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Original Research

Barriers to Community Integration for Older People in Malaysia: A Qualitative Study from Occupational Therapist Perspectives

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ABSTRACT

Introduction
Existing research has addressed the importance of community integration (CI) and its benefits of dwelling in a community but has yet to address the methods and efficiency of improving these activities among older people. Thus, it is vital to understand how healthcare workers can integrate the benefits of CI among older people, especially with the use of occupational therapists (OTs). The latter are actively working to improve ageing individuals mobility within the community.

Objective
This study aims to identify Malaysian OTs' perspectives on CI's and its implication on older people.

Method
Occupational therapist from different states of Malaysia participated in a semi-structured interview, through a virtual medium (Zoom Cloud Meetings). The interview guide encapsulated the theory of critical incident technique (CIT).

Results
Thematic content analysis, over fourteen participants from 13 states of Malaysia, provided insights into CI's barriers for older people in Malaysia. The findings revealed that multifaceted factors from an individual, organisational and socio-environmental perspective limit older people's active CI engagement.

Conclusion
South-East Asia hierarchal and collectivist culture play a significant role in influencing all factors of CI. OTs must understand and incorporate appropriate cultural norms during CI practice development for the older population in Malaysia.

Keywords
Occupational therapist; Critical incident technique; Older people; Community integration; Qualitative study; Societal norms; Cultural norms.

INTRODUCTION

Our world's population is ageing at an accelerated pace. South-Eastern Asia has one of the fastest paces of the growing ageing population. The population aged 65-years and above doubled from 6% in 1990 to 11% in 2019.[1] Similarly, in Malaysia, the population aged 60 and over has doubled from one million in 1970 to 2.2 million in 2017. By 2040 the Malaysian population is projected to increase by 40 million, of which 7 million will be aged individuals[2]—labelling us as the "ageing nation".[3] Apart from the population growth, aged are also living longer. Therefore, it is essential to ensure that the older Malaysian well-being is are of the utmost priority. It is undeniable that older individuals are less healthy than the young ones; this is concerning since there are only 40 geriatrics and 2000 occupational health specialist in the country. Thus, emphasising the need for prevention focused on promoting a better quality of life- such as work, retirement, income, housing, family, community and leisure activities. In addition to this, as de-

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scribed in the World Health Organization (WHO), World Report on Ageing and Health, 2015 social change, filial piety and ageing has also weakened in the 21st century. The rise of smaller families and the younger generation's migration have left a detrimental impact on older people. Burdens such as sharing physical, emotional and financial responsibilities of an aged parent, have left older people facing social exclusion, isolation, poverty and abuse.

Background of Study

In these transitioning times, individuals are diverting from reliance on family or institutional care for older persons because they want to work or care for themselves. Thus, specific consideration is needed to meet older persons' needs to ensure that environments are accessible, including homes and public spaces, such as building workplaces and transportation, to improve their socialisation factor. One such consideration is community integration (CI). CI refers to how people can live independently, participate and socialise in their community.[4] Shaikh and Kersten[5] introduced the latest CI model through a conceptual analysis of 33 articles, including the five prominent CI frameworks.[6-10] They summarise CI as an intervention that enhances an individual's ability to be independent to experience a sense of belonging within the community. When such intervention is applied, an older person will enjoy mobility within the place they live in, continue to be socially connected and psychologically adjusted into the community. Occupational therapists (OTs) are already fostering this intervention in their approach to enhance a meaningful occupational activity such as leisure or productive activities among the older population.[5]

The evidence on CI currently elaborates primarily on younger demographics or people with specific health conditions such as acquired brain injury, people with intellectual disabilities, people with spinal cord injuries, and mental illness rather than older people.[11-17] These health conditions are also evident among the ageing population. Who faces various anatomical and physiological changes with an added complication of a slow recovery rate. These physical changes can often lead to disabilities and impairments within the elderly population. For instance, deteriorating health conditions mentioned above could lead to chronic pain that results in life on a wheelchair. Such restrictions can limit mobility and strength, along with cognitive impairments. The older population may face CI challenges due to various medical conditions or experience different transitions throughout their life course. Lifecourse changes in later stages can impact negatively on older person's physical and mental health. Changes such as the death of a spouse or friend, retirement, migration of children, psychological problems, change in social and economic status, social discrimination such as ageism and some realising that their days are coming to an end.[13,18-21] These forms of numerous factors can impact social, financial, psychological and physical change. The fact that one has to go through a process of adjustment in later life stages highlights how CI can help the ageing population.

Stav et al[22] in their systematic review of occupational engagement and health outcomes of the community-dwelling older adults, concluded that the core of occupational therapy practises lies in using engagement in occupation in the community to promote well-being and prevention of illness. As the definition of healthy ageing transitions from a medical model to "the process of developing and maintaining the functional ability".[23] OTs play a primary role in facilitating and identifying factors regarding older people's ability or inability to participate in the community. We notice that various CI attributes highlighted by authors Shaikh, Kersten[5] fell in the similar territory of the person-environment-occupational-performance (PEOP) model. Based on the PEOP model, OTs are often required to view clients holistically. OTs must take into account internal (such as psychological, cognitive, physiological factors) as well as external conditions (natural and built environments, social support, social culture and values) that may hinder or facilitate older person participation in purposeful activities.[24] This form of integration is possible since OTs training prepares them with the knowledge base of various conditions and impairments with specific attributes to address modifiable behaviours of the older persons habits or routines which may impact their physical health and wellness.[25] Such interventions are beneficial for the growing number of the elderly population, and it helps with lowering public healthcare burden.[22] Thus, there is a need to ensure continuous capacity building activities among healthcare workers, who should have adequate knowledge to cope and equip with information on who to refer their patients to manage their patients efficiently.

Within the Malaysian healthcare context, there is a lack of information on the support OTs provide and their ability to enhance elderly integration back into the community. There is evidence within the Malaysian context, indicating the meaningful community engagement improves an older person's quality of life.[26] Therefore, this study aims to capture Malaysian OTs' perspectives on integrating CI's and its implication on older people.

METHODOLOGY

A qualitative approach was applied to integrate critical incident technique (CIT) that captures rich, in-depth perceptions and experience of OTs in Malaysia. This approach helped formalises the interpretation of OTs experience of facilitating older people integration into the community. Purposive sampling was applied to recruit 14 OTs from 13 states in Malaysia. The state of Selangor had two OT representatives as it is the state with the highest population.[28] The participants were distinguished based on their location (state) and their practice area (private practice, government hospital setting, or private hospital setting). Study team applied stringent selection criteria on the recruitment of participants. For instance, selected qualified participants had a minimum of one-year working experience with older people. Online interviews were conducted from August to September 2019. The interviews lasted for 20-30-minutes and were recorded through the Zoom application. Researchers applied thematic content analysis to reflect critical incidents finings which addresses study objectives.[27] The study findings are based on all nine CIT credibility checks developed by Butterfield, Maglio[29] as listed: audiotaping interviews, interview fidelity, independent extraction of a critical incident, exhaustiveness of themes, participation rates, placing incidents into categories by

an independent judge, cross-checking by participants, expert opinions, and theoretical agreement. This research has been approved by the Perdana University Internal Review Board (IRB) committee (PU IRBHR0224).

RESULTS

The average age of participants was 32.1, whereby the average years of work experience between these individuals is 8.5-years. Thematic findings were divided into three main categories of factors. These themes are described in Table 1.

Table 1. *Summary of OTs Perceptions of Barriers to Community Integration of Older People in Malaysia*

Factor	Barriers
Individual related factors	• Lack of volition of older people • Complex medical condition of older people • Lack of awareness of older people • Self-consciousness
Organisational factors	• Lack of resources • Administrative restrictions
Socioenvironmental factors	• Lack of awareness among family members • Lack of cooperation of family members • Overprotective family

Individual Related Factors

Lack of volition of older people: OTs define lack of volition as a lack of willingness, motivation, interest, or refusal to participate in the tailored intervention actively. Mainly OTs identify individual factors that limit an older person to engage in CI actively. Some OTs reported that the time allocated for intervention is spent on persuading the older person to participate in the intervention, mainly due to a lack of motivation. Furthermore, OTs have also reported that some older clients leave sessions or activities before completion. This form of limitation is described as a huge limitation that inhibits OT to complete the therapy process; these stunts progress. An example of this is quoted below (P12008).

"*…when we have activities, in a group, there are those who are interested and those who are not. So those who are not interested would usually go home earlier*" (P12008).

Complex medical condition of older people: Due to various medical conditions, it becomes increasingly difficult to motivate the clients as their health deteriorates. Participant P12013 quoted the following as a barrier.

"*… when they are in pain, especially chronic pain, they are reluctant to come out and join the community. So, I feel that this is an obstacle for an OT or the caregiver. How do we encourage such individuals to actively take part while they are experiencing physical pain…*" (P12013)?

OTs report that increased doctors, clinic, and surgery appointments correlate to the older person's ability to participate in therapy due to lack of time or mobility issues.

Lack of awareness of older people: Awareness here is defined as understanding the importance and benefits of being engaged in meaningful activity or community interactions. As for the social factor, family or caregivers seem to play a vital role as well. For instance, OTs reported that older people assume that it is their children's familial obligation to care for them; therefore, they do not need to be independent or integrated into the community. This is expressed in the following quote from P05511 participant.

"*… the older people here feel like their sons and daughters should take care of them… a common response is: "Oh. I raised my kids so that they can care for me now. So why do I need to do these things myself?*" (P05011).

