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Community Action Plan for Adolescent Substance Use Prevention: The First Step to Creating a Community Participatory Action

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Abstract

Background: The study was designed to explore and catalyze the development of action plan for adolescent substance use prevention in a rural community in Ebonyi State, Nigeria. **Methodology:** This study adopted a two-phase multi-method design. The first phase was a quantitative assessment that determined the real-life situation of adolescents' substance use in the community using 417 respondents. Contemporaneously, the second qualitative phase focused on the development of an action plan by community stakeholders for adolescent substance use prevention using thirty (30) participants selected through purposive sampling. The reliability of the instrument for quantitative data was established using a test re-test method and computed using Pearson moment correlation. A coefficient of 0.8 was obtained. Validity was established for both quantitative and qualitative instruments. The generated data were subjected to descriptive statistics whereas the qualitative data from respondents' narratives were analysed thematically. **Result:** The data revealed that participants who have ever used substances consisted of 128 (59.5%) males and 87 (40.5%) females. The findings on the opinion of 30 participants interviewed about the consequences of substance use brought out majorly four consequences of substance use. The result of catalysing the involvement of community residents towards developing community action for adolescent substance use showed that the challenges associated with adolescents' substance use as identified by the participants were discussed under one theme—living with the cause and three elements. **Conclusion:** Substance use prevention policies and plans in the local community have strong potential for stimulating local adolescent substance use prevention actions.

Keywords

Community Action Plan, Adolescent, Substance Use Prevention, Community

Participatory Action

1. Introduction

Several published studies in Nigeria suggest significant rates of substance abuse among adolescents, which is cause for concern [1] [2] [3] [4]. Cigarette (79.8), cannabis (60.3), alcohol (89.9), smokeless tobacco-snuff (56.3), tramadol (59.6) and others such as superglue (5.4) are the common psychoactive substances used in study participants.

Although current estimates of substance use prevalence are high, the actual frequency may be greater, in part because people who have substance abuse problems are less likely to participate in surveys [5]. Against the background that there is absence of functioning facilities for child and adolescent mental health care capable of early diagnosis and treatment of substance related mental health problems in the South East of Nigeria [6], a strong emphasis on prevention of mental illness and promotion of mental health through substance use prevention programmes has been necessitated.

It is hoped that the present study will stimulate community involvement in developing and implementing local action plans for preventing availability and the use of substances thereby reducing the prevalence of health challenges and other vices associated with substance use. Objectives of the study are to determine whether research participants are aware of the negative consequences of adolescent substance use, determine knowledge regarding community approaches for adolescent substance use prevention among study respondents and catalyze the involvement of community residents in developing local Prevention Action Plans (PAPs) for the adolescent substance use.

2. Materials and Methods

2.1. Study Area

The study was carried out in Umuhuali, Ebonyi State. Ebonyi is one of the 36 States in Nigeria and one of the five States that make up the South Eastern Nigeria. The people of the State are predominantly farmers and traders.

2.2. Study Design

A two phased multi-method study research design was adopted. The first phase was a quantitative baseline survey that determined the real life situation of adolescent substance use in the community, and the second qualitative case study which focused on developing an action plan for adolescent substance use prevention.

2.3. Population of Study

There was no documented population of the community, however, according to

the Local Government Chairman, the population of Amokwe-Umuhuali was approximately 1900. It is worthy to note that there are four major secondary schools in Ezilo that serve the educational needs of the adolescents (Comprehensive Secondary School, Community Boys' Secondary Schools, Girls' Special Science School and Girls' High School Ezilo) within and outside Ezilo. All the adolescents in each of the schools served as clusters that were sampled from.

2.4. Sample

In phase one (survey), a simple random sampling procedure was adopted in selecting four hundred and seventeen (417) respondents from the four secondary schools that serve the educational needs of the adolescents in Umuhuali using Taro Yamane method.

In phase two, a purposive sampling approach was used to pick thirty (30) participants, with the researcher's judgement as to who could provide the best information being taken into account in order to meet the study's objectives [7]. These were made up of 12 students, the key 12 community residents as well as 6 special adults who were selected for active participation in interviews and focus group discussions in order to accomplish the research objectives.

2.5. Instruments for Data Collection

In phase one, Substance Use Involvement Test (SUIT) was used in assessing the prevalence of substance use among adolescents in the community while focus group discussion and interview guide were used in collecting information from all the selected key community residents and selected adolescents.

The Substance Use Involvement Test was a seven-item short screening questionnaire designed to determine whether or not persons used psychoactive substances. The researcher created it as an easy way to check for the usage of alcohol, cigarettes, cannabis, cocaine, amphetamine-type stimulants, sedatives, hallucinogens, inhalants, opioids, and other drugs.

The SUIT has two sections, A and B. Section A was made up of 5 items that dealt with personal characteristics of respondents while section B is a two item section that dealt with substance use by respondents. The first out of the two items provided ten possible options of substances adolescents can involve self with. The major function of the second item on section B was to validate the response given by respondents on the first item (substance use).

Key Informant Question Guide: A series of in-depth interviews were undertaken with key community residents (stakeholders) identified by the researcher using an interview guide. These interviews provided for in-depth discussion regarding the key research issues. The interview guide consisted of two major parts. The first part consisted of questions that address substance use issue and perceived consequences of adolescent substance use whereas the second part consisted of questions that address opinions regarding approaches regarding the issue of adolescents' substance use in the community. Sample question: 'What are your views about substance use? (Prompt: why do you think of these, probe

further to explore reasons for these views, prompt on the link between participant's views and perceived consequences of adolescent substance use?)

Interview Guide for Focus Group Discussion: Focus group discussions were conducted using a focus group guide with three major questions aimed at facilitating community residents' involvement in the development of local Prevention Action Plans (PAPs) for adolescents and the establishment of systems and structures for collaborative processes of coordinating and monitoring progress in order to address one of the research objectives. Sample question: As key members of the community, what do you perceive as challenges to adolescent substance use prevention?

2.6. Instrument Psychometric Properties

The validity of the instruments was established by examining them critically for content relevance and clarity of statement by two experts. Items that were not acceptable to the experts were eliminated or further revised as suggested by the experts. The researcher ensured data quality by guaranteeing data transferability and credibility by employing the thick description strategy, in which she gathered sufficient detailed descriptions of data in contexts and reported them with enough detail and precision to allow the reader to make a judgement about transferability. Similarly, credibility was built by the researcher devoting enough time to data collection activities to gain a thorough understanding of the norms, language, and perspectives of the group under investigation, as well as to screen for disinformation. Through engagement, the researcher also built trust and rapport with informants, which enables the researcher to obtain useful, accurate and rich information. Also, reliability estimation of two sets of scores generated through instrument pilot testing yielded correlation co-efficient of 0.81.

2.7. Procedure for Data Collection

After the review, approval and all permissions were gotten. The researcher scheduled all forms of data collection for adolescents and community key informants. All quantitative data were collected from adolescents in school during break period as were permitted by the school principals. In order to ensure maximum return rate and eliminate inappropriate or incomplete filling of the questionnaire, the researcher personally administered the instruments with the assistance of school teachers (one from each school) and the respondents were guided through the questions. For the same reason, respondents were not allowed to take the instruments home.

A series of well-planned in-depth interviews and discussions were undertaken with 12 adolescents and 18 key community members (stakeholders) identified by the researcher. These took approximately one hour in duration for interviews and four hours of focus group discussion at each sitting. Interviews and focus discussions were held at different points within the community as agreed by participating members.

2.8. Ethical Considerations

Ebonyi State University's Institutional Review Board granted ethical approval; permission to enter into the community was obtained from the local government chairman and village development union president. Permission for entries into the schools was given by the school principals. Therefore, for the purpose of this study, group parental consent was obtained from all participants' parents during school meeting for those below 16 years and consent was gotten from each participating student. Each participant was informed of the purpose and nature of the study. It was also made clear to the participants that they can withhold consent at any time during the course of the study and that they will not suffer any adverse consequences for declining to participate. At the end of the study, a feedback of the study result was presented to the Community head and Local government chairman.

2.9. Data Analysis

Quantitative data collected on prevalence of substance use were presented with frequencies and percentages. On the other hand, analysis of qualitative data collected from interviews and focus group discussions was done based upon a six-phase thematic analysis approach (8). Themes identified using this approach formed the evidence- base from which the conclusions in this study were drawn.

3. Results

Four hundred and seventeen questionnaires were distributed to adolescents. Out of this number, 385 responded giving a response rate of 92.32%. Contemporaneously, the information gathered from twelve interviewed adolescents and eighteen community stake holders were also interpreted and presented in line with identified themes with regard to adolescents' substance use prevention through community PAP in Amokwe-Umuhuali Community of Ebonyi State.

Female participants were greater (214 [56%]) in number than males (171 [44%]). The distribution of the sample according to age range revealed that most of the respondents were in the age range of 15 to 19 years (64.4% of the participants).

The findings on the prevalence of substance use among adolescents in Amokwe-Umuhuali Community of Ebonyi State are as shown in **Table 1**. The participants who have ever used substances consisted of 128 (59.5%) males and 87 (40.5%) females. The data revealed that the majority of respondents used alcohol (77.7%), followed by tobacco (12.6%) and cannabis (4.2%). However, it is worthy of note that of these proportions, none of the female respondents had ever taken tobacco (0%). Similarly, only 1 (11.1%) female against 8 (88.9%) males had taken cannabis before, whereas there was no striking difference in pattern of alcohol consumption between females (82 [49%]) and males (85 [51%]) respectively. The pattern of alcohol use between the two groups, points to the fact that alcohol is a social drink in most communities.

Table 1. Prevalence of substance use among adolescents of amokwe community.

Substance Use	Male	Female	Total
	(% of total participants)		
Ever used substances			Total N = 385
Yes	128 (59.5%)	87 (40.5%)	215 (55.8%)
No	43 (25.3%)	127 (74.7%)	170 (44.2%)
The substances ever used			Total N = 215
Tobacco product	27 (100%)	0 (0%)	27 (12.6%)
Alcoholic beverages	82 (49%)	85 (51%)	167 (77.7%)
Cannabis	8 (88.9%)	1 (11.1%)	9 (4.2%)
Cocaine	0 (0%)	0 (0%)	0 (0%)
Amphetamine	2 (100%)	0 (0%)	2 (0.9%)
Inhalant	1 (100%)	0 (0%)	1 (0.4%)
Sleeping pills	3 (75%)	1 (25%)	4 (1.9%)
Hallucinogens	3 (100%)	0 (0%)	3 (1.4%)
Opioids	2 (100%)	0 (0%)	2 (0.9%)
Others	0	0	0

3.1. Opinion about the Consequences of Substance Use in Adolescents among the Community Residents

Narratives of the thirty participants interviewed brought out majorly four consequences of substance use. These are mental illness, loss of potentials, worsened poverty level (“loss of economy”) and involvement in serious crimes. The data from the interview sessions were further analysed in a bid to elicit any meaningful pattern in opinion among the various stakeholder groups and across genders.

The results indicated that while majority of the participants agreed that mental illness and worsened poverty level are consequences of substance use, especially among adolescents, all (100%) of the male opined that loss of potentials and involvement in serious crimes came top of the list. They also reiterated that loss of potentials in particular is the main driver of other consequences, and most times the observed deviant behaviours.

The findings from the interview on mental illness revealed that, of the 90% of the participants (27 of the 30), all adult stakeholder groups (100%) were of the opinion that mental illness is a major consequence of substance use. One of the participants was less diplomatic and said “*Substances make people mad and useless*”. Some (37.5 % [3 out of 8]) of the male adolescents did not agree to any direct link between mental illness and substance use. They rather explained that mental illness comes into play when substances are abused, not from ordinary day-to-day use. All female adolescents discussed mental illness as a consequence of substance use.

It is worthy of note that on the issues of loss of potentials and involvement in

serious crimes being consequences of substance use, all participants (100%) irrespective of stakeholder and gender groupings were strong in their opinion on these as consequences. One of the participant uttered “*I know that people who take to hard drugs, drop out from school or fail in handwork*”. The link to involvement in serious crimes came out very strong among these groups, as all participants believed that serious crimes are carried out with the use of hard drugs. Another participant buttressed the points by saying “*I am aware that those involved in crimes that lead to the killing of people and burning of houses take hard drugs*”. However, this did not exclude the fact that one of the female adolescent respondents, although not strongly, was also of the view that while substance use promote crime, it also plays a part in building confidence among the youth for security reasons.

Worsened poverty level came trailing behind the other three opinions on the consequences of substance abuse. The findings revealed that the adolescent group differed greatly in opinion on worsened poverty level as a consequence of substance use. Of the eight male adolescents interviewed, only 2 (25%) agreed that loss of economy is a consequence of substance use. 75% (three out of four) of the female adolescents said substance use could worsen an already bad situation regarding poverty level.

