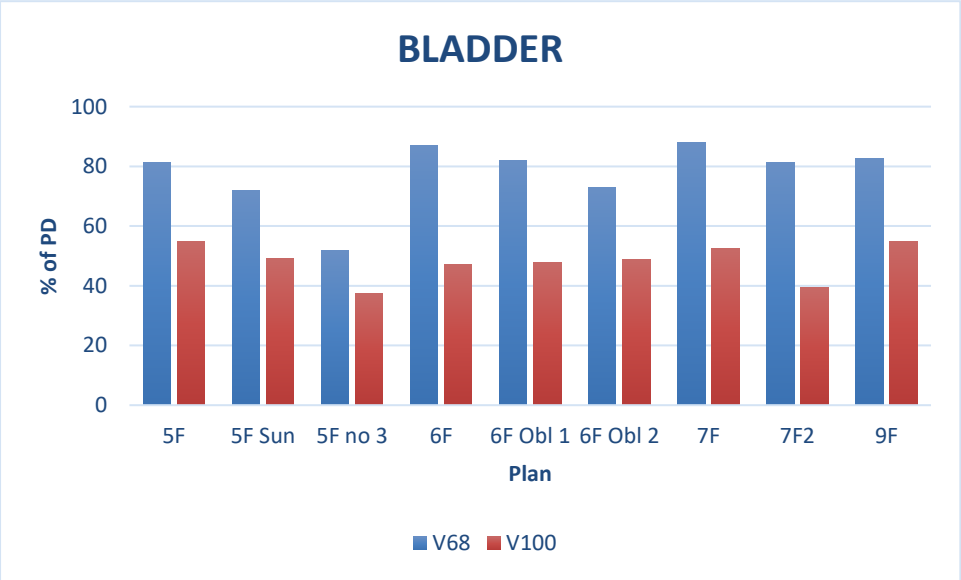

Figure 3: Urinary bladder dose constraints

With respect to V68% and V100%, the plans that gave the least doses were plan 3 (5F no. 3), plan 2 (5F sun), plan 8 and; lastly, plan 6 (6F oblique 2). The averaged values of V68% and V100% for the best plans were as follows: plan 3: (51.792±0.323; 37.447± 0.102), plan 2 (71.832±1.032; 49.034±0.917), plan 6 (72.103±0.052; 48,023±1.062).

Plan 7 (7F) and plan 4 (6F) had the highest doses to the bladder while the remaining four had comparable dose levels. V68% and V100 for plan 7 were 88.106±1.034%, and 52.468±2.013.

Analysis of radiation dose to femoral heads

Radiation dose to femoral heads was analysed and averaged values per treatment plan are shown in Figure 4 below.

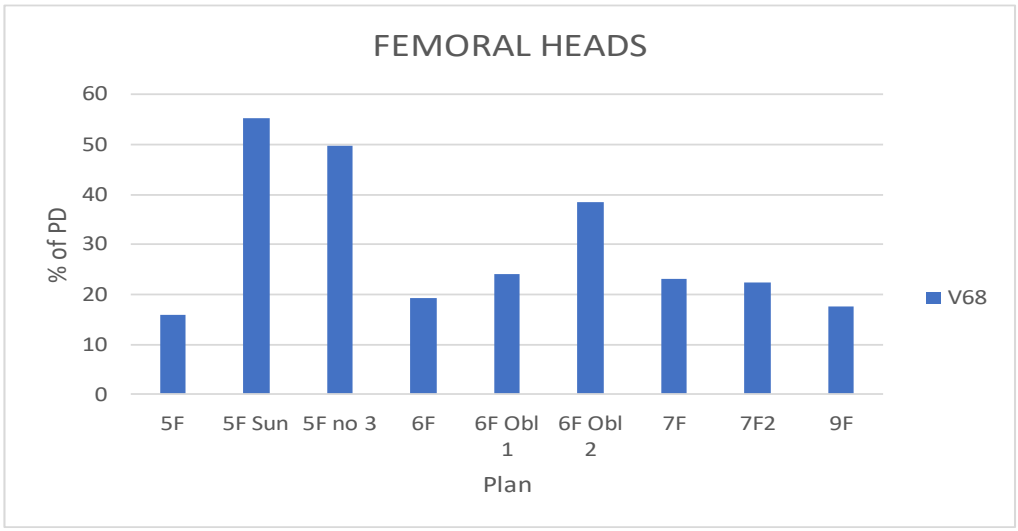

Figure 4: V68% Femoral head doses

The femoral dose was determined per patient by taking the highest V68% value on either side. In this regard, the best plans were 5F, 6F, 9F, 7F2 and 7F. Their averaged values were 15.234±2.001; 17.043±1.073; 17.239±1.025; 19.022±1.034; 22.011±1.224. In addition to the above mentioned, techniques 6F oblique 1, 6F oblique 2 and 5F number 3 also met the dose constraint requirement of V68%<50%.