OTs also states that the older population hold firm cultural beliefs, in contrast to the modern understanding that it is beneficial to be actively involved within the community. A quote to express such a notion from participant P07006 is noted below:

"*… she (the older person) used to be a housewife who cared for many of her children; therefore, she stayed home most of the time… I think she grew up with the concept that women stay at home. Therefore, she 'doesn't feel the need to go out*" (P0700).

Self-consciousness: In this case, OTs define self-consciousness as older people being conscious or afraid of how the public or loved ones view them. They either do not wish to see others deemed "more capable" than them or do not want to let others know that they are less capable. This was captured in a quote by participant P13006.

"*… due to the fact he feels that ' 'he's not the same as other (abled) individuals, he thinks less of himself. He feels inadequate when he compares to others who seemed to look "normal". He feels embarrassed whenever he sees other people staring when he fumbles during a walk or walks with a walking stick. He would rather sit still and be silent instead"…*" (P13006)

This mindset prevents older people from going out into the community and discourages invitation of people to come within their spaces. One OT reported that older people within a nursing home discouraged her from bringing people of a similar age group to visit them. Reasons being that they felt inferior, seeing peers in a better condition than them.

Organisational Factors

Lack of resources: FA large portion of the OTs credited the inability to perform successful CI due to the lack of resources and facilities, such as time, specific equipment, human resources and funding. When faced with a lack of resources, OT interventions are often streamlined, compromising therapy's effectiveness. For example, the OT cannot demonstrate real environment opportunities that improve the mobility aspect by which the patient could apply in their day to day-based activities. It is essential to show how a patient can use the therapy in the comfort of 'patient's home; especially for those who are actively engaged in preparing meals for themselves or to help family members with such preparation. A

participant P05003 expressed such concern in the following quote:

"… *it would be useful to demonstrate the benefits of therapy when it is integrated into the day to day activity that the patient has to do. For instance, a patient claimed that she usually carries out her meal preparation in the sedentary position. Thus, making it difficult to demonstrate safe use of the walker or walking aid to show that she could improve her mobility by moving around the kitchen rather than sitting down to help out or prepare the meals*…" (P05003).

Administrative restrictions: OTs have also reported that they are not empowered to carry out interventions and programs despite believing that it is beneficial for older people. Such empowerment would be helpful, especially in the current situation since most therapeutic, evidence-based approaches require consent from a health professional or a family member's approval.

"… *sometimes therapeutic planning or interventions are delayed or stretched over time because a plan must be proposed to the doctor, followed by and approved. Besides, the family member's approval is needed before this is conveyed to the patient or acted on. At times such delays impact our ability to interact with the patient while they are in the hospital. Limiting our ability to convey or apply any form of the therapy, because the patient is already discharged from the hospital. At times doctor work on their timelines that is rarely communicated with us because we don't have a say* …" (P05017)

OTs' empowerment or streamlining operational guidelines that permit OTs to carry out relevant interventions is critical, especially for community-based activities. For instance, OTs should be allowed to plan and supervise older person visitation to community spaces such as beaches, malls, or even the use of public transportation.

Socioenvironmental Factors

Lack of awareness among family members: Findings also indicate that the family members do not understand the need for the therapy or differentiate the necessary therapy type, which would be beneficial. The following is an example shared by participant P05016, who stated that an older ' 'person's caregiver could be the barrier in ensuring implementation of CI (independence and occupational performance) which could directly benefit the older person.

"… *it depends on whether the sons and daughters also support the therapy and recommendations because sometimes they feel, "oh, ' 'it's (the concept of being independent) not necessary, I can bring Mom out whenever she wants. She'll be in a wheelchair anyway so that I can push her*"(P05016).

Lack of cooperation of family members: Low engagement correlates to lack of family 'members' active participation in the older person's life. An example of this is noted when a family member actively engages in the therapy sessions, older person compliance improves. This result, into meaningful CI engagement. Quote on this example is noted below:

"…*my ' 'client's daughter is not supportive. Whenever I'm conducting my sessions, I'll try to include the daughter. ' 'I'll request her active engagement in the therapy by showing her what and how to apply the learnings from a session on her own when they are at home but instead, she will dismiss the learnings or interactions to concentrate on her handphone*…" (P07001).

These forms of disassociation or lack of active engagement also contribute to the fact that there is no dedicated caregiver among family members. Instead, the family members will select different caregivers based on the type of follow-up or medical need. At times other family members will opt to take the older person to their preferred health professionals.

Overprotective family: OTs reported that at times family members or a caregiver believe there is no need for the older person to engage in any activities. The belief is based on the fact that it is unsafe for the older person to participate in activities such as cooking or driving, thus discouraging involvement in activities or community involvement.

"…*the caregiver is concerned over the safety of the older person, thus carries out all day to day task themselves – for instance, the caregiver will not permit the older person to participate in the preparation of meals actively. At times the caregiver also states that its time consuming to wait around while the older person completes a specific task – it's much faster if I do it myself. So, they prefer promptness in completing the task, which the patient cannot replicate*…" (P06003).

DISCUSSION

The participants of the study identified barriers in CI attributing to individual-related, organisational and socio-environmental factors. Barriers which are linked to the environmental factors and individual autonomy were more prominent than others.[31-34] Such factors were predominantly driven by cultural influences which are critical contributing factor hindering effective CI interventions in Malaysia.

OTs reported that the older people believe that it is their children's familial obligation to care for them; therefore, they do not need to be independent (one of the factors of CI). Such beliefs are generally documented across Asia as cultural norms that reduce the emphasis on independence and places a high interdependence value[33,35,36] These cultural norms are integrated into Asian values of filial piety caring for parents or elders as a sign of respect.[37] In addition to this, older people who had family responsibilities, such as caring for young ones felt the lack of need or desire to participate in community activities.[33] Similarly, it is also specific cultural beliefs that older people are accustomed to, which transitions into a norm. An example of a norm in Asian societies is that women should stay at home in contrast to being out in the community, which causes them to be more isolated.

In the study, OTs reported that older people do not desire to view others who are more mobile than they are, causing them to be self-conscious. This mindset links to a social construct in Asia known as "face". The "face" is the governing force that

influences social interaction based on how one perceives the other person opinion. The "face" is imperative as it determines' 'one's status and position, which is vital in an honour culture society seen across Asia.[38] One of the factors that threaten "losing face"(defined as loss of respect or social status), would be a lack of mobility.[39] Therefore, aspects of CI such as social connection, and sense of belonging and adjustment in the community is reduced to maintain a sense of self-respect rather than "lose face" by drawing attention or care.

The participants' lack of resources in this study is similar to obstacles faced by other OTs,[31,32,40] particularly time and funding. The current findings are based on the number of OTs in the population, as the ratio of OTs per population in Malaysia is 1:20,000 in contrast to the ideal 1:5,000,[41] highlighting the dire lack of OT professionals in the Malaysian context. Therefore, this study's results highlight the significant consequences of how lack of resources can compromise service quality.[40] This study illustrates OTs' inability to provide holistic or community-based interventions, as they are often required to prioritise curative care due to limited resources.[31,32] Without OTs being able to safely simulate scenarios and environments where older people can practice functional skills, CI attributes such as independence, occupational performance and adjustment are challenging to achieve.

A lack of professional autonomy limits the number of interventions that the OTs could provide to the older population. Such limitations, in obtaining approval from medical experts and family members to proceed with specific interventions, often delay the therapy's benefits. These forms of barriers are also echoed by Kronenberg and Pollard,[36] who emphasised that in the Asian context, the medical field's hierarchical concepts regarding medical doctors, who are the authoritative figure who makes the definitive decision inpatient care. OTs in Malaysia and other sub-disciplines in health care, all face similar inpatient care barriers.[42,43] This hierarchical approach is an evident and notable social tendency approach in other studies reported within South East Asia.[44,45] Alternatively, the lack of CI intervention can also be due to the lack of understanding of the OT role proposed by Turcotte and Carrier[31]; 'OT's often integrates and customises interventions gardening or arts crafts to benefit therapy outcomes. Other health professionals or hospital authority who collaborate to maintain older people's quality of life may not understand such interventions' therapeutic benefits, thus tend to decline or disregard such efforts.[31,32]

Family members' knowledge, attitude and perception are crucial as they often heavily influence or take autonomy of decisions regarding the older's medical care. This transfer of authority is a common phenomenon in the current literature.[46,47] This amplifies when family members provide financial support for the older person's medical needs, or when older people no longer have the cognitive capacity to decide for themselves. In such circumstances, the family members then often step in to decide what they believe is right for older people. The strong autonomy of family members can contrast CI's attribute of place to live. For instance, barriers to integrating CI could hinder older persons' homeownership and decision-making on activities they could carry out within the home. The lack of awareness reported in older people is closely related to cultural beliefs of a collectivist mindset or interdependent society of – "*if I can care for the older person, they do not need to do anything*". This mindset directly contradicts CI attributes, and therefore family members see OT services as "unnecessary".

Overprotective behaviour is concerning as OTs identified the older clients as having the potential and capacity to be integrated into the community, but unable to do so due to family members' restrictions. Such restrictions are due to caregivers' resentment towards their caregiving role and the patient's attitude of dependency.[48] These study findings reflect cultural norms documented across Asian countries; societal norms that place the burden on children to care for their parents have resulted in resentment towards caregiving. Thus, older persons' caregiving is seen as the "caring trap" in cultural and social expectations.[49] Undoubtedly, the results of this 'study's highlight the issue of overprotective behaviour in an Asian context and how it directly conflicts with CI attributes such as independence and place to live.