Further analysis of the narratives from the interview sessions showed that while the pattern of agreement on the consequences of substance use was 100% on the four consequences among all adult stakeholder groups, the female adolescents slightly differed (One out of four [25%]) on loss of economy as a consequence. There was a great disagreement among the male adolescents on this. Out of the eight male adolescents interviewed, six (75%) said substance use does not impoverish the user. Similarly, the male adolescents differed from other stakeholder group on the issue of mental illness as a consequence. Three out of eight (37.5%) adolescents compared to 100% of other stakeholder group, said that substance use cannot lead to mental illness.

3.2. Opinions Regarding Community Approaches to Adolescent Substance Use Prevention

Proper parenting, school-based and community-based interventions, and interventions by the government through implementation of the law came out strongly from the narratives of the informants. As such, these were further analysed to bring out the picture among the various groups and across gender.

The results showed that majority (80%) of the participants are of the view that proper parenting can forestall involvement with drugs. Of this proportion, only half of the adolescents interviewed held this view. Similarly, one male and one female participant differed on this. To further buttress the majority stance, one of the participant said “*Children whose parents are involved in the activities of their children, knowing their friends and directing them appropriately rarely use drugs*”. The six participants that differed are of the view that some parents in their community are not knowledgeable in ways of training children, therefore

need education. All participants urged that efforts be made to empower parents to create and enforce explicit drinking guidelines, as well as to increase communication between children and their parents concerning substances.

On school-based interventions as approaches to prevention of substance use, 23 (76.7%) participants considered this as an important way of building children's character. Out of this, it is worthy of note that all females interviewed agreed with this view. Three adult males and half of the adolescence had different opinions. While this group were of the opinion that the school interventions might not achieve much as regards habit formation, majority of the participants reiterated that teaching children about consequences substance use, building their skills and providing them with motivation and the opportunities they need are paramount to make them remain substance free, and that this is achievable.

Opinions on using community-based interventions were also strong among 21 (70%) of the participants. All six participants (100%) in the special group buttressed the importance of community interventions in moulding adolescents. Similarly, all female adults and majority of the male adults (7 out of 8) held same view. However, only 25% of the male adolescents and 50% of the female adolescents had the same opinion. Seventy-five (75%) percent of the male adolescents and half of the female adolescents differed as to whether community systems and approaches are feasible intervention options for prevention of substance use.

Regarding the role of the government in the prevention of substance use among adolescents, all (30) participants interviewed were of the view that legal action against substance peddlers is the only way out of substance use by adolescents. One of the participants specifically states "*In current days, the government is not serious with enforcing laws*". It is worthy of note that, of all the participant groups, the male adolescents differed most in opinion along three out of the four opinions that strongly came out. It is interesting to note that their opinion on the government role in the prevention of substance use was strong in support.

The female adolescents strongly support all intervention approaches other than community-based interventions, except for one participant who felt that proper parenting was not an issue to over-emphasis. While the opinion of the male adults fluctuated along the interventions, the entire interviewees in the special group agreed strongly on all approaches as ways of preventing substance use, and thus bringing about the desired change in behaviour regarding substance use

3.3. Local Prevention Action Plans (PAPs) for the Prevention of Adolescent Substance Use

Narratives of the discussants brought out two major broad themes which are "environmental context-living with the cause" and "remedies rooted in education". In order to develop adolescent substance use prevention action plan (PAPs), the discussants found it necessary to highlight and build discussion around the facilitators of adolescent substance use for effective plans to be de-

veloped. The result showed that the challenges associated with adolescents' substance use had three subthemes: 1) growing of weeds and substance sale 2) Community existential discordance, and 3) Lack of information regarding drug.

3.4. Growing of Weeds

The participants of the study drew attention to the fact that the main challenge is not foreign to the people rather it is something that thrives well in the community system which makes it more difficult to tackle. Twenty out of the thirty leaders (66.7%) reported that people plant and grow cannabis in their various houses and use them at varying degrees. Some grow them for sale to make money while others grow them for personal use which may include smoking and using them as vegetables in food. This brings up another aspect of the challenge which points towards the fact that one cannot categorically say that somebody does not use substance in the community because some are using it without the knowledge of it.

Excerpt: "it is in our culture to invite people to share meals with us and it is not out of place at all for someone to oblige and join. By so doing, some people are consuming foods prepared with Indian hemp without knowing it and enjoying the after effect without linking it to a particular content in the food they ate".

3.5. Community Existential Discordance

83.3% of the leaders revealed in the course of the discussions that discordance in the community was one of the major challenges but that the people have grown to adapt to it. There is discordance among the people themselves and between them and their leaders thereby introducing gaps that make cohesion in the community impossible. When the community experience unrest, it creates an opportunity for many to resort to substance use for one reason or the other, and such unrests in themselves are distractive in the sense that people abuse substances under the cover of such confusion without being noticed.

3.6. Lack of Information Regarding Drugs

The issue of inadequate information was pointed out and was dual directional: one is inadequate information regarding drugs on the part of the youths. 76.7% of the leaders identified lack of information regarding drugs as one of the major challenges to substance use. They opined that adolescents take these substances without having a grip of the implications, but merely see it as something they are mature enough to consume.

Excerpt: "you know substance use is mainly youth problem and they operate under ignorance" (female adult participant).

The other aspect of information gap is on the part of the parents. Due to one reason or the other, they are not conversant with activities of their youths (children) while in school and after school. Some are not aware of the involvement of their children in substance use because they are carried away by other

things such as being concerned with their grades in school. They do not associate the thought of substance use with their children and that is why the children get away with such acts unnoticed over a time when it should have been identified and handled.

Excerpt: “I agree with this, we focus on position of our children in school without attention to their activities, and to be honest we rarely pay attention to other aspects of our children development (adult participant)”.

For the preventive action, the participants made valuable suggestions which generated into a broad theme and three subthemes. 70% - 93.3% identified three key elements that are vital in any effort to develop preventive actions against substance use amongst adolescent. These elements include:

3.7. Remedies Rooted in Education

The elements here include: 1) Leveraging on organized gatherings, 2) Parental involvement and 3) Reduction in the availability of substances in the community

3.8. Leveraging on Organised Gatherings

93.3% of the participants suggested that the best approach is to embrace and make use of what we already have. By this, they meant penetrating schools with teachings on substance use and its consequences. This will become workable when such topics are integrated into the school curriculum. This will enable the students to have strong foundational information on substance use and equally make them to be more responsible when making decisions on such matters.

Excerpt: “school teaching of consequences of substance use would be of great help and impact”.

Another panacea for prevention is taking this knowledge down to where women hold their meeting such as the popular annual “August Meeting”. Normally, issues that are discussed in such meetings are vital ones and will draw the attention of women to the importance of understanding, so as to be in a better position to help their children. Another is organising programmes for the youths and the community at large where topics on substance use would be well discussed.

Excerpt: “august meeting education of women”, and “organized community education and programmes for young people”.

3.9. Parental Involvement

The most of the participants stressed the need of encouraging parents to become more involved in their children’s upbringing. Getting more active in children’s upbringing involves providing teenagers more time to tackle their psychological needs.

Excerpt: “We know that doing these things is important but we do it for certain cases—if we have time” (adult male participants).

“spending a lot of time with parents to support them psychologically”, “encouraging adolescents to talk to us”, “answering their questions about their con-

cerns".

They were of the opinion that problems of substance abuse escalated because parents have not given enough time to it. Giving time to these youths will avail parents the opportunity to know and understand their problems and to help them make the right decisions.

Excerpt: "I offer my children and my neighbours' children psychological and social support as it is very important. Last week we had a 16 year old girl who was impregnated. I spent plenty of time with her just to let her feel that she is not alone and to answer her questions" (adult).

"I think, that is right, we need more of such care to forestall substance use. [referring to the story of the little girl]. You know this is very important for speeding up her adjustment" (adolescent).

3.10. Reduction in the Availability of Substances

Seventy percent (70%) of the participants were of the view that the community-based intervention towards reduction of substance availability in the community is a strong factor. Whereas (100%) of the respondents unanimously opined that legal action on drug peddlers within the community will go a long way in controlling adolescent substance use.

It is worthy to note that majority of the adult discussants in part mentioned the need for the establishment of a system for monitoring and coordination of any community substance use prevention action to be implemented in the community.

4. Discussion

4.1. Prevalence

In this present study, substance use was a reality and indeed high in prevalence as suggested by the survey. Similar to this, high prevalence was reported in various studies conducted within Nigeria [8] [9] [10] [11] [12]. Also, report from Ethiopia shows prevalence of 14.1% [13]. Majority of the cited reviewed studies did show a higher use of substances among male than females as seen in the current study. This gender difference in the substance use may be as a result of soaring freedom of movement and association grounded in culture among male. The findings also revealed that alcohol followed by tobacco were the commonest used substances which are comparable to other studies by [13] [14]. In the present study, it was not surprising that all users of tobacco products were male because in African culture especially in Nigeria, there is cultural stigma associated with female smoking cigarette. The society regards female smokers as prostitutes who lack moral upbringing.

4.2. Consequences of Substance Use in Adolescents among the Community Residents

The findings from the interview on mental illness revealed that 90% of the par-

ticipants were of the opinion that mental illness is the major consequence of substance use. Reviewed literature shows that psychoactive substance users have physical, physiological, psychosocial and psychiatric problems [15]. There is significant evidence that teenagers who use substances are more likely to develop substance use disorders and psychiatric illnesses as adults [16]. Early alcohol and cigarette use has been linked to a higher chance of school failure, poor academic progress, and school dropout, according to research [17]. This study shows that all participants strongly believed that loss of potentials and involvements in serious crimes were the consequences of substance use.

This is true because, illegal drug use have been associated with criminal behavior among adolescents [18].

4.3. Opinions Regarding Approaches for the Prevention of Substance Use in Adolescents

Proper parenting, school-based treatments, and community-based interventions were the most commonly identified techniques in the prevention of substance use in adolescents. It is important to stress that, regardless of the technique taken, early detection, awareness and prevention programmes, and routine monitoring of adolescent health should all be prioritised. Given the prevalence and impact of substance use among children and adolescents, it is critical to identify and implement effective interventions and delivery platforms aimed at improving social skills, problem-solving skills, and self-confidence [19]. A number of these health-related activities are tracked by school-based surveys of teenagers in diverse settings. Through family, school, and community prevention programmes, the focus should be on modifiable risk factors and improving protective factors [20]. The many forms of prevention programmes can be implemented through school, community, and health-care systems, with the main goals of case discovery, referral, and treatment, or risk factor reduction [21].

4.4. Catalyze the Involvement of Community Residents in the Development of Prevention Action Plans for the Adolescents

In the quest to collect meaningful information on how best to develop effective prevention actions plans for adolescents, the participants made meaningful suggestions on local challenges to substance use amongst which include growing of weeds, community existential discordance and lack of information regarding drugs.

This is a very important finding that is yet to receive further empirical support. This is because studies have shown that the prevalence of substance abuse is quite high in African, especially in Nigeria [22] [23] but none have delved deeply into identifying challenges such as living with the cause of the problem. Living or having adapted selves to the cause is an enormous challenge because it would require a self-made decision for someone to quit the act of substance abuse in such situation. That is to say that any external body trying to tackle it may achieve only little success as the people already know the nooks and cran-

nies of where to locate substances easily as it is grown within the community. [24].

However, the United Nations Office on Drugs and Crimes [25] identified that the type of drugs that are used by a person may be influenced by the availability and price. Given that substances are readily available so using or avoiding substances solely or partly depends on self-made decision. This argument draws support from two constructs in the self-efficacy theory: use self-efficacy and refusal self-efficacy. Ajzen in the theory posited that the use self-efficacy comes into play when people abuse substances because they know where to obtain and how to use them while the refusal self-efficacy represents beliefs in one's ability to resist the pressure to abuse despite having access to it.

There have been series of inter-community war among the people in the time past which has drawn national notice but no study has linked it to substance abuse. Community unrest is capable of perpetrating substance use because during such periods, many things happen without people noticing, as attention is occupied by other factors linked to safety and survival. It is worthy to note that in such times, panic and anxiety are inevitable and some use substance with the expectation that it would put anxiety under control and keep their nerves calm. More so, most of the people at the forefront of such unrest are youths and some use substance to remain "high", alert, or unusually active as they claim it energizes them. This is not surprising in comparison with findings from other studies [23] [26] [27] who found out that among the reasons why youths abuse substances were to keep awake, feel high, curiosity, peer influence and for experimentation. On the other hand, these substances may be provided by the supporters of the conflicting group as a way of showing solidarity. So discordance opens a lot of doors of availability of substances to users and non-users.