To check the significance in the differences of doses to OAR, pairwise comparison was made for some chosen techniques that met most of the requirements using *t-tests*. For plan 3 and plan 6, while dose constraints for rectum at V41% and V100% the *P* values were all above 0.05, V68% of the bladder and femoral heads had p-values of 0.001 and 0.02, respectively; and these were statistically significant. However, between plan 8 and plan 6, all the p-values were above 0.05 and therefore insignificant.

Comparison of DVHs

In order to compare the different plans, DVHs of different beam arrangements were superimposed and analysed. One such comparison is shown in Figure 5 below.

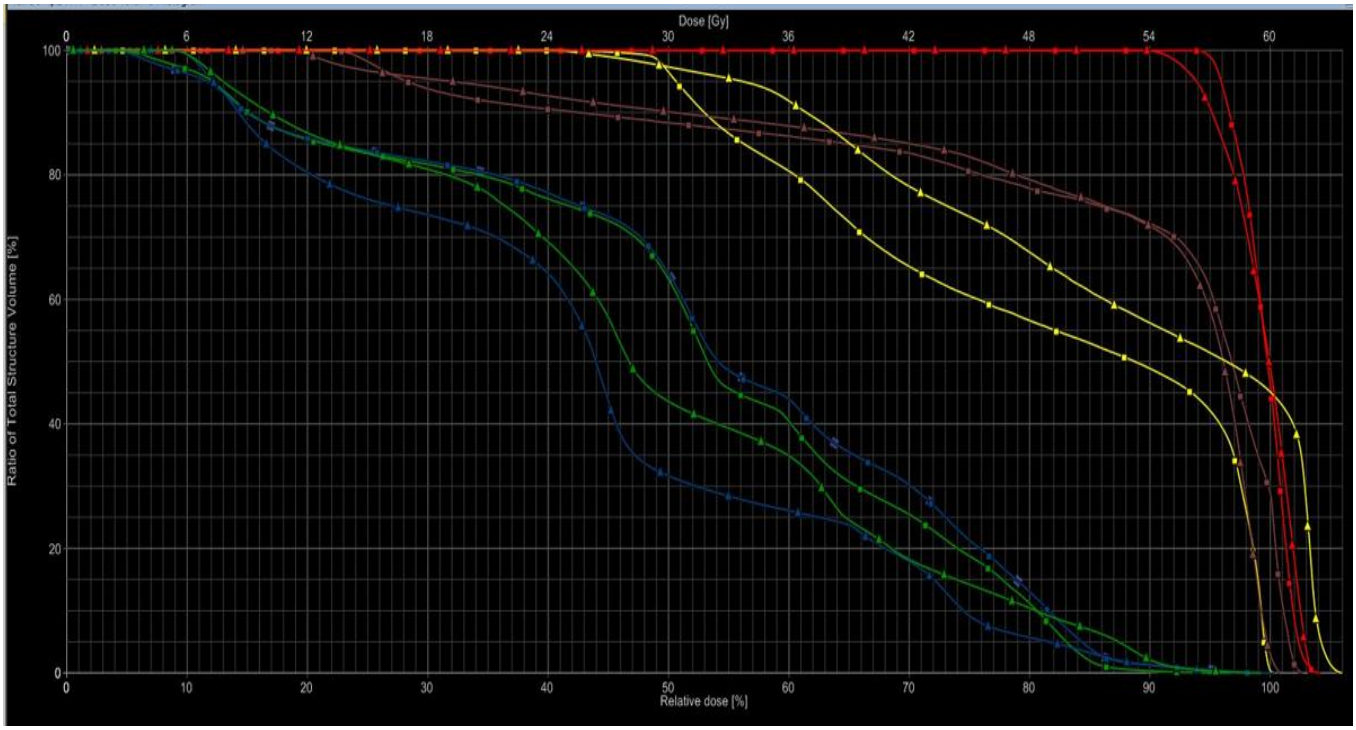

Figure 5: DVHs for PTV, rectum, bladder and femoral heads. (Boxes for 5F3 and triangles for 7F2)