This study finding reflects the fact that multi-facets barriers hinder older person active engagement in CI. Some of the obstacles are a) cultural and ethics, such as the elderly's mindset that reflects cultural norms; b) the social construct of "face"; c) hierarchical social system among health professionals; and finally, d) collectivist culture that leads to family autonomy on the elderly's healthcare and overprotective behaviour of family members. There is a need to increase the general public's awareness regarding the benefits of dignity through independence, which is the first step of promoting CI among the older population. In contrast to the concept of "losing face" that portrays the inability of older individuals or their incapability and valuing dependency upon the family as a sign of filial piety. Instead, the government should enforce a policy that protects a rights-based approach to healthy ageing where the legal, social and structural barriers are protected.

Limitations of the Study

The study explored the barriers to CI from OTs perspective. Unfortunately, there is a limited body of knowledge related to CI factors concerning older people. From an extensive review of the literature, there is little evidence reflecting OTs perspective, especially in an Asian context. The closest comparable research focuses on social participation which reports only one component of CI; consequently, this was used to compare and contrast this study's findings.

Practitioner Implications and Recommendations

Cultural norms have contributed to substantial barriers; these beliefs are also forming the older population mindsets. Furthermore, such beliefs and norms are also seen as barriers of the social construct of "face", that is heavily embedded in the hierarchical social system. Therefore, future research should focus on ascertaining solutions for barriers reflected in this study. Some suggestions include implementing a tertiary education system that trains

prospective healthcare providers to understand the implications of interprofessional behaviour and roles, fortifies structural barriers that impact healthcare access.[50,51] Also, to integrate education on possible psychological interventions for the elderly in overcoming social and infrastructural obstacles.[52,53]

Furthermore, more attention should be in evaluating CI holistically, considering the client's needs and priorities, especially with the new CI model.[5] Lastly, the study notes that no interventions or factors addressed two different CI components, reflecting the sense of belonging and adjustment. More attention and intervention should identify various methods to increase these two factors among the elderly, which should be essential for CI.

CONCLUSION

Healthcare professionals, especially OT, should be empowered to tailor or customise interventions to implement CI for older people in Malaysia. This is imminent since cultural norms are predeterminant factor. As a result of this observation, there are various suggestions for practice and research that incorporate the OTs' experiences in Malaysia succinctly to aid current and future OT practice.

DISCLAIMER

This study finding is the author's statement; hence, views expressed in this manuscript are not an institution or funder's official position.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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Commentary

A Physician's Commentary on Electronic Health Records in the United States Medical Practice

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ABSTRACT

This commentary presents a point of view on how the arrival of electronic health records (EHR) in the United States (U.S.) has changed physicians' practice. EHR implementation has pros and cons. EHR systems have been a great asset during the pandemic and help with efficiency, safety, and cost reduction. Despite their benefits, healthcare providers and organizations still face challenges, including usability and interoperability across systems, contributing to physicians' burnout. Can physicians adopt new technologies and adapt to current challenges? Is it the right time for physicians to stop being observers and become active participants in the process of healthcare innovation and implementation?

Keywords
Physician; EHR; Implementation; Physicians' burnout.

My graduate school education in Health Informatics and Analytics provided me with a wide range of study, which gives me a broader frame of reference to understand and relate to my past clinical experience as a pediatrician and psychiatrist before and after EHR implementation. I would like to share my insights about the past and my hopes about the future of the medical practice in the United States (U. S.).

Electronic health records (EHRs) transformed health care in many ways. Unlike paper records, which were often illegible, incomplete, or unavailable, EHRs collect, store and supply patient information to providers when and where it is needed. EHRs use a computerized provider order entry system (CPOE), which involves entering and sending orders and treatment instructions electronically, rather than using paper, fax, or telephone. CPOE systems represent an essential tool for providing clinical decision support at the point of care, aiming to improve quality, safety, and healthcare delivery efficiency. In 1999 a study at Brigham and Women's Hospital, MA, USA, found that a CPOE system with decision support features reduced the incidence of serious medication errors by 86%.[1]

The Office of the National Coordinator for Health Information Technology (ONC), which resides within the Office of the Secretary of the U. S. Department of Health and Human Services (HHS), is at the forefront of the federal government's health IT efforts. It is driven by its vision to create a "l*earning health system where individuals are at the center of their care; where providers have a seamless ability to securely access and use health information from different sources; where an individual's health information is not limited to what is stored in EHRs, but includes information from many different sources (including wearable technologies) and portrays a longitudinal picture of their health, not just episodes of care; where diagnostic tests are only repeated when necessary because the information is readily available; and where public health agencies and researchers can rapidly learn, develop, and deliver cutting edge treatments*."[2]

The National Institute of Standards and Technology (NIST) recognizes that technical standards are crucial for the innovation puzzle. NIST's focus is to streamline the federal government's participation in the private-sector-led standard system to enable two or more systems or components to exchange information and to use the information that has been exchanged. This process is defined as interoperability by the Institute for Electrical and Electronics Engineering (IEEE).[3]

True interoperability has yet to be realized due to a lack of coordination, lack of standards between EHR systems, and other barriers which hinder information exchange and sharing. Without interoperability, health information cannot become available to the right people, at the right place, at the right time. The coro-

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navirus disease 2019 (COVID-19) pandemic triggered the rapid adoption of telemedicine, revealing a growing need for systems and platforms to support patient-centered care. COVID-19 tested EHRs' capabilities to integrate with telehealth.

In hindsight, during the pandemic, health care could have gone worse without EHRs. When the Institute of Medicine (IOM, 1991) published its landmark report, *The Computer-Based Patient Record: An Essential Technology for Health Care*, which called for the widespread adoption of computerized patient records (CPR's) as a precursor to what we refer to today as EHR systems IOM did not know that they were preparing healthcare for dealing with a future pandemic.

Imagine if the COVID-19 outbreak had occurred before the Electronic Health Records era. Without having remote healthcare delivery, controlling the spread of COVID-19 virus might have been impossible. Patients would have run the risk of getting infected during in-person medical visits unrelated to the pandemic. The health of many healthcare providers would have been endangered as well. Fortunately, we are in the position of being able to rely on remote-access patient visits during the pandemic.

Many other examples illustrate the value of EHRs to healthcare. However, it is essential to note that despite its benefits for quality, safety, efficiency, improved revenue, and cost reduction, it often has mixed or negative impacts on the provider and patient satisfaction.

For example, although physicians appreciate that they can access patient information remotely and provide improved patient care, they are nevertheless frustrated with its inflexibility regarding clinical workflow management. EHRs became an administrative tool to manage physicians'productivity using the "*one size fits all" approach. New patients are entitled to a 50-minute slot, and 20-minutes visits are reserved for returning patients regardless of what brings them to see a doctor. Unfortunately, EHR's do not solve a dilemma: "how can a child psychiatrist fully engage with a special needs child and their family traveling from out-of-state to discuss their concerns in just 20-minutes?*". Gains resulting from spending just a few minutes talking to youth about using drugs might have a more significant impact than any medicine. In short, how can this approach promote patient-centeredness, one of the Institute of Medicine's six core aims?

An additional problem is that diligent completion of EHR documentation leaves little time for physicians to engage their patients in conversations about their health, which would improve patient medical literacy skills. It is estimated that only 12% of American adults have health literacy skills proficient enough to successfully understand health information and navigate our demanding healthcare system.[4] Limited health literacy is associated with poor management of chronic diseases, suboptimal understanding and adherence to medication plans, increased hospitalizations, and poor health outcomes.[5]

There are other issues as well. Should the doctor look at a screen when evaluating a suicidal patient? What are the insights when a physician finds out that the patient was not taking their medications in the first place, only after placing a new order for a higher dose of the same medicine? What are ways to consider monitoring if patients are taking their medications correctly?

Some health insurances have invested in medication compliance programs because of the high cost of prescription medications. For example, in the treatment of hepatitis C, each pill can cost hundreds of dollars. When patients don't take medications, the health insurance industry loses billions of dollars. US health plan Cigna developed a novel monitoring system, aiming to apply machine learning to resolve this challenge by alerting doctors their patients may not be taking their prescribed drugs.[6] This tool, called Health Connect 360, aggregates patients' data from various sources and analytical tools into a dashboard accessible through an online interface to providers. *Via* the interface, doctors and nurses can keep an eye on patients' health. For example, an alert may be triggered if patients forget to pick up their prescriptions or miss an appointment.

For healthcare providers, strategies to address clinical problems with technological solutions remain limited. It requires time and effort to learn new skills. For example, application (APP) advisor was developed by the American Psychiatric Association (APA) as an educational tool to help psychiatrists learn about the efficacy, risks, and suitability of available mobile and online apps.[7] When asked about learning new technology skills, many doctors often comment that it is hard to justify investing their time and effort in innovation without evidence of recognized value. At the same time, they acknowledge the need to create innovative solutions to be better equipped for specific situations. For example, it is hard to reach depressed patients, who, by their condition, are at increased risk of dropping their self-care and avoiding self-advocacy when they need it the most. It is debatable if tracking patients' use of social media could fulfill this role.