Lack of information is pointed out, both the part of the adolescents and their adult parents. Information here include information related to harmful effects of these substances and knowledge of who uses substances or not on the part of the parents; information on how to identify who abuses it, even when to expect that one may be prone to using substance. Some parents have failed to appreciate the change that accompanies migration from childhood to adolescence, and as a result they still perceive their young ones as though they were kids. Some adolescents are therefore, left to struggle with all the pressures from peers and other sources alone without the support of their parents. This explains why many youths do not know the implications of using substance because no one has told them. It is costly to assume that they already know from their studies in school or their personal readings because such topics may not featured in their curriculum at primary or secondary school level when it is reported many of them initiate the use of harmful drugs. According to a study [25], the start age of substance abuse in Nigeria is 10 years. At this age, most people are in their primary or secondary level of education. Although available studies showed that young people are very knowledgeable about the implications of substance abuse, those studies were conducted in countries such as United Arab Emirates, Jordan, and

Lebanon which are dissimilar to Nigerian setting development wise.

Majority of the participants were of the opinion that community should adhere to the increasing knowledge of complications of substance use among adolescents. This is because, in many communities, culture largely predicts the extent of what defines acceptable foods and drinks, be it on daily basis or on special occasions [28], and traditional cultural practices in the community serve as fertile grounds for initiation into drugs [29]. An early analysis of population-adjusted effectiveness of substance addiction prevention programmes identified universal, selected, and recommended treatments [30]. Individuals who are already using substances but have not developed a substance use disorder are targeted by universal interventions, which are directed at all members of a given population (for example, all children of a certain age); selective interventions, which are directed at a subgroup determined to be at high risk for substance use (for example, justice-involved youth); and indicated interventions, which are directed at individuals who are already using substances but have not developed a substance use disorder. Communities must select between these three forms of preventive measures, but no ideal mix has yet been identified by research. Communities may believe it is appropriate to limit assistance to people who are most at risk and have the least protection, or to those who are already abusing substances.

For the preventive action, the participants made valuable suggestions which generated into a theme and three elements which include: 1) leveraging on organized gatherings, 2) parental involvement and 3) reduction in the availability of substances in the community. Majority of the participants were of the opinion that effort to reduce availability of substance in the community (such as monitoring the production, sale, importation and exportation of such substances) through these elements will go a long way in reducing its consumption among the adolescents. There is considerable empirical evidence supporting the effectiveness of prevention programmes and policies focused at preventing the initiation of substance use during adolescence, which is consistent with earlier research [31]. Such programmes should be integrated to foster cooperation among all parties involved, include a wide range of appropriate interventions, promote health and social well-being among individuals, families, and communities, and reduce the negative effects of drug abuse on individuals and society as a whole. However, there are obstacles that could jeopardize this accomplishment [32] identified a number of factors that may influence adolescent substance use including the parent-adolescent connection, peer pressure, drug accessibility, religion, and others, to which communities must respond. In addition, the study rightly pointed out the crucial role of education in combating the identified challenges. Information is power and providing the right information by the right people timely enough to the people who need it is empowering. Both the young one and their parents need the empowerment and the best approach to reach them must be adopted. The settings where the people concerned could be

reached are already established; the primary schools and meeting grounds for parents and youths to capture those that are not in school. To succeed with the schools, the concept of substance abuse must be integrated into the academic curriculum at primary and secondary level. By so doing, young ones will get timely information on the topic. This will resultantly strengthen their resistance to external pressures. For the parents, the women's annual meeting and other similar meetings such as the end of the year community meetings by men and women would be a good platform to engage parents in such tutelage. With information broken down to its simplest form, a good result would be achieved.

In effort to ensure sustainability of the developed action plans, most of the participants suggested the need for monitoring any project to be carried out. Peer educators in various schools will be closely monitored by the guidance counselors in order to keep idea alive. Because the benefits of drug education may be minor compared to the cost-effectiveness of preventative programmes, the cost-effectiveness estimates are fair. However, drug treatment is clearly more cost-effective than prevention or drug law enforcement. Despite its benefit, there is need for constant monitoring and evaluation of such program because, it helps to make decisions.

The role of parental involvement in the prevention and control of substance abuse cannot be exaggerated. Parents are supposed to be the closest relatives of these young ones and are in a better position to identify any change easily. At attainment of adolescence, the tendency is for the young one to drift apart from their parents as they struggle for independence, if care is not taken. Parents should therefore be totally involved in the rearing of their children. In essence, their input should not be limited to home training and minding academic performance alone; it should extend to getting involved in what happens outside home in the lives of their children, getting acquainted with their friends, etc. Here, the researcher is not suggesting assuming the position of a spy but a very friendly and supportive position that will break every barrier in communication and pave way to sharing of fears and challenges.

Policies are developed at any level and can be monitored at any level. Development and monitoring of local policy in the community on substance use prevention will achieve greater followership as the community will have the ownership of the policy. Existing policies in educational curriculum can be reviewed and streamlined to define specific guidelines for substance use prevention among adolescents with the involvement of the communities.

5. Conclusion

From the study findings, the following conclusion was drawn—that substance use is a reality in the community studied and the community stake holders are aware of major problems of substance use. The study further showed that adolescent substance use prevention policies in the local community have a strong potential in promoting mental health and preventing mental disorders associated with substance use.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Health Workers' Preparedness towards Integrating Mental Healthcare into Primary Health Settings: Evidence from Nigeria

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Abstract

Background: The global drive to scale up mental health services and eliminate the treatment gap requires incorporating mental health services into primary health care (PHC). Primary health care provides comprehensive, continuous, and coordinated care and if need be provides referrals to higher levels of care. However, for these services to meet the basic objective of PHC, it is necessary to determine healthcare workers' preparedness for caring for the mentally ill. Therefore, this study aimed to examine health workers' preparedness for integrating mental healthcare into primary settings in a rural community in Nigeria. **Methodology:** A descriptive research design was used to conduct the study among all 215 primary healthcare workers within Nkanu West Local Government Area (LGA). The instrument for data collection was a structured questionnaire constructed by the author. A pilot study was conducted on 10% of the sample population. Cronbach's Alpha formula was used to estimate the reliability coefficient (0.85). The collected data were analysed with descriptive statistical frequencies and percentages. **Results:** Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 20. Findings show that healthcare workers' preparedness to care for the mentally ill at the primary healthcare centre is quite low. It was also found that mental illness is still shrouded by stigma as a result of poor awareness. Consequently, there is still a persistent pervasive belief system that Mental illness is a form of retribution from the gods for one's wrong deed in the study area. **Conclusion:** It was concluded that few of the respondents were prepared for the care of the mentally ill which might be a result of poor awareness about mental health and the negative stereotype given about mental health. From the analysis, it can be deduced that health workers exhibit some degree of positive attitude towards care of the mentally ill, though, mental illness is associated with stigmatization due to a lack of public understanding of mental disorders.

There was strong support for integrating mental health into primary health care by health care providers. Therefore there is a need for community education and building of the capacity of healthcare workers for integration of the care of the mentally ill to be feasible in PHC centres.

Keywords

Mental Health, Primary Healthcare, Health Workers, Stigma

1. Introduction

Mental, neurological, and substance-use (MNS) disorders are extremely common worldwide [1] [2]. Untreated mental diseases represent 13% of the worldwide disease burden, with the treatment gap being highest in poor and middle income nations [3]. Mental diseases also account for 7% of the global burden of disease assessed in disability-adjusted life-years (DALYs) and up to 19% of all years lived with disability [4]. As a result of the aforementioned, MNS are substantial contributors to disease, untimely death, and disability throughout the world [5]. They're also regularly linked to social stigma and human rights violations, especially in low- and middle-income nations (LMICs).

Despite this, treatment care for MNS still lags behind LMICs, especially in Africa. According to the WHO's World Mental Health Survey, the treatment gap for serious mental disorders in those climes has been estimated to be up to 75% [6]. According to Espinosa-Jovel, Toledano, Aledo-Serrano, García-Morales, and Gil-Nagel [7], over 80% of people with epilepsy live in LMICs, and about 6 out of 10 do not receive any therapy. By 2050, "substantial population growth and aging are expected to result in an estimated 130 percent rise in the impact of mental and drug use disorders" in Sub-Saharan Africa [8]. The situation is even more alarming in a highly populated African country like Nigeria. Only 20% of patients with very common mental disorders in the country received treatment in the previous year, and even when they did, it was frequently below basic ethical and clinical standards [6] [9].

No doubt, the society faces grave consequences from the lack of available mental health professionals especially doctors and nurses to render the needed services [10]. This emphasizes the need to expand mental health services, particularly in low- and middle-income countries (LMICs), to enhance access to care. On the other hand, efforts to expand mental health support in LMICs must struggle with a current scarcity of mental health specialists and health facilities capable of providing specialized care for mental, neurological, and substance use disorders (MNS).

As part of the global drive to scale up mental health services and eliminate the treatment gap, incorporating mental health services into primary health care has been identified as the most practicable strategy to enhance access [11]. Primary

health care (PHC) is a community-based management method for providing healthcare services. Primary health care provides care at the point of contact for people with health problems, as well as comprehensive, continuous, and coordinated care and rapid referrals to higher levels of care. Various countries have made different amounts of progress in implementing the notion since it was first published in 1978 [12].

However, in the majority of LMICs, this expectation is rarely met when it comes to MNS problems in primary care. The sophistication of PHCs in dealing with health care challenges at the grassroots level implies that mental health services could be delivered by health services providers close to them in the community rather than the tertiary approach that relies solely on professional psychiatrists. This way, the PHC model easily comes into play.

Primary healthcare is required to provide first contact and, in addition to providing comprehensive, ongoing, and coordinated treatment for people with health problems, it should also demonstrate the ability to refer patients to a higher level of care quickly. However, in the majority of LMICs, this expectation is rarely met when it comes to MNS problems in primary care. Although some reasons have been advanced, such as poor training of primary care providers, a lack of support and supervision, and uncoordinated referral pathway through the multiple levels of the health service, and policy neglect manifesting itself in the form of poor financing, infrequent supply of medications for MNS conditions, and weak health systems [13]. There is however a need for context-specific empirical evidence to inform policy and plan of action towards integration of mental healthcare into PHC. Therefore, the study aimed to determine the healthcare workers' preparedness for the care of the mentally ill, the knowledge of the care of the mentally ill among health workers, the attitudes of health workers towards mentally ill patients, and the health workers' perception of integrated mental healthcare.

2. Methodology

2.1. Design

The descriptive survey research design was used as it explains in detail the characteristics of the study phenomenon in a given setting and accurately unveils information about the study as it appears without manipulation.

2.2. Setting

The study setting was Nkanu West Local Government Area in Enugu State. Enugu State, historically known for its coal deposits that attracted miners and others is a major city in South Eastern Nigeria. The state is pivotal in the South Eastern part of Nigeria, with its major city, Enugu, having historically borne an identity as the capital city of the then Eastern Region, East Central State, old Anambra State and present Enugu State. Nkanu West is one of the suburban/rural local governments in the eastern part of Enugu.

2.3. Population and Sample

All the 226 health workers who consented to the study in the study setting were enrolled. This was possible because of the relatively small population. It has been opined [14] that all respondents can be and should be included in small populations.

2.4. An Instrument for Data Collection

The instrument for data collection was a structured questionnaire developed by the researcher. The instrument was made up of closed-ended questions. Items of the instrument were generated based on the set objectives of the study. The questionnaire is comprised of four sections. There were five demographic questions about the participants in section A, and there were eleven preparedness questions regarding how to care for people with mental illnesses and sources of information in Section B, Section C and D, cover attitudes toward people with mental illnesses and perceptions of the integration of mental health treatment into PHC, had 10 and 9 items, respectively. The main items had a Likert scale rating ranging from 4 to 1. Four (4) respondents strongly agreed, three (3) agreed, two (2) agreed, and one (1) disagreed (D). Based on predetermined goals, the instrument's psychometric qualities were evaluated for face and content validity. A Cronbach's alpha coefficient of 0.85 was obtained, indicating that the instrument had very high dependability.

2.5. Data Collection

Before data collection, approval and administrative permit were obtained from Nkanu West LGA Secretariat and the head of PHC's that participated in the study. Informed consent was obtained from the respondents before the administration of the questionnaires. Data were collected through the use of a pretested questionnaire, copies of which were distributed to the health workers in their workplaces but in between shifts or at the end of work to avoid interrupting their jobs. Data collection lasted for three weeks.

2.6. Data Analysis

Basic descriptive statistics of frequency and percentages were used to analyse and present the data collected. The variables that informed the basis of data collection include: PHC workers' level of preparedness of care for mentally ill persons, source and knowledge of care of the mentally ill persons, as well as attitudes and perceptions of PHC workers towards mentally ill persons were presented in tables.

3. Results

Of 226 distributed questionnaires, two hundred and fifteen (215) were correctly completed giving a 95% return rate. The majority of the participants (46%) were in the age range of 50 years and above while the age 39 and below are the lowest

in the population. Based on the highest academic qualification, a preponderant (48%) showed that the majority of the participants were Diploma holders. Those who had 16 years of working experience (32%) were higher than other categories.