From the DVHs, although the PTV maximum dose for 7F2 is slightly above that of 5F3, the beam arrangement was giving notably higher doses to the bladder (yellow). Otherwise, rectum and femoral doses were comparable for both plans. This observation led to the conclusion that plan 7F2 with gantry angles (0; 52; 104; 156; 208; 260; 312) and plan 3 (5F3) with beam arrangements direct anterior, two laterals and two posterior obliques (gantry angles in degrees: 0, 90, 120, 240 and 270), are equally suitable plans.

Discussion

Conformal treatment planning is a very subjective exercise with the end result depending on inter-observer variation, individual preference and patient anatomy. Despite this, for every parameter that was considered in the study, top three or four plans were identified. For PTV coverage the best plans were plan 8, plan 6 and plan 3. For HI, plan 1 was best followed by plan 7 (7F) and plan 3 (5F3). The HI values were 0.026±0.0013, 0.055± 0.0021 and 0.06±0.0018, respectively. Regarding CI, the top three plans were plan 9 (9F) with a mean value of 1.9210 ± 0.002 followed by plan 4 (6F) 2.025± 0.0132 and plan 3 (5F3) 2.201±0.0439. In terms of rectum sparing, the top four techniques were plan number 3 (5F3), plan 6 (6F oblique plan 2 (5F sun) and lastly plan 8 (7F2). With respect to bladder dose constraints V68% and V100%, plans that gave the least doses were plan 3 (5F no. 3), plan 2 (5F sun), plan 8 and;

lastly, plan 6 (6F oblique 2). The last OAR considered was the femoral head where V68% was used and best plans were plan 1, plan 4, plan 9 and plan 8. The DVH analysis summarised and revealed plan 8 and plan 3 to be comparatively competitive plans.

From statistical analysis, the best dose coverage regarding PTV D_{min} of 95% was for plan 8 (7F2) with the average dose of 95.7% (5730cGy) with the 95% isodose envelope covering the PTV in nine out of ten patients; plan 3 and plan 6 had almost similar results. *T-tests* done between plan 8 and plan 6 and between plan 3 and plan 8 showed statistically insignificant differences in D_{min} results. The worst plan that did not meet the D_{min} requirement was plan 2 (5F sun) with a D_{min} of 88%. With regards to D_{mean}, there were no notable differences in all the nine techniques with all values within 100% ± 0.53%; therefore, PTV D_{max} was considered. All plans met the condition of D_{max}<107% of the prescribed dose except for plan 2 where D_{max} was 115%. The top four plans in terms D_{min} and D_{max} and D_{mean} were plan 8 (7F2), plan 7 (7F), plan 3 (5F3) and plans 5 and 6 (6F and 6F oblique 2), respectively. The differences were also statistically insignificant as depicted by the *t-test* results in which all *p*-values were above 0.05.

However, in terms of homogeneity, plan 2 with five equispaced fields was the best although its dose was 99.67 ± 0.899% as opposed to the top four plans in which D_{mean} was at least 100%. The PTV coverage results were like those obtained by Shawata *et al.* (2019) who reported that the 7F technique (gantry angles 0; 60; 90; 120; 220; 270;300) provided the best PTV mean dose coverage while the 5F3 (gantry angles 0; 45; 90; 270; 315) had the least dose coverage with a mean dose of 99%. Some of their patients were treated with the five-field technique as it saved on therapy delivery time.

Unlike in the current study where 95% isodose envelope of plan 2 (5F sun (gantry angles: 0; 45; 90; 270; 315)) could not cover the posterior aspect of the PTV, Runham *et al.* (2008) managed to achieve it. This was mainly attributed to the study population which had prostate confined-disease (T1 -T2 N0M0), although 45° wedges were also utilised. Shawata *et al.* (2019) also managed to achieve the condition by using open fields using higher energy (15MV) photons unlike in the current study where the highest energy available was 10MV.

The most important limiting factor in radiotherapy dose delivery to the prostate is the rectum. Other OARs considered in the study were the urinary bladder and the femoral heads. The dose constraints for the OAR in the study were obtained based on the ASTRO, ASCO and AUA

recommended intervals for HFRT schedules of 3Gy/fraction for the rectum, bladder and femoral heads.