Remote patient monitoring is a window into patients' lives and allows a provider to collect a wide range of health data and other forms of data. There are efforts to develop electronic platforms to engage patients through the use of wearables (e.g., Fitbit). However, physicians simply do not have time within their schedules to make sense of lengthy lists of numbers generated by wearables patients bring to their appointments. Many physicians have only 30-seconds to analyze data collected over weeks, with no tools to assist them. Concerns about patient privacy is also inherent with wearable technology.

Through the Health Insurance Portability and Accountability Act of 1996 (HIPAA), U. S. citizens have the legal right to request and receive copies of their medical records, including clinical notes.[8] The process of requesting records through a hospital can take time and effort, and patients must pay for the medium through which the medical records are delivered on (e.g., paper copies, compact disks (CDs), digital versatile disk (DVDs)).[9] Starting April 5, 2021, patients will have near-immediate access to most of their electronic medical records, including progress notes; when notes are shared, they become free.[10,11] The OpenNotes initiative

is a research initiative and international movement located at Beth Israel Deaconess Medical Center, which is affiliated with Harvard Medical School. Sharing notes with patients represents a culture shift and focuses on making health care more open and transparent encouraging patients to engage in healthcare decisions. Sharing clinical notes with patientsis made possible thanks to electronic health records in the U. S.

OpenNotes was first discussed in the Annals of Internal Medicine in 2018.[12] An accompanying editorial hypothesized the concept could result in an improved "*shared decision-making process… thereby (encouraging patients to) follow their physicians'advice*" and may save health systems billions of dollars on "*medication nonadherence*."[13]

Unlike OpenNotes, OurNotes is a patient entered notes system. Patients have an option to add a history of present illness (HPI) and their own goals. It allows a patient to contribute to their medical record by updating their family and social history, write a concise, structured interval history, and propose a visit agenda. As a result of the COVID-19 pandemic, Beth Israel Deaconess Medical Center's pilot of OurNotes expanded to telemedicine delivery in mid-March 2020.

Despite the wide use of EHR systems, which have been a great asset during the pandemic, healthcare providers and organizations still face challenges, including usability and interoperability and usability across system, contributing to physician burnout. According to a recent study, burnout has reached epidemic levels, with the prevalence near or exceeding 50% among physicians in training (medical students, residents) and practicing physicians in the U. S.[11]

Physicians' burnout is like a straw that shows which way the wind blows. It suggests a much deeper and more complicated issue in society. It is time for physicians to come out of their offices, explore new ideas and learn new strategies. Physicians hold the knowledge that can only be acquired through practicing medicine. They need to share it readily with stakeholders who have the authority to make critical clinical and administrative decisions. They need to speak up about what is essential for them and their patients. I hope that technology will not compete with but enrich and empower individual patients, healthcare providers, and public health.

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Original Research

Towards Universal Health Coverage: Designing a Community Based Intervention to Scale Up Coverage with Health Insurance, in A-Duiem Administrative Unit, Sudan 2018-2019

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ABSTRACT

Background: Community engagement has proved effective in increasing access to healthcare including health insurance, in developed and developing countries.

Aim: The study aims at designing and testing the effectiveness of engaging the community in awareness-raising and increment of health insurance coverage.

Methods: The study was a social interventional community-based study, conducted in A-Duiem Administrative Unit, A-Duiem Locality, Sudan. Baseline data on enrollment in health insurance was collected from 800 heads of households, whereas data on knowledge and attitudes about health insurance was collected from 420 heads of non-insured households using a standardized questionnaire. Strategies to scaleup health insurance through community engagement was collected from community leaders, local authorities, and health insurance policymakers through in-depth interviews and focus group discussions. The community promotion package of health insurance was implemented for one year and post-intervention data were collected from 420 heads of households. Quantitative data were analyzed using SPSS version 20. Statistical significance was set at $p<0.05$ when the confidence interval was 95%. Qualitative data was analyzed manually using the thematic approach.

Results: The study showed significant improvement in the knowledge of the heads of the non-insured households about health insurance after the intervention; knowledge about the enrollment process and service's package has increased from 34.4% to 61.8% and from 55.8% to 84.7% respectively (p-value 0.0001 in both). The health insurance coverage increased by 17.3% with a significant difference and p-value at 0.0001.

Conclusion: The study concluded that community members have a considerable role in awareness-raising and scaling up of health insurance coverage if they are properly organized, trained, monitored, and supervised. The insufficient commitment of local officials in the unit was a challenge to address during further testing and expansion of the experience.

Keywords
Health insurance; Population coverage; Knowledge; Attitudes; Community engagement; Intervention; Sudan.

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BACKGROUND

Universal Health Coverage (UHC) is the aspiration that all people can obtain the quality health services they need (equity in service use) without fear of financial hardship (financial protection).[1]

Community engagement in the health context is the involvement of the community members in attaining UHC. It also requisites involving community members in developing and implementing policies that will affect them as health consumers. It has proved effective in addressing different health issues, including health insurance (HI) in developed and developing countries,[2,3] such as Rwanda and Thailand.[4,5] It worth adopting it in resource constraint countries.[6]

In Sudan, community engagement has been translated through the construction of health facilities, the top-up of health personnel and the conduction of health education campaigns. Khartoum State; was an inspiring experience, where HI coverage has remarkably increased to 72.2% in 2017,[7] through an intensive community engagement. Others included the White Hands Initiative which mobilizes funds from Zakat, national charity institutions, and community activists to pay HI premium for the poor. Similar successful stories were seen in Gezira State and White Nile State.[8]

Awareness-raising is crucial for the acceleration of HI coverage. Yet, many studies showed low-levels of awareness among populations. Awareness among the community was poor at 13% in a study in Nigeria, including the general principles of community health insurance.[9]

The White Nile State is one of the States with low HI coverage. In mid-2017 it ranked as the 12th of 18 states in Sudan with a coverage rate of 46.9%.[10] This estimate was far less than the national target of 80% set in the strategic plans of the National Health Insurance Fund (NHIF) and the National Health Sector Strategic Plan which aim to achieve universal health coverage by 2019.[11,12]

Among the most important priorities of the strategic plan of the NHIF for the years 2017-2020 are to develop and diversify the mechanisms to provide HI services for the informal and private sectors, to find sufficient funding to cover the poor, and to increase awareness about the importance of HI.[11]

The study question was whether community engagement will contribute to awareness-raising and HI coverage increment in A-Duiem Administrative Unit (DAU)? The study hypothesis was that community members and community organizations could have a role in awareness-raising and HI coverage increment if they are organized, trained, monitored, and adequately supervised. The study aimed at designing and testing the effectiveness of community engagement in awareness-raising and health insurance coverage increment in DAU, A Duiem Locality and White Nile State 2018-2019. Specifically, the study aimed at exploring the perception and preferences of key stakeholders and civil society to community mobilization for HI enrollment; identifying the key stakeholders and civil society expected roles and modalities of engagement; and testing the preferred approaches of community mobilization for HI, through measuring the change in knowledge and attitudes of the target non-insured household' heads and to measure the alteration in the population coverage with HI.

MATERIALS AND METHODS

Study Design and Area

The study was an interventional community-based study that combined quantitative and qualitative techniques for the pre-intervention data collection and a quantitative one for the post-intervention phase. The study was conducted in DAU, which lies in central Sudan and composed of 34 Popular Administrative Units (Hai), 11,681 households which were resident by about 76,000 inhabitants.[13]

Study Population

The study population for the pre-intervention phase included heads of the households (HHs) with a subset of the heads of the non-insured households (HNIHs); community leaders; and members of the community organization in DAU, political and executive leaders at the locality, and decision-makers at all levels of the NHIF, while only the HHs were addressed in the post intervention phase.

Sample Size and Sampling

Eight-hundred (800) HHs among them four hundred and twenty (420) HNIHs were enrolled in the study. A cluster sampling technique was used where the cluster is the Hai. Details of the sample size formula and selection process were depicted in the paper "*Determinants of Non-Insurance in A-Duiem Administrative Unit, White Nile State, Sudan 2018*".[14] The same method was used during the post-intervention phase, but the sample included all HHs whether insured or not. Other study populations were selected purposively[15] based on their proactive role, acceptability by the community, and representation of community organizations. They included seven policymakers from the NHIF at different levels; thirteen local political and executive leaders at the locality and the administrative unit; thirteen traditional community and community-based organizations leaders, including women and youth; and eighty members from the community-based organizations and the community at the administrative unit.

Data Collection

Six data collection tools were developed and tested by the research team. Data collection tools for the HHs, HNIHs, Community leaders, and members of the community organizations were described in details in the paper "*Determinants of Non-Insurance in A-Duiem Administrative Unit, White Nile State, Sudan 2018*".[14] The fifth tool was used to collect data from officials at the NHIF

through face-to-face interviews. The sixth one was used during the post-intervention phase to collect quantitative data through face-to-face interviews with HHs. It was a modified version from the pre-intervention one. The data collectors were qualified personnel from DAU who were trained and supervised during the fieldwork by three experts.

Variables

The quantitative variables for HHs were only their status of insurance and for the HNIHs were their knowledge about and attitudes towards HI.

The qualitative variables for the other study populations included their views about experiences of community engagement in HI, methods of organization of the community engagement in HI, tasks which could be performed, entities that could be engaged in awareness-raising and HI coverage increment, the suggested support from the NHIF to the community work, and the suggested methods for monitoring and supervision of the community work.

Data Analysis

Data were cleaned and analyzed manually for HI coverage during the pre-intervention phase and by SPSS version 20 for other quantitative variables.