3.1. Reported Preparedness for the Care of the Mentally Ill at the PHC Level

The findings of the study showed that respondents' reported preparedness/ ability for the treatment of mentally sick people at the PHC level is not very high. An average item-by-item mean of 1.65 on a four-point scale is low, indicating self-reported inability or poor preparedness of the primary health workers to care for the mentally ill at the PHC. From **Table 1**, 17.2% of the respondents agreed that community-based child mental health care training they received was sufficient to enable them to practice in PHC, 20.9% agree that they were aware of referral protocol for mentally ill patients. A proportion of 9.3% agreed that they had received some training on the assessment of mentally ill patients, whereas 13% agreed that they were particularly trained to identify patients with mental health problems. Among the respondents also, 11.1% agreed that they had adequate occupational mental health training skills; 17.2% indicated that the kind of training skills they had acquired prepared them for MHC; and 16.7% agreed that they were adequately trained for drug prescription for the mentally ill in the community settings. On the adequacy of clinical care for mentally ill patients, 21.8% of the respondents answered in the affirmative. 15.3% agreed that they could provide counselling services for the mentally ill, while 19.6% indicated that they were disposed to providing therapies for a family of the mentally ill (**Table 2**).

3.2. Sources of Knowledge for Mentally Ill Care

The results, reported in **Table 3**, indicate that the respondents acquired their knowledge of mentally ill care from diverse sources. Up to 30.2% reported that they acquired such knowledge were seminars/Workshop/Conferences, 47.9% from classroom lectures were their source and 26.9% from personal experience. Other sources of information about mentally ill care, according to the respondents, proportionately include 30.7% from the textbook, 37.7% from social media networks, and 67.9% from educational articles.

3.3. Attitudes of Health Workers towards Mentally Ill Patients

Table 4 below reported the respondents' reactions to their attitudes toward mentally ill patients. Of the 215 total respondents, 33.4% agreed that they were afraid of caring for the mentally ill, while 42.7% consented to non-stigmatize against the mentally ill. Notwithstanding, 6% agreed that they would detest caring for the mentally ill. 45.1% responded that they would not discriminate against the mentally ill, but 45.5% said that they would not have a restricted at-

titude toward the mentally ill. 25.1% agree that they will feel comfortable caring for the mentally ill and 17.6% agree that it is strange having contact with the mentally ill. On their receptiveness to mentally ill care training, 42.3% agreed that they would be willing to undergo training on MHC to prepare me for the care of the mentally ill; and 39% confirmed that they were happy with integrating into PHC even without undergoing further training.

From **Table 5** below, the findings of the study reveal that 41.3% of the respondents posited that PHC workers were not adequately trained for mental health care, 14.8% agree that mental health care is solely the responsibility of the specialist mental health facilities, and 30.2% agreed that there exist lack of human resources and workforce in PHC to accommodate MHC. Among them, 11.6% agreed that there was no need for the training of PHC workers on MHC; 35.8% agreed that financial resources for the care of the mentally ill would be a major barrier, and 33% agreed that community awareness of the treatment of mental illness was a major barrier. 41.3% agreed that mental illness was associated with stigmatization due to a lack of public understanding of mental disorders; 46% indicated that they needed basic training to improve their expertise and abilities in the field of mental health care, and 37.2% believed there was insufficient government commitment for incorporating mental health into primary care.

Table 1. Socio-Demographic data.

Characteristics	Frequency	Percentage
Age (years)		
50 and above	99	46
40 - 49	71	33
39 and below	45	21
Gender		
Male	17	8
Female	198	92
Highest Educational Qualifications		
B.Sc	19	9
Diploma	189	88
Masters and above	7	3
Years of experience		
Less than 5 years	12	6
6 - 10 years	50	23
11 - 15 years	62	29
16 years-above	91	32
Training on mental health		
Yes	3	1
No	212	99

Table 2. Preparedness for care of the mentally ill as perceived by primary healthcare workers.

Indicate if you received any of the following training listed below	SA	A	D	SD	Mean \pm SD
I received Community-based child mental health care training sufficient to enable me to practice in PHC.	19 (8.8%)	37 (17.2%)	78 (36.2%)	81 (37.8%)	2.04 \pm 0.98
I am aware of the protocol for mentally ill patients.	28 (13%)	45 (20.9%)	72 (33.4%)	70 (32.7%)	2.33 \pm 0.87
Training on assessment of mentally ill patients have been undertaken by me.	35 (16.2%)	20 (9.3%)	95 (44.1%)	65 (30.4%)	1.34 \pm 0.73
I am trained to identify patients with mental health problems.	42 (20.9%)	28 (13%)	84 (39%)	61 (27.1%)	1.22 \pm 0.56
I have adequate occupational mental health training skills.	38 (17.6%)	24 (11.1%)	91 (42.3%)	62 (29%)	1.54 \pm 0.77
The kind of training skills i have acquired prepared me for MHC.	25 (11.6%)	37 (17.2%)	84 (39%)	68 (32.2%)	1.32 \pm 0.65
I can provide adequate clinical care for mentally ill patients.	19 (8.8%)	47 (21.8%)	65 (30.2%)	84 (39.8%)	1.84 \pm 0.88
I can provide counselling services for the mentally ill.	27 (12.5%)	33 (15.3%)	77 (35.8%)	78 (36.4%)	2.13 \pm 0.76
I can provide therapies for families of the mentally ill.	35 (16.2%)	42 (19.6%)	61 (28.3%)	77 (35.9%)	1.34 \pm 0.73
I am adequately trained for drug prescription for the mentally ill in the community settings.	29 (13.4%)	36 (16.7%)	55 (25.5%)	95 (44.4%)	1.43 \pm 0.86

Table 3. Sources of knowledge of care of the mentally ill among health workers.

My source of knowledge of care of the mentally ill include the following	Frequency	Percentage (%)
Seminar/Workshop/Conferences	65	30.2 (%)
Classroom Lectures	103	47.9 (%)
Personal Experience	58	26.9 (%)
Textbook	66	30.7 (%)
Social media network	81	37.7 (%)
Published educational article	146	67.9 (%)

Table 4. Attitudes of health workers towards mentally ill patients.

To what extent do you agree or disagree with the following statement	SA	A	D	SD	Mean \pm SD
I am afraid of caring for the mentally ill.	85 (39.5%)	72 (33.4%)	24 (11.1%)	34 (16%)	2.11 \pm 0.88
I will not stigmatize the mentally.	74 (34.4%)	92 (42.7%)	11 (5.2%)	38 (17.8%)	2.33 \pm 0.89
I detest caring for the mentally ill.	11 (5.1%)	13 (6.0%)	80 (37.2%)	¹¹¹ 51.7%)	1.53 \pm 0.76
I am willing to accept undergoing training on MHC to prepare me for the care of the mentally ill.	87 (40.4%)	91 (42.3%)	24 (11.1%)	13 (6.2%)	1.32 \pm 0.76
I am happy with integrating into PHC even without undergoing further training.	71 (33%)	84 (39%)	35 (16.2%)	25 (11.8%)	1.54 \pm 0.77
I will not discriminate against the mentally ill.	85 (39%)	97 (45.1%)	14 (6.5%)	19 (8.9%)	2.12 \pm 0.85
I will not have restricted behaviour toward the mentally ill.	67 (31.1%)	98 (45.5%)	38 (17.6%)	12 (5.8%)	1.74 \pm 0.89
I have a tolerant disposition towards the mentally ill.	84 (39%)	65 (30.2%)	37 (17.2%)	29 (13.6%)	2.33 \pm 0.76
I will feel comfortable caring for the mentally ill.	51 (23.7%)	54 (25.1%)	49 (22.7%)	61 (28.5%)	1.74 \pm 0.73
It is strange having contact with the mentally ill.	14 (6.5%)	38 (17.6%)	84 (39.0%)	79 (36.9%)	1.43 \pm 0.86

Table 5. Health workers' perception of the process for integrating mental healthcare into primary health care settings.

What do you think about integrating PHC in the care of mentally ill patients?	SA	A	D	SD	Mean \pm SD
PHC workers are not adequately trained for mental health care.	74 (34.4%)	89 (41.3%)	22 (10.2%)	30 (14.1%)	1.99 \pm 0.58
Mental health care is solely the responsibility of the specialist mental health facilities.	41 (19%)	32 (14.8%)	84 (39%)	58 (27.2%)	2.13 \pm 0.84
There is a lack of human resources and workforce in PHC to accommodate MHC.	80 (37.2%)	65 (30.2%)	34 (15.8%)	36 (16.8%)	2.34 \pm 0.93
There is no need for the training of PHC workers in MHC.	14 (6.5%)	25 (11.6%)	91 (42.3%)	85 (39.6%)	1.52 \pm 0.56
Financial resources for the care of the mentally ill will be a major barrier.	75 (34.8%)	77 (35.8%)	42 (19.5%)	21 (9.9%)	1.64 \pm 0.77
Community awareness of the treatment of mental illness is a major barrier.	84 (39%)	71 (33%)	14 (6.5%)	46 (21.5%)	2.32 \pm 0.75
Mental illness is associated with stigmatization due to a lack of public understanding of mental health disorders.	91 (42.3%)	89 (41.3%)	18 (8.3%)	17 (9.1%)	1.64 \pm 0.78
Basic training is required in order for me to improve my knowledge and skills in providing mental health care.	81 (37.6%)	99 (46%)	11 (5.1%)	24 (11.3%)	2.13 \pm 0.76
There is no strong government support for integrating mental health into a primary health care setting.	79 (36.7%)	80 (37.2%)	25 (11.6%)	31 (14.5%)	1.34 \pm 0.73

4. Discussion

As evidenced in the results of this study, less than 20% of the participants consented to the position that they had sufficient community-based child mental health care training, awareness of referral protocol for mentally ill patients, and assessment of mentally ill patients have been undertaken by them, identifying patients with mental health problems, adequacy of occupational mental health training skills, and preparedness for MHC. The findings also imply that there is a lack of awareness regarding mental health and the prejudice that comes with it. Within the context of this study and in line with the position of Abimbola [15], there is still a pervasive belief system that mental illness is a form of retribution from the gods for one's the wrong deed thus they try as much as possible to avoid contact with such person. The outcome of the work is in line with a study [16] in which health workers were observed to have very poor knowledge of depression. The work is equally in tandem with the work of Abera, Tesfaye, Belachew, and Hanlon [17] where the participants were found to have poor knowledge of mental illness (23.4%). Yet, this disagrees with realities found in other parts of the world like Australia [18]. The implication is that developed countries are more knowledgeable about mental illness.

Analysis revealed that the major source of the respondent's knowledge of mental health was published educational articles, classroom lectures, social media networks, seminars and personal experience. Published educational articles are reliable means of circulating medical information. Classroom lectures and

social media are equally other powerful means of circulating information which might be responsible for the study outcome. The result of the study is in line with the report by Gureje, Abdulmalik, Kola, Musa, Yasamy and Adebayo [3] where social media and published educational articles were found to be the major sources of awareness of mental health. The study is equally in line with related studies [19] [20] where seminars and manuals were reported as the major source of the respondent's knowledge of mental illness respectively. The study thus indicates that such knowledge sources as in-service training are conspicuously missing.

A greater number of the study participants have favourable attitudes towards the mentally ill for instance 39% and 45% strongly agree and agree that they will not discriminate against the mentally ill. This might be a result of the awareness some have concerning mental illness. It might equally be a result of knowledge gained through experiences acquired over years of nursing practice. The findings are similar to a study that investigated attitudes regarding mental health and the incorporation of mental health support into primary health care in Cambodia's Lave En District [21]. Approximately 81 percent of those polled said they were personally interested in providing mental health care in their units. Similar optimism was recorded among nurses rendering care to remote communities of Australia [22]. In a study that investigated the perceived barriers and opportunities associated with integrating mental health into primary care in south-west Ethiopia [17], almost all PHC employees in their survey said mental health treatment was important in Ethiopia, and the proportion of the respondents said they wanted to give mental health care. Contemporaneously, a good number of study participants have negative attitudes toward the mentally ill and this will have a substantial effect on the care they will render irrespective of their knowledge base. As revealed, 39.5% and 33.4% strongly agreed and agreed that they'll not be comfortable caring for the mentally ill while 22.7% and 28.5% affirmed that they are afraid of caring for the mentally ill.

It is general knowledge that lowering stigma and promoting human rights for persons with mental illnesses could go a long way toward improving the quality of life of those who suffer from mental illnesses. Yet study reveals that about a third to a half of the respondents still perceived that lack of community awareness and stigmatization of the mentally ill as a major barrier to the achievement of the successful integration of the mentally ill. Also, approximately half of the respondents perceived that they require basic training, adequate staffing and improved Government support to provide health care to those who are suffering from mental illnesses. The findings matched a study that investigated public health professionals' opinions of mental health programs in Equatorial Guinea, Central-West Africa [23]. According to those interviewed, the current mental health system does not match the demands of the community. Professionals cited infrastructure capacity, stigmatization, and a lack of other resources such as training programmes, knowledgeable staff, medications, and data as key fac-

tors limiting the efficacy of mental healthcare [20] [24].