The dose to the rectum could not meet the set constraints mainly because, in this study, the rectum was part of the treatment volume as the pelvic lymph nodes were involved. This was different from the guidelines where pelvic nodes are not included in the PTV (Morgan, 2018). In an article comparing CFRT and HFRT of the prostate with nodal involvement, Vladimir *et al.* (2020) highlighted that the clinical trial and Italian trial carried by Arcangeli *et al.* (2017) were the only trials with published results on the subject. The rectum dose constraints used with IMRT technique were V50Gy<17%; V31Gy < 31% (Vladimir *et al.*, 2020).

The other OAR that was considered was the urinary bladder where dose constraints for V100% and V68% were analysed. Although all techniques did not ultimately satisfy the conditions of V68% <50% and V100< 5%, mainly due to the reasons indicated in the case of rectum doses, plan 3 could be modified to suit the required standard. The results seemed to agree with those obtained by Runham (2008), where 5F3 (gantry angles 0; 90; 120; 240; and 270) and 6F (gantry angles 30; 90; 120; 240; 270; 330) had statistically insignificant results at 95% CI. Although in Runham (2008) the 5F technique results absolutely agreed with those from Shawata *et al*., (2019). Unfortunately, Shawata *et al.* (2019) did not have the 5F3 technique in their studies. The 5F technique was the 5Fsun in this study, which was the second top plan in terms of bladder sparing.

Lastly, the study also considered femoral head doses where V68%<50% was used. All plans met this requirement except for the 5Fsun where the averaged doses were about 55%. However, the best three plans with remarkably low doses were the 5F equispaced with direct anterior, followed by the 9F (equispaced with a direct anterior) and 6F (equispaced and a direct anterior). The results were contrary to those found by Shawata *et al.* (2019), where plan 2 had the least doses to the femurs. This difference could be attributed to the higher photon energies that were used (15MV versus 10MV). From analysing PTV and OAR doses, the information was consolidated and other factors taken into consideration in order to come up with the best technique that could be adopted clinically.

Conclusion

The purpose of treatment planning is to achieve a reasonable therapeutic index where good tumour control and normal tissue sparing are simultaneously achieved. Analysing the PTV

coverage and OAR seeks to achieve this aim. In order to answer this objective, the researchers examined the DVHs for PTV and OAR, 95% isodose envelope, homogeneity index and potential treatment delivery time. Analysing the DVHs for the techniques 5F3, 6F oblique 2 and 7F2 one could pick very little variations. In fact, the t-test analysis of the 6F oblique 2 and 5F3 were not statistically significant.

In conclusion, plan 3 (5F3) is the best treatment plan if dose escalation is to be considered. Although this plan was not among the top ones in femoral head doses, it met the requirement of V68%<50%. The plan also has the advantage of saving on treatment time (few treatment fields) thus making it more clinically feasible. The other two plans that may be considered in order of priority are plan 6 (6F oblique 2) and plan 8 (7F2) to cater for differences in patient anatomy, inter observer variation and individual preferences. With flexible manoeuvring and optimisation provided by current treatment planning systems (TPSs), it is hoped that the techniques will produce quality dosimetry and; ultimately, a reasonably positive outcome for the patients.

Study limitations

HFRT in high-risk PCa disease with pelvic lymph node involvement is still a controversial topic where more evidence-based results are awaited (Vladimir, 2020). As a result, to the researcher's knowledge, there were no established standards regarding dose constraints, especially for the OAR. The established guidelines, for example, those by Swanson *et al.* (2020), aimed at encouraging implementation research of HFRT in PCa in Africa, and indicated only patients with T1-T2 tumours as eligible. However, in Zimbabwe, like in most LMICs, the majority of patients present with advanced localised disease (T3-T4) (Musarurwa *et al*., 2019). The problem is exacerbated by the fact that advanced techniques like IMRT are not available in these countries. To the researcher's knowledge, there were two established trials with pelvic nodes irradiation, namely the Vladimir *et al.* (2020) 10-year trial, which followed the Italian one of Arcangeli *et al.* (2017). While the Italian trial used 3D-CRT technique, there were no results on the OAR dose constraints used and thus insufficient to draw guidelines from. The limited literature on the subject was therefore a major limitation of the study.

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