The study team agreed on three key indicators to assess the level of knowledge; including the process of enrollment into HI, service package offered by HI, and HI premium. The results were qualified as good, moderate, poor, or did not know when the interviewee knew the three, two, one, or zero of the specified indicators respectively.

Descriptive statistics were carried out for quantitative data and inputs were summarized as frequencies and proportions using a 95% confidence level.

Inferential statistics using chi-square were used to test the difference in HI status, knowledge, and attitude of HNIHs towards HI before and after the intervention. A probability value of less than 0.05 was considered statistically significant.

Qualitative data were revised immediately after collection, transcribed, ordered, coded, summarized, and manually analyzed by a qualified qualitative data specialist using the thematic approach. The outcomes were presented in terms of texts.

The Intervention

The study team designed the intervention based on the information derived from the pre-intervention survey.

Almost all HI officials agreed that the community have a great role to promote HI, citing several experiences in Sudan such as Khartoum, Gezira, Northern, and the White Nile States, and the White Hands Initiative as well as worldwide such as Rwanda, Ghana, and Ethiopia. Eighty-nine percent (89%) of the HNIH confirmed that the community could have a considerable role in HI awareness-raising and coverage increment.

Almost all the study participants from DAU were inspired by the community initiatives and solidarity in developmental interventions in the unit and therefore they believe that the promotion of the HI among the community can follow the same tracks.

Regarding mobilization and organization of the community, most of the HI officials suggested the establishment of community committees at different levels in DAU with clearly identified tasks and relationships and with contribution from the HI as a rapporteur. Almost all the participants from the locality and administrative unit have proposed the establishment of an executive community committee at the administrative unit including stakeholders assisted by sub-committees at the Hai level (residential settings). Most of them emphasized the importance of the subcommittees, indicating that their role is essential in facilitating entry to the community at the Hai level. Based on that, the intervention included the establishment of a community committee at the level of the unit and subcommittees at the level of Hais.

Most of the study participants enumerated the main tasks for the committees as increasing community awareness about HI, performing the households' inventory, assisting in the process of enrollment of the non-insured in HI, and attracting financial resources to pay the premiums of the poor. Besides, a minority of the participants added the importance of monitoring the quality of the health services and participation in their improvement. Because of these suggestions the study team specified the terms of reference, tasks, powers, and relations for the committees.

Different community-based organizations and activists joined the project, in the form of community mobilization and contribution to establish the proposed community structure, which was called A-Duiem Administrative Unit Community Committee (DAUCC).

Members of DAUCC were trained by the study team about planning, HI, and community engagement in HI. After training they set and approved the unit plan, based on the structure and guidelines provided by the study team. They divided the administrative unit into six geographical sectors and assigned a supervisor for each one.

The Hai committees were formed through free selection in general meetings held for the people at each Hai and supervised by the members of DAUCC. The members of Hais' committees were trained in two-days workshops, using a manual designed by the study team. The training included theoretical and practical sessions about HI, community engagement in HI, surveying, planning, implementation, fundraising, and monitoring.

As for the support which the HI directorate could pro-

vide to the community committees, most of the participants mentioned training of the community committees, provision of educational materials for awareness-raising, participation in awareness campaigns and limited participation in transport and financial support to conduct the activities. However, few suggested providing the place for the committees and financial incentives for the volunteers.

Almost all the study participants indicated that monitoring and supervision of the community work could be through regular reports and meetings. Some study participants suggested social media such as WhatsApp and others to engage and communicate with expatriates. The monitoring of the community work was decided to be through regular reports and joint meetings between DAUCC and the study team. The monitoring tools included forms for the reports to summarize the performance of DAUCC, sectors, and Hai committees. Also, a WhatsApp group was created for continuous communication.

The implementation of the intervention continued for one year. The follow-up of the work by the official authorities, including local HI, was very weak. Some of the Hais' committees performed very well, whereas others were inactive, and their work was not as was expected to their great enthusiasm during the training sessions. There was great dropout among the members and some of them requested financial incentives. However, for those who performed well, their interventions were directly impacted on the improvement of the Hais' insurance status. The meetings of DAUCC and Hais' committees were irregular.

RESULTS

Ninety-nine percent (99%) of household's participants have responded in pre- and post-intervention surveys. Regarding the other study populations, almost all of them responded both in the interviews and the focus group discussions (FGDs).

The percentage of the non-insured families who stated that they had heard of HI increased from 63.1 to 98.6% after the intervention. The knowledge enrollment process in HI and the services provided by it increased from 34.4 to 61.8% and from 55.8 to 84.7% respectively. The difference was statistically significant

Table 1. *Knowledge of NIHH bout HI before the Intervention (2018) and after the Intervention (2019) in DAU,White State, Sudan*

Knowledge	Before Intervention (n=419)		After Intervention (n=144)		*p*-value
	N	%	N	%	
How to be enrolled in HI	144	34.4%	89	61.8%	0.0001
Services provided by HI	234	55.8%	122	84.7%	0.0001
Family premium per year	17	4.1%	6	4.2%	0.958

Table 2. *Insurance Status of the HH in DAU before the Intervention (2018) and after the Intervention (2019)*

S.No.	Hai Name	Pre-Intervention		Post-Intervention		*p*-value
		Insured HHs (%)	Total HHs	Insured HHs (%)	Total HHs	
1	1st Hai	29 (59.2)	49	16 (80)	20	0.102
2	4th Hai	42 (67.7)	62	17 (85)	20	0.134
3	7th Hai	28 (58.3)	48	14 (70)	20	0.369
4	10th Hai	23 (53.5)	43	13 (65)	20	0.394
5	Hai Elumaraa	20 (50)	40	9 (45)	20	0.717
6	West Unity and Unity Hai	19 (48.7)	39	12 (60)	20	0.415
7	The 13th Hai, Sq.1	44 (68.7)	64	17 (85)	20	0.156
8	The 13th Hai, Sq.3	29 (59.2)	49	16 (80)	20	0.102
9	The 14th Hai, Mabrouka	4 (16.7)	24	14 (70)	20	0.0004
10	The 16th Hai, AbuGabraSq.5 and Elshigla	27 (40.3)	67	24 (60)	20	0.049
11	The 16th Hai, AbuGabraSq.6	15 (42.8)	35	16 (80)	20	0.008
12	The 16th Hai, AbuGabraSq.10	4 (16.7)	24	11 (55)	20	0.008
13	The 16th Hai, AbuGabra Sq. (13-14-15-7)	21 (51.2)	41	12 (63.2)	19	0.888
14	The 17th Hai, Alrabaa	14 (41.2)	39	13 (65)	20	0.086
15	The 18th Hai, Hai AlArab and Salim	20 (50)	40	10 (50)	20	1
16	The 19th Hai, AlDaraga	0 (0)	19	12 (60)	20	0.0001
17	The 20th Hai, AlSalam	4 (16.7)	24	12 (60)	20	0.003
18	The 21st Hai, ElEngaz	11 (52.4)	31	7 (35)	20	0.228
19	The 23rd Hai, ElTadamon and Eleshlag	21 (51.2)	41	17 (85)	20	0.011
20	The 24th Hai, Awaad	6 (23)	26	10 (50)	20	0.059
	Total	381 (47.6)	800	272 (64.9)	419	0.0001

(*p*-values were 0.0001 in both cases). On the other hand, knowledge about yearly family premium did not increase, as it was 4.1% before and 4.2% after the intervention (Table 1).

There was no great change in the attitude of the NIHHs towards HI as measured by the desire to be enrolled in it, as itwas high in both cases; 97% and 97.8% before and after the intervention respectively.

The percentage of HI coverage in the administrative unit increased by 17.3% (from 47.6 to 64.9%) after the intervention and there was a statistically significant difference as the *p*-value was 0.0001. The average of the coverage increment was more than 30% and it was statistically significant after the interventions in six Hais as *p*-values were 0.0004, 0.049, 0.008, 0.008, 0.0001 and 0.003 in Mabrouka, Abu Gabra Sq. 5 and El Shigla, Abu Gabra Sq. 6, Abu Gabra Sq. 10, Al Daraga, and Al Salam respectively as shown in Table 2.