5. Conclusion

Evidence from this study supports that there is a need for community education and the building of capacity of health care workers for integration of the care of the mentally to be feasible in PHCs. The major source of the respondent's knowledge of mental health was published educational articles hence a reliable means of circulating medical information. Meanwhile, classroom lectures and social media were equally other powerful means of circulating information and thus might be responsible for the outcome. In addition, the study aimed to determine the attitudes of health workers toward mentally ill patients. From the analysis above, it can be deduced that health workers exhibit some degree of positive attitude towards the care of the mentally ill. This might be as a result of the awareness some have concerning mental illness and as a result of knowledge gained while in school or experience gained over the years of practice. Finally, the researchers investigated how health care providers felt about the process of integrating mental health care into primary care settings. Due to a lack of public knowledge of mental diseases, mental illness is related to stigmatization. This means that there is a need to deepen the knowledge and information access of mentally ill care providers to ensure that they are abreast with evolving techniques and relevant evidence. Care providers expressed significant support for incorporating mental health within primary health care, which would help to reduce stigma and promote human rights for persons with mental health concerns. Basic training for mental health care providers is required to improve their knowledge and skills.

6. Limitation

The self-reported surveys utilized in the study had a propensity to underestimate reality, particularly in issues involving substance use among adolescents, however, the instrument had adequate face validity was acceptable reliability.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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The Impact of the FreeStyle Libre™ Flash Glucose Monitoring System on Glycemic Control in Patients with Diabetes; Observational Multicenter 15-Months Study

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Abstract

Objectives: The study was to determine the impact of using the FreeStyle Libre™ flash glucose monitoring system on glycemic control and the rate of events due to diabetes in people with diabetes from different types and age groups. **Methods:** a retrospective cohort chart review study was carried out at three centers in the Taif region in the Kingdom of Saudi Arabia: The study was approved by an accredited centralized institutional review board. Paper or electronic medical records were included for individuals of any age with diabetes (type 1, type 2, gestational diabetes) managed with diet, insulin therapy, or/and oral antihyperglycemic medication and/or non-insulin injection therapy. The primary outcome measure was the laboratory HbA1c level as well as reduction. Secondary outcome measures were frequency of severe hypoglycemia, admission to hospital or ER visit related to diabetes complications, and severe hyperglycemia (DKA or HHS). **Results:** Data was analyzed from 1695 patients. The average HbA1c before using the flash glucose monitoring system was 9.60% ± 1.44% and 3 months HbA1c after using the FreeStyle Libre™ flash glucose monitoring system was 8.70% + 1.45% for a difference of -0.90% ([95% CI -0.92; -0.88]; p < 0.0001). The 6 months HbA1c was 8.17% + 1.53% for a difference of -1.47% ([95% CI -1.50; -1.44]; p < 0.0001). The 12 months HbA1c was 7.87% + 1.56% for a difference of -1.85% ([95% CI -1.88; -1.81]; p < 0.0001). There was a highly significant reduction in HbA1c over time after using the flash glucose monitoring system. The reduction in HbA1c is consistent among all subgroups; namely GDM on a diet,

GDM on insulin, type 1 adult, type 1 children, type 1 pregnant women, type 2 on a diet, type 2 on OAD, type 2 on basal insulin plus OAD, type 2 on multiple-dose insulin, and type 2 pregnant women, obese, non-obese, males, females, age group < 65 & age group > 65 years, (p-values < 0.001). Severe hypoglycemia 3 - 6 months before using the flash glucose monitoring system was 9.56 ± 1.73 versus 0.52 ± 0.50 in the last six months of the study (p-value < 0.001). Hyperglycemic hyperosmolar state or diabetic ketoacidosis 3 - 6 months before using the flash glucose monitoring system was 7.40 ± 2.26 versus 0.49 ± 0.50 in the last six months of the study (p-value < 0.001). Emergency room visits & hospital admissions due to diabetes complications 3 - 6 months before using the flash glucose monitoring system were 1.98 ± 0.81 versus 0.49 ± 0.50 in the last six months of the study (p-value < 0.001). **Conclusion:** The benefits of using the FreeStyle Libre™ flash glucose monitoring system are self-evident in reducing HbA1c and events due to hyperglycemia or hypoglycemia.

Keywords

FreeStyle Libre™ Flash Glucose Monitoring System, Diabetes, HbA1C, Hypoglycemia, Diabetic Ketoacidosis, Hyperglycemic Hyperosmolar State

1. Introduction

By the year 2040, the worldwide prevalence of diabetes mellitus (DM) is expected to be above 9.5%, with a total number of more than six hundred Million [1]. Also, the prevalence of DM is escalating rapidly in the Kingdom of Saudi Arabia (KSA), accompanied by the consequent over-exhaustion of the resources related to the healthcare system [2].

At the end of the second decade of the third Millennium, the American Diabetes Association (ADA) thought up and published its first endorsement for the term time-in-range (TIR) to guide those who are responsible for diabetes management as well as individuals with DM, achieve better control of the blood glucose level by the employment of the continuous glucose monitoring (CGM) systems [3] [4].

FreeStyle Libre™ flash glucose monitoring system (FGM), a new technology for generating continuous glucose data including estimated HbA1c, TIR, time below range (TBR), and time above range (TAR), was developed for facilitating technology access to diabetes management. The essence of the flash glucose monitoring system lies in its ability to generate and analyze the dense glucose data generated by the system in a user-friendly way. The collection of the data has also been simplified to a quick scan of the sensor with the reader [5]. Hence, a panel of diabetes experts from the KSA published their consensus on using standardized reporting and TIR in the management of DM cases. They recommended the use of such technology and analyzed data by using the internationally recommended standardised CGM metrics [6].

Therefore, the rationale behind carrying out the current study was to assess

the outcomes of the utilization and introduction of the flash glucose monitoring system on glycemic control as well as the DM events (hypoglycemia, HHS, DKA).

2. Patients and Methods

The current observational retrospective cohort non-interventional single-arm chart review study was carried out at three hospitals in the Taif region in KSA: Alhada Armed Forces hospital, Prince Mansour Military Hospital, and Prince Sultan Military hospital.

The study was conformed to the 2011 Declaration of Helsinki principles and the Good Pharmacoepidemiology Practices (GPP) guidelines. The study was approved by an accredited centralized institutional review board, and informed consent was not required.

The three centers each conducted a database search for potential patients' records for two years, from June 2019 until Jun1 2021, to be included in the study. Paper or electronic medical records were included for individuals of any age with diabetes (type 1, type 2, gestational diabetes) managed with diet, insulin therapy, or/and oral antihyperglycemic medication and/or non-insulin injection therapy.

In accordance with the Health Insurance Portability and Accountability Act (HIPAA) privacy rule, data extracted from the charts were HIPAA de-identified (anonymized) [7].

For inclusion in the analysis of this study, individuals of any age or gender, or type of diabetes should have been using the flash glucose monitoring system (Abbott Diabetes Care, Alameda, California, USA) for at least three months when the data were collected, and HbA1c measurements should be recorded for the last 3 - 6 months before using the technology.

The definition of a baseline HbA1c was a result recorded 3 - 6 months before device use commenced. If additional baseline HbA1c measurements were available, the one nearest to the index date was used. The definitions of follow-up HbA1c measurements were those of 3 months, six months, and 12 months after using the flash glucose monitoring device. All HbA1c measurements used in the analysis had been recorded in the medical records and were from a laboratory test.

In addition to baseline HbA1c concentrations, the study centers also extracted information that had been recorded in the medical records prior to initiation of the device used for age, gender, obesity, type of diabetes, duration of diabetes, insulin, oral hypoglycemic drugs (OADs), frequency of self-monitoring of blood glucose (SMBG), frequency of severe hypoglycemia, admission to hospital or emergency department visit related to diabetes and severe hyperglycemia (DKA or HHS). Also, the change in glucose metrics time in range (TIR), time below range (TBR), and time above range (TAR), as well as the frequency of scanning, were collected for the period after using the flash glucose monitoring device.

2.1. Outcomes

The primary outcome measure was the change in laboratory HbA1c level. Secondary outcome measures were assessing the frequency of severe hypoglycemia,

admission to hospital or ER visit related to diabetes complications, including severe hyperglycemia (DKA or HHS). Analysis of the primary end-point was also performed for the subgroups: age (<65 and \geq 65 years), gender, obesity, and type of diabetes.

2.2. Statistical Analysis

To detect a change in HbA1c of 0.35% with a power of 80% (at $p < 0.05$), based on an SD of change in HbA1c of 1.1% [8], the sample size required is 141. To allow for subgroups analyses by type of diabetes with different treatment regimens (10 groups) more than 1410 subjects are needed.

A paired t-test was used to assess differences between HbA1c measurements before and after the patients started to use flash glucose monitoring device. Subgroups were compared using paired t-test in each group on baseline HbA1c. All statistical tests were carried out using a significance level of 95%. A value of $p < 0.05$ was considered statistically significant. SPSS software (Statistical Package for the Social Sciences, version 25.0, SSPS Inc, Chicago, IL, USA) was used for the statistical analyses. Data was presented as (mean \pm SD) for continuous variables after testing for normality of all variables; all of them were normally distributed. Frequency & percentage were used for categorical variables.

3. Results

A total number of 1722 records of individuals with DM at the specified period were reviewed. Twenty-seven cases are excluded because they did not have HbA1c data before using the flash glucose monitoring device (15 records) and lost follow-up after the start of using the flash glucose monitoring device (12 records). Thus, the analysis of this study included 1695 patients where both data were available.

Description of the Included Cohort

According to the eligibility criteria, only 1695 individuals with DM were included in the analysis. Out of all included patients, 966 were females (57.00%), and 729 were males (43.00%). The mean age of cases was 43.7 ± 15.8 years. The mean duration of DM was 15.3 ± 9.8 years. About half of the patients (49.2%) were obese. Type 1 DM cases were 283 (16.70%), gestational diabetes (GDM) 160 (9.44%), and Type 2 DM cases were 1252 (73.86%) of the entire cohort. Further details about the included types of DM according to treatment regimen are shown in **Table 1**.

Glucose profile (HbA1c) before and after the FreeStyle Libre™ flash glucose monitoring device: the overall sample and subgroup analyses

For the primary outcome, the average HbA1c using the flash glucose monitoring device was $9.60\% \pm 1.44\%$, and three months after using the flash glucose monitoring device was $8.70\% \pm 1.45\%$, for a difference of -0.90% ([95% CI -0.92 : -0.88]; $p < 0.0001$). The six months HbA1c after using the flash glucose monitoring device was $8.17\% \pm 1.53\%$ for a difference of -1.47% ([95% CI -1.50 : -1.44]; $p < 0.0001$). The 12 months HbA1c after using the flash glucose monitor-

ing device was 7.87% + 1.56% for a difference of -1.85% ([95% CI -1.88: -1.81]; $p < 0.0001$). There was a significant reduction in HbA1c over time after using the flash glucose monitoring device, as shown in **Table 2** & **Figures 1-3**.

Table 1. Baseline characteristics.

Type of DM	N		Age years		Duration years		Gender				Obesity	
			Mean	SD	Mean	SD	Male		Female		N	%
All	1695	100%	43.7	15.8	15.3	9.8	729	43.0%	966	57.0%	834	49.2%
GDM Diet	63	3.7%	34.0	3.8	0.1	0.0	0	0.0%	63	100.0%	38	60.3%
GDM Insulin	97	5.7%	32.5	3.8	0.1	0.0	0	0.0%	97	100.0%	53	54.6%
T1 Adult	103	6.1%	27.9	6.6	17.6	5.8	36	35.0%	67	65.0%	55	53.4%
T1 Ped	151	8.9%	14.0	2.0	3.0	0.8	72	47.7%	79	52.3%	65	43.0%
T1 Preg	29	1.7%	25.3	1.8	18.3	1.6	0	0.0%	29	100.0%	13	44.8%
T2 BI OAD	314	18.5%	51.2	10.3	20.6	7.0	157	50.0%	157	50.0%	155	49.4%
T2 Diet	54	3.2%	32.3	5.4	1.3	0.5	28	51.9%	26	48.1%	22	40.7%
T2 MDI	293	17.3%	49.1	10.8	19.7	7.2	148	50.5%	145	49.5%	142	48.5%
T2 OAD (2-3)	545	32.2%	53.9	10.8	19.8	7.0	288	52.8%	257	47.2%	278	51.0%
T2 Preg	46	2.7%	31.3	2.9	4.9	0.8	0	0.0%	46	100.0%	13	28.3%

BI = basal insulin, MDI = multiple-dose insulin.

Table 2. Glucose profile and diabetes events pre & post FGM.