DISCUSSION AND CONCLUSION

The expectations of almost all the study participants about the possibility of a successful community engagement in awareness-raising and HI coverage increment is not strange for the Sudanese people as they see it as a religious matter in the first place "*a believer for a believer is like a building pulling together*" said prophet Mohamed peace be upon him.[16] It also corresponds to what has been proven by studies in many developed and developing countries, which indicated that community participation has high effectiveness in addressing various health issues, including HI. Examples included the role of the community in HI and UHC in South Africa, Rwanda, Thailand, and other countries.[2,3,5]

In Sudan, too, there was a broad community participation on all issues, including health, ranging from building health facilities, motivating health workers, and conducting health convoys. There were also several experiences of community participation in HI, such as the experience of the White Hands Initiative, which aims at involving Zakat, institutions, and individuals in paying the insurance premium for the poor.[17] Together with the different HI initiatives of the community in Khartoum, Gezira and Sennar states.[18,19]

Most of the methods for organizing the community and its tasks, mentioned by the study participants, were also performed by the HI community committees in the Khartoum State.[18] Fundraising as a task suggested for the committees was used to be carried out by most of the communities engaged in HI in Sudan. As mentioned above, the non-governmental community organization "*White Hands Initiative*" was created in Sudan specifically to raise fund to pay the HI premium of the poor.[17]

In the intervention period some committees and some members performed very well, this was also noticed in Rwanda, where there was a good performance. This good performance in Rwanda was due to the good leadership and high commitment, strong and real desire to work, attention to defining and describing tasks accurately, training and raising competencies.[4] Most of these factors were also available in this experience. Yet other important factors that were not available in this intervention, and they were also similar to the experience in Rwanda include coordination and cooperation and methods of solving the problems.[4] The literature also shows that for the community work to be successful, people who want to volunteer must have several traits, including the true desire to volunteer, complete willingness to exert effort; money; and time, impartiality and selflessness, honesty and sincerity, activity, sincerity and dedication, the ability to work with the team and the ability to coordinate with the relevant authorities, to demonstrate high ethics in dealing with others and not to seek success in the failure of others.[3] In this experience, despite the availability of traits in some committee members, many of them lacked traits such as willingness to exert effort; money; and time, dedication, and ability to coordinate. Similar challenges to the work were also found in several experiences such as the inability to continue voluntary work, multiple individual obligations, and the lack of follow-up, encouragement, and direction by the administrative authorities.[3]

The weakness of the local authority's follow-up for the community work has greatly affected its success. This was also noticed in an interventional study conducted in Ghana about the design and implementation of community engagement interventions towards healthcare quality improvement. The study, which was published in 2016, indicated that if the community engagement in the healthcare process is not well-supervised and monitored, the intervention will not provide the desired outcomes.[6]

The significant improvement in the knowledge of the NIHH about HI after the intervention was expected, as the members of the community committees shared the knowledge which they received during the training with their families and neighbors and within their Hais. It was also noticed that during the intervention period some community activities were performed for awareness-raising about HI, among that was a campaign performed for secondary schools' students.

The minor change noticed about the attitudes of NIHH toward HI and their desire to be ensured was because even before the intervention their attitude was excellent and nearly all of them had the desire to be ensured. This was also seen in Nigeria, where the respondents to the study showed a positive attitude towards HI and 97% of them expressed their interest in participating and enrolling themselves in HI.[9]

The change in the population coverage with HI after the intervention which was statistically significant is considerably high compared to other areas in Sudan (17.3%). For example, when comparing it with the annual change in the percentages of HI in A-Duiem locality, the White Nile State and the national level at the end of the years 2017, 2018 and 2019, which were -0.3%, 10% and 11.6%, respectively in A-Duiem, 0%, 11.4%, and 13% respectively in the White Nile State, while at the national level, it was 12%, 10.1%, and 11.9%, respectively.[7] Before 2015, the annual percentages changes in Sudan were even lower, as they were 3.5%, 1.5%, 4.6% and 3% between the years 2011 to 2015.[19]

Several studies and reports supports that this increase is due to the community engagement in HI, including what happened in Khartoum State when a great increase occurred in the HI coverage and the State ranked the first among the states of Sudan.[7] That was happened after the implementation of the comprehensive HI coverage project, with the participation of the community committees.[18] In Rwanda the HI coverage increased from 9 to 90% in 9-years from 2003 to 2012 due to the active participation of the community.[4] Another evidence was also seen in a study conducted in Ghana to evaluate the impact of community engagement on healthcare utilization and health insurance enrolment. It was found that in a short period (12-months) the intervention resulted in a 7.2% point increase in the HI enrolment of the members in the intervention communities who were uninsured at baseline.[20] Similarly the effectiveness of the community engagement in public health interventions was found to have a positive impact on the health outcomes of the disadvantage groups in a meta-analysis study which included 131 studies.[21]

In conclusion, the study demonstrated that community members and community organizations could have a major role in awareness-raising and HI coverage increment, if they were organized, trained, monitored, and supervised properly. This was apparent from the significant change in knowledge about HI and the increase in population coverage with HI after the intervention. The study produced several documents that could be used by the concerned to ensure effective community involvement in HI, such as committees' formation documents, the training manual for the committee members, the inventory and classification forms and the report forms.

LIMITATIONS OF THE STUDY

One of its limitations was that it relied on data before and after the intervention and did not include another geographical area for comparison. The intervention period continued for only one year due to the limited available time and budget. The best for such studies is to continue for a longer time to test the continuity of the intervention.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical and administrative approvals were obtained from the Ministry of Health in the White Nile State and DAU respectively and oral informed consent was obtained from the study population according to the guidelines of the National Health Research Ethics Committee.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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Observational Study

Prevalence and Risk Factors of Low High-Density Lipoproteins-Cholesterol: An Analysis of the United States of America National Health and Nutrition Examination Survey, 2015-2016

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ABSTRACT

Background
Non-communicable diseases (NCDs) are the leading cause of mortality worldwide, with cardiovascular diseases (CVDs) being the most predominant. This is a similar trend in the United States (U.S.). Modifiable and non-modifiable factors are important determinants of dyslipidaemia, a known cause of CVDs.

Objective
This study aimed to explore the pattern of high-density lipoprotein cholesterol (HDL-C) distribution and its associated risk factors.

Methods
The data was collected from the National Health and Nutrition Examination Survey (NHANES) 2015-2016 database which is part of the yearly cross-sectional survey. The NHANES uses complex multistage probability sampling method in data collection. The target population was the noninstitutionalized civilian living across the U.S. The primary sampling units were individuals. Socio-demographic characteristics, body measurement (waist circumference) and blood samples (to determine HDL-C and total cholesterol levels) were recorded. In the database, 5000 respondents were randomly selected for analysis. Statistical analyses were performed using Stata version 14.0. The results are described as means and standard deviation (SD) for group and continuous variables. Regression analyses were used to identify risk factors of low HDL-C.

Results
Of the complete cases (3989), 49.03% were males. The mean age was 46.57±15.44-years. The mean HDL-C was 1.39±0.45 mmoL/L. The prevalence of low HDL-C was 32.8% in males and 12.5% in females. The results obtained from multiple linear regression indicated that male gender, age, ethnicity, country of birth, number of children aged 0-18-years per household, waist circumference, family income to poverty ratio and total cholesterol were significantly associated with HDL-C. Multivariable logistic regression revealed male gender, age 30 to 49-years, ethnicity, smoking, enlarged waist circumference (cm), low family income to poverty ratio and high total cholesterol were associated with low HDL-C.

Conclusion
The prevalence of low HDL-C of was 22.4 %. This was distributed into 32.8% in males and 12.5% in females. The associated risk factors show that lifestyle modification is important in the prevention of low HDL-C and consequently, CVDs.

Keywords
HDL-C; Risk factors; Cardiovascular diseases; NHANES.

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INTRODUCTION

Non-communicable diseases (NCDs) have been the leading cause of mortality worldwide, with cardiovascular diseases (CVDs) being the most predominant.[1] This trend is not different from that observed in the United States.[2,3] Despite overall reductions in deaths from CVDs over the past few decades, approximately 2,200 individuals in the United States (U.S.) die of CVDs each day.[3] This represents a serious public health problem.

Cardiovascular disease risk factors are conditions that are associated with the early onset of the disease. Some of these risk factors are modifiable while others are not. Modifiable CVD risk factors include smoking, dyslipidaemia, obesity, diabetes, hypertension, sedentarism, psychosocial stress. Age, sex, and heredity are not modifiable risk factors.[4,5] Certain types of dyslipidaemia are hereditary and may not be modifiable, for example, familial hypercholesterolemia.[6] Some studies have shown that high-income persons have a lower cardiovascular risk as opposed to low-income individuals. This shows that the socio-economic status plays a vital role in the development of CVDs. People suffering from food insecurity will be exposed to high energy foods and saturated fatty acid foods. Such food types are cheap and readily available. Among other factors, low educational level plays a role in the consumption of poor-quality foods.

Dyslipidaemia is defined as an increased triglyceride and lowered high-density lipoprotein cholesterollevel in serum. Itis a common CVD risk factor and has been demonstrated to be associated with increased risk of developing CVDs.[1,5] Differences in dyslipidaemia are seen across population, race, and ethnic groups. In the U.S., Non-Hispanic blacks have much higher death rates from CVDs and stroke than other races.[3]

There are different types of cholesterol with varying functions and the level of serum cholesterol is influenced by several factors. Several epidemiological studies have demonstrated that increased levels of plasma total cholesterol and low-density lipoproteins (LDL) are strongly and directly related to a greater incidence of coronary heart disease.[7] Elevated plasma triglycerides and very-low-density lipoproteins (VLDL) are directly associated with the risk of atherosclerotic heart disease, although not as independent risk factors.[6] In contrast, high-levels of high-density lipoprotein-cholesterol (HDL-C) have been found to be a protective factor for the development of CVDs, hence, also known as "good cholesterol".[6] HDL-C protects against heart disease by transporting the "bad cholesterol" from the blood to the liver, preventing accumulation in the arteries. Low-levels of HDL-C are therefore considered a risk factor for CVDs.[2,6] In addition, low HDL-C is used to determine metabolic syndrome.[2] Metabolic syndromeconsists of a group of risk factors for CVDs and type 2 diabetes mellitus (T2DM), which often occur together. These risk factors include raised blood pressure, dyslipidaemia, raised fasting glucose and central obesity.[5]

Alberti et al[5] further noted that patients with metabolic syndrome are twice at risk of developing CVD over the next 5 to 10-years compared to individuals without metabolic syndrome, therefore risk increases overtime. Also, metabolic syndrome confers a five-fold increase in risk for T2DM in such patients.[5]

An increased waist circumference is attributed to poor lifestyle and is used to measure central obesity; a characteristic of metabolic syndrome. This has several implications, including insulin resistance in diabetic patients. With changes in lifestyles such as increased sedentarism, increased consumption of cheap fatty foods, smoking, and lack of physical exercise, there is risk of total cholesterol accumulation in the blood and a decrease in HDL-C. Many studies have reported an increase in sedentary lifestyle among the adults of the U.S.[8] It is therefore necessary to examine HDL-C levels and the pattern of its distribution across the U.S. population. Knowing the prevalence and factors associated with low HDL-C will help policy makers to take better measures and initiatives to prevent CVDs.