HbA1c	Mean	SD	Reduction		95% CI		p-value
			Mean	SD	Lower	Upper	
3 - 6 months pre FGM	9.60	1.44					
3 Months	8.70	1.45	0.90	0.42	0.88	0.92	<0.001
6 Months	8.17	1.53	1.47	0.67	1.44	1.50	<0.001
12 Months	7.87	1.56	1.85	0.70	1.81	1.88	<0.001
Severe hypoglycemia							
3 - 6 months pre FGM	9.54	1.73					
Last 6 Months of study	0.52	0.50	9.02	1.80	8.94	9.11	<0.001
Hyperglycemia							
3 - 6 months pre FGM	7.40	2.26					
Last 6 Months of study	0.49	0.50	6.91	2.33	6.80	7.02	<0.001
ER & admission							
3 - 6 months pre FGM	1.98	0.81					
Last 6 Months of study	0.49	0.50	1.49	0.94	1.44	1.53	<0.001
TIR post			Increase		95% CI		p-value
	Mean	SD	Mean	SD	Lower	Upper	
3 Months	45.62%	3.40%					
6 Months	56.93%	2.63%	11.31%	4.27%	11.10%	11.52%	<0.001
12 Months	67.90%	2.58%	22.26%	4.30%	22.05%	22.48%	<0.001

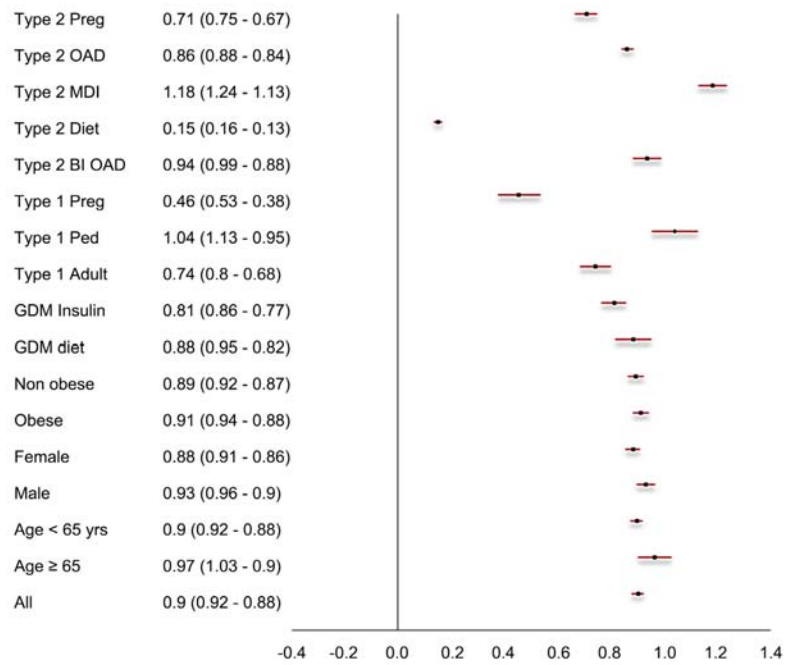


Figure 1. Reduction in HbA1c at 3 months post FGM.

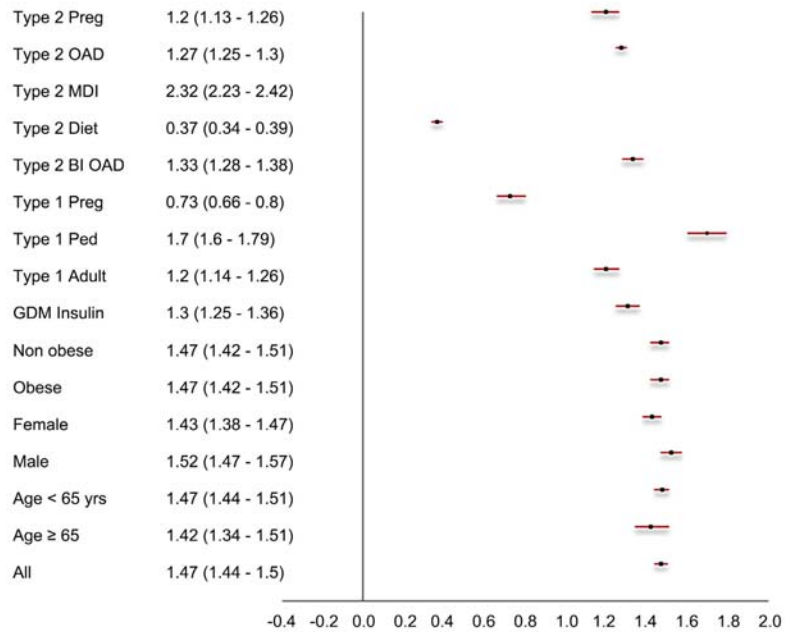


Figure 2. Reduction in HbA1c at 6 months post FGM.

The reduction in HbA1c over time is consistent among all subgroups; namely GDM on a diet, GDM on insulin, type 1 adult, type 1 children, type 1 pregnant women, type 2 on a diet, type 2 on OAD, type 2 on basal insulin plus OAD, type 2 on multiple-dose insulin, and type 2 pregnant women (p-value < 0.001), as shown in Table 3 & Figures 1-3. Moreover, the reduction in HbA1c over time is consistent among all other subgroups: obese, non-obese, males, females, age group < 65 & age group ≥ 65 years, as shown in Figures 1-3.

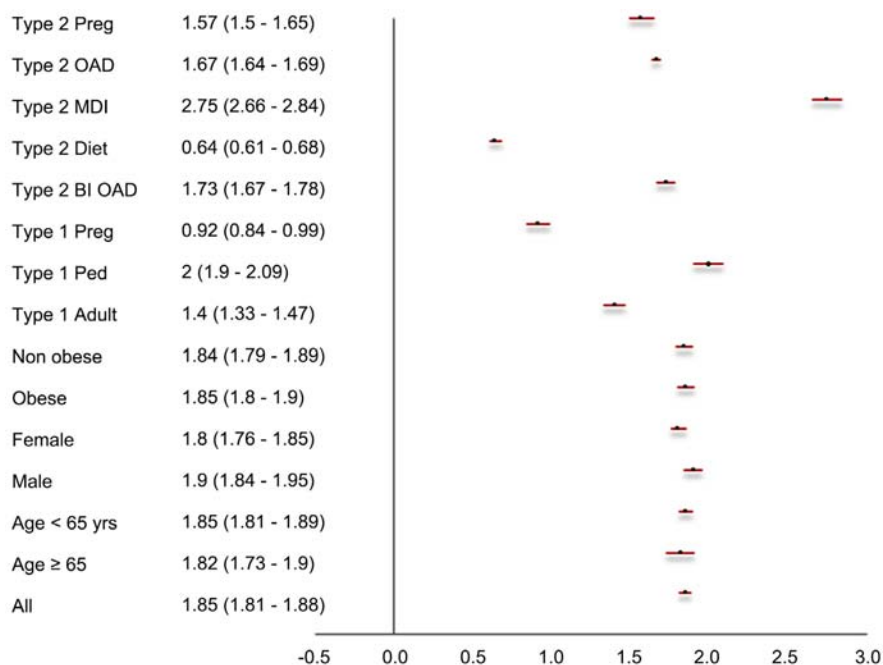


Figure 3. Reduction in HbA1c at 12 months post FGM.

Time in range (TIR) after using the flash glucose monitoring device was increased by time. For the entire cohort, it improved to 45.62% + 3.40% at three months after using the flash glucose monitoring device (p-value < 0.001). It increased to 56.93% + 2.63% at 6 months (p-value < 0.001) and to 67.9% + 2.58% by 12 months (p-value < 0.001), as shown in **Table 2**. In addition, the TIR change was consistent among all study subgroups all over the time of the study, as shown in **Table 3**.

The frequency of SMBG scanning before the FGM was 3.0 ± 1.4 per week. On the other hand, the frequency of flash glucose monitoring scanning was 22.5 ± 1.7 per day, as shown in **Table 4**.

Events related to DM before and after using FreeStyle Libre™ flash glucose monitoring device: the overall sample and subgroup analyses

Severe hypoglycemia 3 - 6 months before using the flash glucose monitoring device were 9.56 ± 1.73 versus 0.52 ± 0.50 during the last six months of the study (p-value < 0.001), as shown in **Table 2**. Severe hyperglycemia events defined as Hyperglycemic Hyperosmolar State (HHS) or diabetic ketoacidosis (DKA) 3 - 6 months before using flash glucose monitoring device was 7.40 ± 2.26 versus 0.49 ± 0.50 in the last six months of study (p-value < 0.001), as shown in **Table 2**. Emergency room visits & hospital admissions due to diabetes complications 3 - 6 months before using the flash glucose monitoring device were 1.98 ± 0.81 versus 0.49 ± 0.50 in the last six months of the study (p-value < 0.001), as shown in **Table 2**.

Moreover, the same impact seen for severe hypoglycemia events, severe hyperglycemia events & emergency room visits & hospital admissions were consistent among all the study subgroups (p-values < 0.001), as shown in **Table 5**.

Table 3. Glucose profile pre & post FGM: sub group analysis.

		HbA1c				Time in range after FGM		
		Baseline	3 m	6 m	12 m	3 m	6 m	12 m
GDM diet	Mean	8.7	7.8*			45.4%		
	SD	0.5	0.6			3.6%		
GDM insulin	Mean	8.6	7.8*	7.3*		45.5%	57.5%	
	SD	0.5	0.5	0.5		3.5%	2.5%	
Type 1 Adult	Mean	8.6	7.9*	7.4*	7.3*	45.8%	57.0%	67.7%
	SD	0.5	0.5	0.5	0.6	3.4%	2.7%	2.6%
Type 1 Ped	Mean	9.8	8.7*	8.1*	7.8*	45.8%	56.9%	67.8%
	SD	0.9	1.1	1.1	1.1	3.3%	2.6%	2.6%
Type 1 Preg	Mean	7.9	7.4*	7.2*	7.0*	46.1%	56.5%	67.2%
	SD	0.3	0.3	0.3	0.3	3.7%	2.3%	2.8%
Type 2 BI OAD	Mean	8.9	7.9*	7.5*	7.1*	45.8%	57.0%	68.0%
	SD	0.6	0.7	0.7	0.7	3.4%	2.6%	2.6%
Type 2 Diet	Mean	7.9	7.8*	7.6*	7.3*	46.5%	57.5%	68.5%
	SD	0.2	0.2	0.2	0.3	3.3%	2.6%	2.5%
Type 2 MDI	Mean	9.8	8.6*	7.5*	7.1*	45.9%	56.8%	67.9%
	SD	1.0	1.0	1.3	1.3	3.4%	2.6%	2.6%
Type 2 OAD	Mean	10.7	9.8*	9.4*	9.0*	45.2%	56.8%	67.9%
	SD	1.7	1.7	1.8	1.8	3.4%	2.6%	2.6%
Type 2 Preg	Mean	8.9	8.2*	7.7*	7.3*	45.6%	56.8%	67.9%
	SD	0.7	0.7	0.8	0.8	3.4%	2.8%	2.5%

* p-value < 0.001 comparizon to baseline HbA1c.

Table 4. Frequency of blood glucose monitoring pre and post FGM.

	SMBG per week		FGM scanning per day	
	Mean	SD	Mean	SD
All	3.0	1.4	22.5	1.7
GDM Diet	2.8	1.5	22.5	1.8
GDM Insulin	3.1	1.5	22.4	1.7
T1 Adult	3.3	1.4	22.6	1.7
T1 Ped	3.0	1.4	22.4	1.7
T1 Preg	3.1	1.3	23.1	1.4
T2 BI OAD	2.9	1.4	22.5	1.7
T2 Diet	3.3	1.3	22.5	1.6
T2 MDI	2.8	1.4	22.5	1.7
T2 OAD	3.0	1.4	22.5	1.8
T2 Preg	2.6	1.3	22.7	1.6

Table 5. Diabetes events post FGM; sub group analysis.

	Severe hypoglycemia		DKA or HHS		Admission	
	3 - 6 month pre FGM	Last 6 months	3 - 6 month pre FGM	Last 6 months	3 - 6 month pre FGM	Last 6 months
GDM deit	9.27	0.54*	7.37	0.49*	1.86	0.49*
	1.71	0.50	2.40	0.50	0.82	0.50
GDM insulin	9.42	0.44*	7.30	0.45*	1.80	0.39*
	1.60	0.50	2.08	0.50	0.80	0.49
Type 1 Adult	9.34	0.48*	7.38	0.46*	1.94	0.57*
	1.86	0.50	2.11	0.50	0.83	0.50
Type 1 Ped	9.54	0.58*	7.27	0.44*	2.03	0.50*
	1.82	0.50	2.28	0.50	0.83	0.50
Type 1 Preg	9.66	0.62*	7.62	0.59*	1.86	0.52*
	1.70	0.49	2.80	0.50	0.79	0.51
Type 2 BI OAD	9.54	0.45*	7.48	0.50*	2.00	0.53*
	1.75	0.50	2.24	0.50	0.80	0.50
Type 2 Diet	9.50	0.57*	7.57	0.56*	2.02	0.39*
	1.60	0.50	2.08	0.50	0.84	0.49
Type 2 MDI	9.67	0.55*	7.28	0.54*	1.97	0.52*
	1.67	0.50	2.26	0.50	0.81	0.50
Type 2 OAD	9.54	0.53*	7.42	0.47*	2.03	0.47*
	1.74	0.50	2.30	0.50	0.80	0.50
Type 2 Preg	9.78	0.48*	7.83	0.61*	1.80	0.43*
	1.78	0.51	2.22	0.49	0.86	0.50

* p-value < 0.001 comparison to baseline (6 month pre FGM).

4. Discussion

The flash glucose monitoring system (Abbott Diabetes Care, Alameda, California, USA) is an innovative continuous glucose monitoring (CGM) that has been adopted as an alternative or adjunct to the well-established approach the self-monitoring of blood glucose (SMBG) for patients receiving insulin therapy or other treatments [9] [10] [11] [12].

In the flash glucose monitoring system, a sensor is placed on the back of the upper arm where the sensor filament sits below the skin [13]. Every minute, the sensor monitors glucose levels in the interstitial fluid and automatically records glucose data every 15 minutes. Each sensor has 14-day battery life. To retrieve stored data, a specialized reader device or a smartphone with near-field communication capabilities can be used to scan the sensor. The monitoring device (whether smartphone application or reader) shows the current glucose level, a trend arrow that shows which way glucose levels are trending, and a graph of

glucose readings over the last eight hours [14].

The current observational multi-center study showed that, among individuals with type 1 or type 2 or gestational DM, the implementation of the flash glucose monitoring system was associated with a reduction in HbA1c, regardless of the type or the treatment used. This HbA1c benefit was consistently observed across various clinical subgroups studied: GDM on a diet, GDM on insulin, type 1 adult, type 1 children, type 1 pregnant women, type 2 on a diet, type 2 on OAD, type 2 on basal insulin plus OAD, type 2 on multiple-dose insulin, type 2 pregnant women, obese, non-obese, males, females, age group < 65 and age group ≥ 65 years. These findings are significant as they add to the growing evidence supporting the beneficial effects of using the flash glucose monitoring system on glycemic control [15] [16] [17] [18] [19].

All of the studied cases were established DM cases except those with GDM. The study included a large sample (1695) that enabled the subgroup analysis. Additionally, it used a pre-post design to mitigate potential bias and confounding.

This study's sustained reduction in HbA1c may be due to patients checking their blood glucose more frequently via the flash glucose monitoring device because it is more convenient for them. The information on their glycemic profile could have helped them adjust their treatment or behavior, either on their own or through their healthcare providers, where the latter was facilitated by remote monitoring through digital tools either the smartphone application or cloud-based software.

Increase in the frequency of blood glucose scanning by the device may have supported individuals with DM in identifying foods that significantly increase their blood glucose resulting in better diet selections [15].

For individuals with DM who are on insulin and can adjust insulin doses independently, more frequent scanning with the flash glucose monitoring device with its ambulatory glucose profile (AGP) may have led to more informed decision-making regarding dose adjustments resulting in improved glycemic control. These findings suggest that it has the potential to decrease HbA1c in various DM populations independently [15].

The reduction is better over time as the learning curve for individuals with DM and their healthcare providers increases. Once again, these findings could be associated with frequent healthcare provider involvement through remote monitoring. Healthcare team may have used information from the flash glucose monitoring system to facilitate the revision of medications, adjustments in medication doses, and lifestyle/behavior changes. That led to better interventions and follow-up with their healthcare team, resulting in more significant reductions in HbA1c compared to the same patients before using the flash glucose monitoring device. Ultimately, flash glucose monitoring systems should function to provide the patient and their healthcare team with more information to make better-informed decisions and prevent clinical inertia. The improvement of glycemic control was reflected in the HbA1c reduction after using the flash glucose

monitoring system, the decrease in the number of HHS or DKA events, and the number of emergency room visits & hospital admissions due to diabetes complications.

Hypoglycemia is an essential factor that must be considered when managing DM. This analysis shows that the rate of experiencing severe hypoglycemic events is reduced over time when using the flash glucose monitoring system. This finding may be attributable to patients checking their blood glucose levels more readily and frequently, leading to measures to prevent hypoglycemia. Additionally, the incidence of hypoglycemic events declines as patients continue to use their flash glucose monitoring devices. The decreasing number of hypoglycemic events supports this over time (9.54 ± 1.73 3 - 6 months before using the flash glucose monitoring system to 0.52 ± 0.50 last six months of the study). These results are consistent with current literature suggesting that the flash glucose monitoring system decreases the incidence of hypoglycemic events [20] [21] [22] [23] [24].

The current study results agree with two pivotal trials highlighting the significant contribution of flash glucose monitoring systems in DM. The IMPACT (T1DM) and REPLACE (T2DM) showed that flash glucose monitoring system could safely and successfully replace the routine SMBG and deliver remarkable clinical benefits to T1DM and T2DM patients using insulin. The multi-center randomized controlled study on adults with T2DM on intensive insulin therapy (REPLACE study) from 26 European diabetes centers was conducted to assess the safety and efficacy of new flash glucose-sensing technology to replace SMBG. The study concluded that flash glucose-sensing technology use in T2DM with intensive insulin therapy results in no difference in HbA1c change and reduced hypoglycemia, thus offering a safe, adequate replacement for SMBG. Both studies (IMPACT) and (REPLACE) showed that the flash glucose monitoring system significantly reduced all critical measures of hypoglycemia without increasing HbA1c (time in range). Hypoglycemia reduction was quick and sustained without an increase in HbA1c vs. SMBG [21] [25].

Moreover, the SELFY trial was conducted in the UK, Irish, and German children with type 1 diabetes aged 4 - 17 years old. The study showed that children with DM improved glycemetic control safely and effectively with short-term flash glucose monitoring compared to SMBG in a single-arm study. However, the study was one-arm non-comparative [26].

Finally, flash glucose monitoring improved QOL and patient-reported outcome measures. Two different measurements of QOL (the Diabetes-Treatment-Satisfaction Questionnaire and the Diabetes Quality of Life survey) showed an increased overall satisfaction for flash glucose monitoring vs. taking finger-sticks. These results serve as a reminder of how much hypoglycemia impacts T2DM [21] [25].

This study is not without limitations. First, investigators were unblinded during data collection, which may have introduced investigator bias and exaggerated treatment effect sizes. Second, be retrospective in nature. However, further

research assessing cost-effectiveness is required to support this claim.

In conclusion, the benefits of implementing the flash glucose monitoring system in all types of DM of all age groups and from different treatment regimens have been self-evident in reducing HbA1c and the rate of hypoglycemia events and the rate of HHS, DKA, or hospitalizations.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Association of Hyperhomocysteinaemia with Hyperglycaemia, Dyslipidaemia, Hypertension and Obesity

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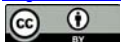
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Abstract

There is conflicting scientific data about the link between, high homocysteine (Hcy) levels in the general population, and obesity. This is a case-control study aimed to assess the role of hyperhomocysteinemia in obesity and its associated illnesses, including hypertension, dyslipidemia, and hyperglycemia in Gezira state, Sudan. Two hundred and eleven participants were included in the study, 140 were obese (117 females and 23 males) and 71 were normal weight control, the obese median age was 49.49 ± 12.2 years. The control group consisted of 71 individuals with an average age of 45.78 ± 17.67 years. Among those who were already known to be obese, 67 (47.9%) reported having type II diabetes mellitus, 71 (50.7%) reported having hypertension, and 35 (25%) were obese without having either diabetes or hypertension. Three mls of venous blood from each participant were collected in the morning after a 12 h overnight fasting in Lithium heparin containers then the plasma was separated and stored at -80°C for analysis. Serum Hcy and lipid profile were measured using the enzymatic method by Cobas C 411 analyzer. In comparison to obese non-hypertensive, the results showed that obese hypertensive with Hcy levels > 15 mol/L had a considerably increased risk (OR 1.12). When Hcy levels > 15 mol/L were compared to obese diabetics and obese non-diabetics, insignificant difference was shown (P: 0.345). Males had a higher likelihood of having hyperhomocysteinemia than females did (OR 1.2). Homocysteine, cholesterol triglyceride, LDL, and HDL mean values were compared between case and control groups using the independent sample t-test, and the results revealed statistically significant (P: <0.05). Relationships between hyperhomocysteinaemia and cholesterol, triglycerides, LDL, and HDL in the group of obese individuals were not statistically significant (P:

0.574, 0.265, 0.748, and 0.14), respectively. Obesity and Hcy concentrations were shown to be substantially correlated. However, there was no statistically significant association between baseline plasma Hcy levels and hyperglycemia, hypertension, or dyslipidemia.

Keywords

Homocysteine, Hyperglycaemia, Dyslipidaemia, Hypertension, Sudan

1. Introduction

Obesity is a global issue that has been connected to changes in the physiological function of adipose tissue. More than half of the world's population will be obese by 2030 [1]. The fact that obesity is unequal, some are metabolically healthy meaning they do not have any additional metabolic disturbance, but most are metabolically unhealthy. Slight, and progressive, differences in glucose tolerance, inflammatory response, adipose tissue distribution, pattern of adipokine secretion, and age may contribute to this phenomenon. Age-related increases in obesogenic variables are anticipated to make obesity more common in middle-aged and elderly people. As a result, the majority of co-morbidities related to obesity is common to aging and may have similar basic processes [2].

Obesity and nutritional deficiency or excess lead to endoplasmic reticulum (ER) stresses resulting in secretion of impaired unfolded protein. ER dysfunction and the consequence of unfolded protein have a role in inducing metabolic disturbance [2]. Mitochondria regulate apoptosis by the intrinsic pathway triggered in response to cellular stress signal and apoptosis regulatory proteins [3]. Apoptotic proteins level are increased in adipocyte of obese human, therefore excess food can cause mitochondrial dysfunction and susceptibility to apoptosis which improve metabolic syndrome [4]. Mitochondrial defect lead to cellular oxidative damage caused by generation of reactive oxygen species (ROS) that exceed the natural antioxidant is an initiating factor in metabolic disturbance [2].

Hcy is a sulfur containing amino acid, form in the cytoplasm during intracellular metabolism of methionine. Within the methionine cycle, methionine is converted to S-adenosylmethionine (SAM) which acts as methyl donor. S-adenosylhomocystine (SAH) is formed following methyl donation by SAM and Hcy formed through liberation of adenosine from SAH by enzyme SAH hydrolase. Due to the reversal physiologic reaction of S-adenosylhomocystine hydrol Hcy accumulation leads to synthesis of S-adenosylhomocystine which is stronger inhibitor of S-adenosylmethionine dependant transferase that methylate abroad spectrum of cellular component (lipid, DNA and protein) [5].

Hcy a sulfurous-amino acid is crucial for the metabolism of methionine and folate. Hyperhomocysteinemia is the term for a condition where there is an abnormally high level of Hcy in the plasma (above 15 mol/L) (HHcy). Increased

total plasma homocysteine (tHcy) is regarded as harmful for cells and is linked to a variety of health issues such as obesity, metabolic syndrome and cancer [6].

Several possible mechanisms can explain the relationship between Hcy concentrations and obesity, according to a meta-analysis study conducted by Wang *et al.* first, higher Hcy levels were linked to lipid accumulation in tissues, resulting in obesity. Second, Hcy induced endoplasmic reticulum stress induces deregulation of the cholesterol and triglyceride biosynthesis pathways, causing lipids to be not processed correctly. Third, obesity is recognized as a chronic inflammatory condition. In this view, elevated inflammatory markers (such as CRP and fibrinogen) were observed to be related with Hcy levels. Finally, visceral adipose tissue impairs various hepatic activities via the portal by disrupting the proper functioning of enzymes that remove. However, it is still unknown what causes obese to have higher Hcy [7].

Each extra unit of Hcy concentration above 14 mol/L in diabetic patients was discovered to be associated with an increased risk of diabetic retinopathy and renal failure [6]. By interfering with insulin receptor phosphorylation and therefore influencing the downstream signaling cascade, it has been demonstrated that Hcy reduces insulin signaling. A rise in the production of the adipose tissue peptide hormone resistin also coincided with the signaling problem. Obesity and resistin have both been related to diabetes in the past [8].

Increased risk is shown in obese patients with aberrant lipid profiles and Hcy, which increases cardiovascular morbidity and mortality in type II diabetes mellitus, particularly if it was coupled with hypertension [9]. According to recent studies, the link between Hcy levels and MetS components, notably systolic blood pressure, increases the risk of cardiovascular disease (CVD) [10].