The objective of this study was to determine the prevalence of low HDL-C and its associated risk factors. The pattern of distribution of HDL-C was also investigated. We hypothesised that an unhealthy lifestyle and low socio-economic status are associated with low HDL-C. We further hypothesize that some demographic characteristics are linked to HDL-C.

METHODOLOGY

Description of Variables

There were 13 variables included in the data analysis. The selection of these variables from the dataset was based on the available published literature, underpinned by the knowledge of the investigators. The outcome variable was HDL-C (continuous variable). This was dichotomised into low (< 1.03 mmol/L) and normal (≥1.03 mmol/L) HDL-C. The explanatory variables were age, sex, ethnicity, marital status, educational level, country of birth, family income to poverty ratio, number of children aged 0-18-years per household, smoking, health insurance coverage, waist circumference and total cholesterol.

In the analyses of the relationship between the explanatory variables and the outcome variables, some variables were categorized based on the literature and standards. Age was categorised based on the existing literature into six categories, with a 10-year interval. The number of children aged 0-18-years in a household was grouped into five categories; households with five or more children are generally considered to have more financial constraints. The waist circumference was classified into normal and enlarged, based on sex. This grouping was based on the recommended normal waist circumferencefor males(≤102 cm) and females(≤88 cm) from the National Cholesterol Education Program - Adult Treatment Panel III (NCEP ATPIII) (2001). The marital status categories were married, widowed, divorced, separated, never married, and living with partner. The educational attainment level was grouped as less than 9th grade education, 9-11th grade education (includes 12th grade and no diploma), high school graduate/GED, some college or associates (AA) degree and college graduate or higher. Ethnicity was categorised as Mexican American, oth-

er Hispanic, Non-Hispanic White, Non-Hispanic Black and other race-including multi-racial. The country of birth was dichotomised into U.S. or other. The smoking status was categorized as never smoked, former smoker or current smoker. Health insurance coverage was dichotomised into being covered or not.

Some categories with a small number of observations that had no direct influence on the analysis were either merged with another category or considered as missing. For instance, for the variable health insurance coverage, those who refused to respond (n=3) and those who did not know (n=4) were all considered to be missing values. Those who refused to disclose their marital status (n=2) were also considered as missing values. One participant did not know their country of birth, and this was considered a missing value. One person did not know his/her educational level, this was classified as missing. Also, two outliers were considered as missing values for HDL-C.

Statistical Analysis

Statistical analyses were performed using Stata version 14.0 (StataCorp LP, College Station, Texas, 77,845 USA). The results are described as means and standard deviation (SD) for group and continuous variables. Proportions are also presented for categorical variables.

High-density lipoprotein-cholesterol as a continuous variable: The association between HDL-C and age groups, marital status, educational level, ethnicity, number of children per household and smoking status were assessed using the one-way analysis of variance with *f*-test. Meanwhile for binary categories; sex, country of birth, insurance coverage and waist circumference categories, the Student's *t*-test was used as the measure of association. Normality check of HDL-C was confirmed with a histogram and homoscedasticity using the Levene's test. A simple linear regression was used to test the significance of an increase or decrease of mean HDL-C values across groupsor continuous variables taking validity conditions into consideration. Collinearity was checked using the variance inflation factor (VIF) and all variables had a VIF<10. The multivariate linear regression model was used to check the association of the independent variables to HDL-C. The step-by-step method was used, taking probability of entry to be 5% and of removal 10%. Normality of residuals was assessed using Qnorm and the Breusch-Pagan test, normality present (p value not significant).

Low high-density lipoproteins-cholesterol as binary variable: A Chi-square (χ) test wasused to determine the prevalence and difference in prevalence across groups after examining its applicability. Socio-demographic factors (age, sex, country of birth, marital status, education level, health insurance coverage and number of children per household aged 0-18-years), anthropometric factor (waist circumference) and lifestyle factor (smoking), were created as dummy variables. Economic status (family income to poverty ratio) and nutrition factor (total cholesterol) were used as continuous variables. Univariate logistic regression was used to examine the risk of low HDL-C according to various determinants. The step-by-step method was used, and results compared with those of step wise approach, probability of entry 5% and of removal 10%. The results of both models were similar. The test of Hosmer and Lemeshow was used to check the fitness of the model the result was not significant (p=0.92), confirming the appropriateness of the model. The results presented are those of the step-by-step method. Adjusted odds ratio was presented together with a 95% confidence interval. All reported p-values were based on 2-sided tests and p-values<0.05 were considered statistically significant.

RESULTS

Basic Characteristics of Study Population

The general characteristics of the study population are shown in Table 1. This represents the whole cohort and complete cases. The results in the whole cohort and complete cohort were similar, further analysis was done on the complete cases. The sex distribution was almost equal between both genders. At least half of the respondents were married. Over a quarter of the respondents were at least college graduates. More than half of the respondents had never smoked and almost a quarter were current smokers. Majority of participants had health insurance coverage. The most predominant ethnic group was the non-hispanic white, accounting for 30% of the total population, while the least represented was other hispanic, constituting 14.1% of the population. Most of the participants (64.4%) were born in the U.S. Over half of the respondents had no children under 18-years of age in the household.

Several characteristics showed statistically significant associations with HDL-C in the univariate linear regression model. For instance, there was an increase of 0.03 mmol/L of HDL-C for any unit increase in family income to poverty ratio and this increase was statistically significant. Also, a 1.3% increasein HDL-C wasaccounted for by the family income to poverty ratio. Similarly, for any unit increase in the male waist circumference (cm), there was a decrease of 0.2 mmol/L of HDL-C and this decrease was statistically significant. This male waist circumference accounted for 5.9% decrease in HDL-C. In the age category, with age group 30-39-years as the reference, there was an increase in 0.08 mmol/L of HDL-C for the 50-59-years age group. Age contributedto only 1.0% of the change in HDL-C. In these comparisons, we assumed all other variables were held constant.

All variables were included in the multiple linear regression model (Table 2). After adjustment, marital status, educational level, smoking status and health insurance coverage were no longer statistically associated with HDL-C (all p>0.05). Males had a decrease of 0.23 mmol/L of HDL-C compared to females; this was similar to the result obtained in the univariate model. This suggests the other covariates had no effect on sex. Similarly, in the family income to poverty ratio, there wasa 0.02 mmol/L increase in HDL-C for any unit increase in the family income to poverty ratio, this increase was statistically significant. This increase was similar to that obtained with the univariate analysis. There was also no significant change in the association between HDL-C and the other variables: age, country of birth, number of children aged 0-18-years per household, ethnicity and total cholesterol when compared to the univariate results.

Table 1. *Overview of General Characteristics of the Study Population*

	Whole Cohort n=5,000	Complete Cases n=3,989
Sex		
Male (%)	49.4	49.0
Missing (n)	0	
Age (years)	46.9±15.6	46.6±15.4
20-29 (%)	17.8	18.1
30-39 (%)	18.3	18.6
40-49 (%)	18.5	18.9
50-59 (%)	18.5	18.5
60-69 (%)	19	18.7
≥70 (%)	7.9	7.4
Missing (n)	0	
Marital Status		
Married (%)	51.1	52
Widowed (%)	4.2	3.9
Divorced (%)	10.9	10.7
Separated (%)	3.5	3.6
Never married (%)	19.8	19.3
Living with partner (%)	10.5	10.5
Missing (n)	2	
Educational Level		
Less than 9th grade (%)	11.1	10.5
9-11th grade (Includes 12th grade with no diploma) (%)	12	10.9
High school graduate/GED or equivalent (%)	21.4	21.7
Some college or AA degree (%)	30	30.7
College graduate or above (%)	25.5	26.3
Missing (n)	1	
Ethnicity		
Mexican American (%)	17.9	17.7
Other Hispanic (%)	14.1	13.8
Non-Hispanic White (%)	30	32.4
Non-Hispanic Black (%)	21.7	20.5
Other Race - Including Multi-Racial (%)	16.2	15.6
Missing(n)	0	
Country of Birth		
Born in 50 US or Washington, DC(%)	64.4	65.7
Other(%)	35.6	34.3
Missing (n)	0	
Family income to poverty ratio	2.46±1.62	2.48±1.61
Missing (n)	500	
Number of Children 0-18-Years per Household		
0(%)	54	54.2
1(%)	16.8	16.6
2(%)	15.5	15.9
3(%)	8.5	8.1
4(%)	3.6	4
≥5(%)	1.5	1.2
Missing (n)	0	
Smoking Status		
Never smoked (%)	58.1	57.9

Former smoker (%)	21.6	22.1
Current smoker (%)	20.3	20.1
Missing (n)	6	
Covered by Health Insurance		
Yes (%)	81.1	81.3
Missing (n)	7	
Waist circumference (cm)	100.10±16.86	100.33±16.91
Missing (n)	403	
Total cholesterol (mmol/l)	4.95±1.07	4.95±1.07
Missing (n)	405	
Direct HDL-cholesterol (mmol/l)	1.39±0.45	1.39±0.45
Missing (n)	405	
Values are means±SD or numbers (percentages) as appropriate		