When Hcy oxidation is aberrant, the endothelium becomes injured because it is unable to break down Hcy. Hcy undergoes auto oxidation at high Hcy levels. This process takes place in plasma and produces ROS that damage cells' oxidative defense mechanisms and are harmful to endothelial cells. Vascular cell adhesion molecule and monocyte chemo attracted protein are released as a result of oxidized LDL. The first lesion in atherosclerosis is a fatty stripe caused by the conversion of the monocyte into a macrophage, which then absorbs the oxidized LDL [11]. Hcy may promote CVD by a number of ways, including an increase in muscle cell proliferation that narrows blood arteries, changes to blood coagulation factors, oxidative harm to the vascular endothelium, and damage to arterial walls [12].

In hypertension, the artery walls thicken and the blood flow resistance rises. As a result, the heart beats more quickly and the blood pressure leaving the heart increases. Due to the lack of early symptoms, high blood pressure is referred to as the silent killer. Only when an organ in the body is inflamed or harmed can the effects of elevated blood pressure become apparent [8]. By inhibiting the nitrogen oxide-induced vasodilation, encouraging the proliferation of vascular smooth cells, and altering the elastic properties of the vascular wall, Hcy causes

oxidative damage to the vascular endothelium, which results in hypertension [13].

The current study's hypothesis was that elevated plasma Hcy concentrations are linked to obesity and its associated illnesses, including hypertension, dyslipidemia, and hyperglycemia.

2. Material and Method

2.1. Study Design and Participants

This was a case-control research conducted in Gezira state in a period between 2019 until 2022 with 140 obese as the case and 71 normal weight as the control. Participants were recruited by trained field workers and gave their written consent voluntarily.

2.2. Ethical Consideration

IRB in the faculty of medical laboratory science at the University of Gezira provided ethical approval for this work. All participants signed a standard informed consent form.

2.3. Data Collection Tools

A questionnaire was utilized to collect data on demographics, lifestyle, and health concerns such diabetes, hypertension, obesity, renal disease and, kidney disease, and heart disease.

2.4. Physical Examination

All of the participants underwent a physical examination as well as laboratory tests. The patient's height and weight were measured during the physical examination. The participants' body weight was assessed while they wore light clothing and wore no shoes. In an upright position, the height was measured without shoes. BMI was computed by multiplying a person's weight in kilograms by their height in meters squared. BMI of less than 25 were considered normal weight, while those with a BMI of 30 or more were considered obese.

2.5. Laboratory Tests

In a lithium heparin container, three ml of venous blood samples for Hcy and lipid profile (cholesterol, triglyceride, low density lipoprotein, high density lipoprotein) measurement were collected and centrifuged immediately. Plasma was isolated and kept at -20 degrees Celsius. The concentration of plasma Hcy was determined using an enzymatic technique on a Cobas c311 analyzer. The normal reference range was up to 15 mol/L. The diagnostic criteria used for the parameters were follows: hyperhomocysteinemia = blood Hcy > 15 $\mu\text{mol/l}$, hypercholesterolemia = blood cholesterol > 5.7 mmo/l, hypertriglyceridemia = blood triglyceride > 2.26 mmol/l, obesity = BMI > 30 kg/m².

2.6. Statistical Analysis

The data was analyzed using version 18 of the Statistical Package for Social Science (SPSS). Descriptive statistics were calculated for the data in the form of mean and standard deviation ($SD \pm$) for quantitative data and frequency and distribution for qualitative data. In the statistical comparison between the different groups, the significance of difference was tested using Student's t-test that used to compare mean of two groups of quantitative data and inter-group comparison of categorical data was performed by using chi square test (X^2 -value) and fisher exact test (FET). The association of hyperhomocysteinemia (>15.0 mol/L) with obesity, as well as related metabolic disease such as hypertension and diabetes, was reported as odds ratios (OR) obtained by separate logistic regressions for each outcome variable, with age and gender adjustment. Using multiple logistic regressions, we calculated the OR for the combined risk against hyperhomocysteinemia.

3. Results

The study involved 211 participants, of whom 140 were obese (23 men and 117 women) had a median age of 49.49 ± 12.2 . There were 71 people in the control group whose average age was 45.78 ± 17.67 years. According to socio demographic information, the distribution of the study population is presented in (Table 1).

Among those who were known to be obese, 67 (47.9 percent) reported having type II diabetes mellitus, 71 (50.7 percent) reported having hypertension, and 35 (25 percent) were fat without either diabetes or hypertension (Table 2).

17 (or 42.5%) of the 67 (47.9%) obese diabetic patients were hyperhomocysteinaemic. 23 participants, or 57.5 percent, of the 71 obese and hypertensive subjects were hyperhomocysteinaemic. After stratification according to tHcy levels, the frequency of diabetes and hypertension among study participants was compared using the chi square and Fisher's exact tests. The results showed that obese hypertensive with tHcy levels > 15 mol/L had a significantly higher risk (OR 1.12) compared to obese non hypertensive. When compared to obese diabetics and obese non-diabetics, with tHcy levels > 15 mol/L demonstrated in significant difference ($P: 0.345$). Males were more likely than females to have hyperhomocysteinemia (Table 3) and (Table 4).

The independent sample t-test was used to compare the mean values of Hcy, cholesterol triglyceride, LDL, and HDL in case and control, and the results showed statistically significant ($P < 0.05$) increases in these markers. However, there were statistically significant ($P < 0.05$) drops in the mean HDL levels in the same group (Table 5).

In the group of obese people, the relationships between hyperhomocysteinaemia and cholesterol ($P = 0.574$), triglycerides ($P = 0.265$), LDL ($P = 0.748$), and HDL ($P = 0.14$) were not statistically significant (Table 6).

Table 1. Frequency, percentage and average of Socio-demographic data.

		Case (N = 140)		Control (N = 71)	
		F	%	F	%
Gender	Male	23	16.4	20	28.2
	Female	117	83.6	51	71.8
Age Group	20 - 40 Years	33	23.6	38	53.5
	41 - 60 Years	84	60.0	22	31
	61 - 80 Years	23	16.4	11	15.5
Age/years		49.49 ± 12.2		45.78 ± 17.67	

Table 2. Frequency and percentage of the disease presence in obese group.

		Case (N = 140)	
		F	%
Hypertensive	Yes	71	50.7
	No	63	45.0
Diabetes	Yes	67	47.9
	No	67	47.9
Hypertensive + Diabetes	Both of them	39	27.9
	One of them	60	42.9
	None of them	35	25

Table 3. Frequency and percentage of Hcy in diabetes and hypertension.

		Hypertension		Total	Diabetes	
		Yes	No		Yes	No
Hyperhomocysteinemia	Count	23	17	40	17	23
	%	57.5	42.5	100%	42.5	57.5
Normal Hcy level	Count	48	46	94	50	44
	%	51.1	48.9	100%	53.2	46.8
Total	count	71	63	134	67	67
	%	53	47	100%	50.0	50.0

Table 4. Odds Ratio, confident interval and significant difference for hyperhomocysteinemia in hypertension, diabetes and gender.

		Odds Ratio	Confident interval	P-value
Hypertension	Yes	1.12	0.808 - 1.569	0.572
	No	0.86	0.573 - 1.316	
Diabetes	Yes	0.79	0.532 - 1.201	0.345
	No	1.22	0.872 - 1.730	
Gender	Male	1.20	0.552 - 2.623	0.63
	Female	0.96	0.815 - 1.137	

Table 5. Association between Hcy and lipid profile in case and control.

			Mean	STD	P-value
Homocysteine	Obese	140	12.65	4.9	0.002
	Control	50	10.45	3.8	
Cholesterol	Obese	140	184.64	56.9	0.000
	Control	71	150.73	37.5	
Triglyceride	Obese	140	252.05	151.0	0.000
	Control	71	135.82	79.0	
LDL	Obese	140	99.91	61.8	0.021
	Control	71	85.15	29.9	
HDL	Obese	140	37.76	9.9	0.023
	Control	71	40.99	9.5	

Table 6. Association of Hcy level and lipid profile in obese group.

	Pearson Correlation	Sig. (2-tailed)
Cholesterol	-0.041	0.574
Triglyceride	0.081*	0.265
LDL	-0.023**	0.748
HDL	-0.106	0.144

4. Discussion

There is a considerable knowledge gap about Hcy, including the patterns of Hcy concentrations in populations, the impact of gender on Hcy levels in the blood, and the physiological processes that Hcy impacts. The current study's findings indicated that men had a higher risk of hyperhomocysteinemia than women did (odds ratio were 1.20). Previous Studies have shown that males have higher concentrations of Hcy than females, but the difference disappears after menopause. Studies have also suggested possible associations between Hcy and a number of endogenous sex hormones also have been discovered that high Hcy levels were negatively associated females' cardiovascular health but not to males. This shows that there are differences in both the variables affecting Hcy in males and females as well as the impacts on the body, which is quite intriguing and merits more research [14].

In this investigation, odds ratios OR and their associated 95% confidence intervals (95% CIs) were used to assess the relationship between Hcy levels and hypertension (HTN) (OR [95% CI] = 1.12 [0.808 - 1.569], P = 0.572). Although the authors discovered that 57.5% of their hypertensive participants had hyperhomocysteinemia, the association between plasma Hcy and the risk of hypertension was statistically insignificant after age and gender adjustments. Numerous studies suggested that patients with hypertension had higher levels of Hcy than those who did not. Other epidemiological studies have investigated the connec-

tion between the polymorphism and HTN, however the outcomes were controversial. Retrospective studies revealed a strong connection. However, after adjusting for known risk factors, a meta-analysis of prospective studies discovered that a 25 percent lower usual Hcy level—which can be achieved in many populations by fortifying cereals with folic acid—was only linked to an 11 percent (95 percent CI 4 percent - 17 percent) lower CHD risk. The lower confidence limit's weak relationship, though significant, may or may not be entirely non-causal [15].

Hcy levels were measured in 67 hyperglycemic individuals for the current study, although there was no statistically significant correlation ($P = 0.345$). 17 (42.5%) of the hyperglycemic individuals had elevated Hcy levels. Various results about the relationship have been reported. In their investigation of the association between Hcy and hyperglycemia, Vayá *et al.* discovered a weak correlation [15]. According to Elias and Eng, Shaikh *et al.*, and other researchers, Hcy levels in diabetes mellitus can be either low or high. The findings of Mishra *et al.* and Akali *et al.* who discovered elevated Hcy levels in diabetes individuals are at odds with the results of our study. High Hcy levels were discovered to be a significant risk factor in diabetes patients. The research by Shaikh *et al.* provided evidence in favor of this work [13].

When compared to control, Hcy was significantly higher in the obese group. According to a meta-analysis research, obese patients had mean Hcy levels that were higher than those of non-obese patients. The results from the Mendelian randomization method supported the theory that the enhanced risk of obesity was plausibly influenced by the increased Hcy levels [16]. The levels of Total Cholesterol, Triglycerides, and LDLc were significantly higher in the obese group, while the levels of HDLc were significantly lower when compared with control group. These supported the assertion made by GeraLd H, *et al.* [17] that low HDLc is a well-recognized independent and potent predictor of atherosclerosis [17]. In the present study hyperhomocysteinaemia and cholesterol ($P = 0.574$), triglycerides ($P = 0.265$), low LDL-C levels ($P = 0.748$), and HDL-C ($P = 0.144$) were not found to be statistically significantly associated. The results of Vayá *et al.* supported the insignificant relationship. However, Nabipour *et al.* discovered a strong correlation between high Hcy levels and reduced HDL cholesterol [13].

It is important to note the study's shortcomings. First, the study population evaluation was based on a single sample of total Hcy taken at baseline where it is correct to assume that Hcy levels, particularly free Hcy levels, may have an impact on results, second researchers unable to demonstrate a temporal or causative link between Hcy and obesity due to the retrospective case control research design, and also determine the impacts of the risk factors, only qualitatively.

5. Conclusion

Hcy concentrations and obesity were shown to be significantly associated. The

study supported the idea that there is a tangential relationship between plasma Hcy and obesity. The correlation between baseline plasma Hcy levels and hyperglycemia, hypertension, and dyslipidemia was not statistically significant, though. Better and more trustworthy results would likely come from a study examining the relationship between plasma Hcy levels and hyperglycemia and hypertension a few days after treatment discontinuation. Unfortunately, it could be dangerous to stop treating diabetics.

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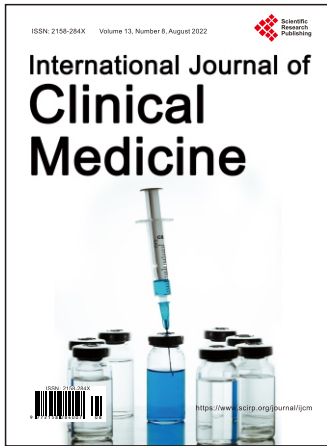
Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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