Table 2. *Variation of HDL-C with other Characteristics of the Study Population (Multiple Linear Regression) (n=3989)*

	Complete Cases		*p*
	Adj b	**95%CI**	
Sex			<0.001
Male	-0.23	(-0.25;-0.2)	
Female	(reference)		
Age (years)			<0.001
20-29	-0.004	(-0.05;0.04)	
30-39	(reference)		
40-49	-0.01	(-0.05;0.03)	
50-59	0.05	(0.01;0.10)	
60-69	0.09	(0.05;0.14)	
≥70	0.16	(0.10;0.22)	
Marital Status			0.41
Married (%)	(reference)		
Widowed (%)	0.01	(-0.06;0.08)	
Divorced (%)	0.03	(-0.01;0.07)	
Separated (%)	0.02	(-0.04;0.09)	
Never married (%)	0.03	(-0.01;0.06)	
Living with partner (%)	0.04	(0.001;0.09)	
Educational Level			0.17
Less than 9th grade (%)	-0.05	(-0.10;0.02)	
9-11th grade (Includes 12th grade with no diploma) (%)	-0.03	(-0.08;0.02)	
High school graduate/GED or equivalent (%)	-0.04	(-0.08;-0.002)	
Some college or AA degree (%)	-0.04	(-0.07;-0.003)	
College graduate or above (%)	(reference)		
Ethnicity			<0.001
Mexican American (%)	(reference)		
Other Hispanic (%)	-0.01	(-0.05;0.04)	
Non-Hispanic White (%)	0.07	(0.03;0.11)	
Non-Hispanic Black (%)	0.16	(0.11;0.20)	
Other Race - Including Multi-Racial (%)	-0.01	(-0.05;0.04)	

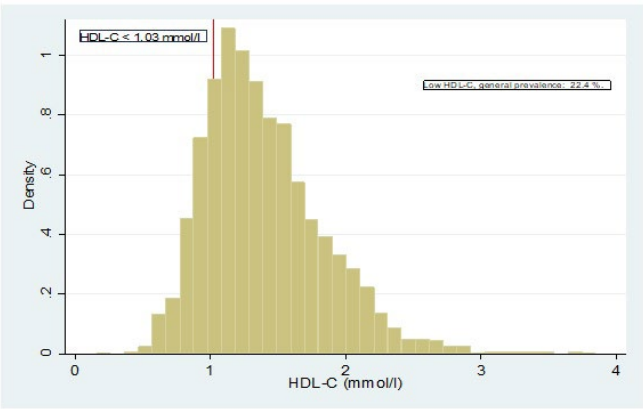
Country of Birth			65
Born in 50 US or Washington, DC (%)	0.05	(0.02;0.09)	
Other (%)	(reference)		
Number of Children 0-18-Years per Household			0.01
0	0.07	(0.01;0.14)	
1	0.01	(-0.05;0.08)	
2	0.04	(-0.03;0.11)	
3	0.02	(-0.06;0.09)	
4	(reference)		
≥5	0.06	(-0.06;0.19)	
Smoking Status			0.08
Never smoked	(reference)		
Former smoker	-0.01	(-0.04;0.02)	
Current smoker	-0.04	(-0.07;-0.004)	
Covered by Health Insurance			0.07
Yes	(reference)		
No	-0.03	(0.02;0.002)	
Waist circumference (cm)	-0.01	(-0.01;-0.009)	<0.001
Family income to poverty ratio	0.02	(0.01;0.03)	<0.001
Total cholesterol (mmol/l)	0.05	(0.04;0.06)	<0.001

Adj b=slope adjusted for other covariates, CI= Confidence Interval

HDL-C Distribution

The prevalence of low HDL-C of the general population was 22.4%, Figure 1. This prevalence was more than two times higher in males than in females, 32.8% and 12.5%, respectively and this difference was statistically significant, Table 3. Elderly people above 70-years of age and thoseaged 20-29-years had lower HDL-C compared to the rest of the population. The prevalence of low HDL-C was statistically significant across the age group. Married individuals or those living with partners had lower HDL-C (25%) compared to those who were widowed, separated, divorcedor never married (almost 20%). The prevalence of low HDL-C was statistically significant across marital status. Men with an en larged waist circumference had a lower HDL-C (42.7%) compared to men with a normal waist circumference (24.8%) and this difference in prevalence was statistically significant. Similarly, females with an enlarged waist circumference hada nearly five-fold higher prevalence of low HDL-C (16.2%) as opposed to females with normal waist circumference (3.3%), this difference was also statistically significant. A higher prevalence of low HDL-C was found among current smokers compared to former smokers and those who had never smoked; these differences were statistically significant. There was no difference in the prevalence of low HDL-C between people born in the U.S. and those born in other countries.

Figure 1. *HDL-C Distribution Across the Population*



Univariate logistic regression showed that country of birth was not statistically significant. Males had higher odds of having low HDL-C compared to females (OR 3.42;95% CI: 2.90-4.01). The odds of having low HDL-L were 2.25 times higher in males with an enlarged waist circumference than males with a normal waist circumference. The odds of having low HDL-L were 5.75 times higher in females with an enlarged waist circumference than females with a normal waist circumference. Current smokers had higher odds of having low HDL-C compared to those who hadnever smoked (OR: 1.73; 95% CI: 1.43-2.08). Similarly, former smokers had higher odds of developing low HDL-C compared to those who had never smoked (OR: 1.57: 95% CI: 1.3-1.88). There wereincreasing odds of having low HDL-C across the number of children aged 0-18-years per household category.

All variables except country of birth were entered into the multiple logistic regression. Marital status, educational level, health insurance coverage and number of children aged 0-18-years

Table 3. *Prevalence of Low HDL-C According to the Sample Population Characteristics*

	Complete Cases		
	Low HDL-C		
	n	%	p
Sex			<0.001
Female	254	12.5	
Male	641	32.8	
Age (years)			0.003
20-29	131	18.2	
30-39	197	26.6	
40-49	183	24.3	
50-59	164	22.3	
60-69	163	21.9	
≥70	57	19.3	
Marital Status			0.01
Married	500	24.1	
Widowed	28	17.8	
Divorced	82	19.3	
Separated	28	19.7	
Never married	149	19.4	
Living with partner	108	25.8	
Educational Level			<0.001
Less than 9th grade	107	25.7	
9-11th grade (Includes 12th grade with no diploma)	122	28.0	
High school graduate/GED or equivalent	201	23.2	
Some college or AA degree	277	22.7	
College graduate or above	188	17.9	
Ethnicity			<0.001
Mexican American	192	27.2	
Other Hispanic	154	28.1	
Non-Hispanic White	292	22.6	
Non-Hispanic Black	120	14.7	
Other Race - Including Multi-Racial	137	22.0	
Country of Birth			0.21
Born in 50 US or Washington, DC	572	21.8	
Other	323	23.6	
Number of Children 0-18-Years per Household			0.008
0	444	20.6	
1	161	24.4	
2	147	23.2	
3	78	24.1	
4	50	31.3	
≥5	15	30.6	
Smoking Status			<0.001
Never smoked	433	18.8	
Former smoker	234	26.6	
Current smoker	228	28.5	

Covered by Health Insurance			<0.001
Yes	684	21.1	
No	211	28.3	
Waist Circumference (cm)			
Male			<0.001
≤102	270	24.8	
>102	371	42.7	
Female			<0.001
≤88	19	3.3	
>88	235	16.2	
p-value of Pearson's Chi-square test			

Table 4. *Characteristics of the Sample Population Associated with Low HDL-C (multivariable logistic regression) (n=3989)*

	Low HDL-C		**Likelihood Ratio test *p***
	Adj OR	**(95%CI)**	
Sex			<0.001
Female	1		
Male	3.43	(2.88;4.1)	
Age (years)			0.04
20-29	1.24	(0.81;1.9)	
30-39	1.68	(1.12;2.52)	
40-49	1.69	(1.14;2.51)	
50-59	1.38	(0.94;2.01)	
60-69	1.26	(0.87;1.81)	
≥70	1		
Marital Status			0.69
Married	0.97	(0.61;1.55)	
Widowed	1		
Divorced	0.83	(0.49;1.39)	
Separated	0.75	(0.4;1.4)	
Never married	0.94	(0.56;1.57)	
Living with partner	1.05	(0.62;1.77)	
Educational Level			0.76
Less than 9th grade	1.08	(0.77;1.51)	
9-11th grade (Includes 12th grade with no diploma	1.16	(0.85;1.59)	
High school graduate/GED or equivalent	1.01	(0.78;1.31)	
Some college or AA degree	1.13	(0.89;1.43)	
College graduate or above	1		
Ethnicity			<0.001
Mexican American	2.28	(1.7;3.05)	
Other Hispanic	2.84	(2.11;3.82)	
Non-Hispanic White	1.91	(1.48;2.47)	
Non-Hispanic Black	1		
Other Race - Including Multi-Racial	2.68	(1.97;3.64)	
Number of Children aged 0-18-years per Household			0.34
0	0.68	(0.34;1.38)	

1	0.82	(0.41;1.67)	
2	0.75	(0.37;1.53)	
3	0.7	(0.34;1.45)	
4	1.01	(0.47;2.18)	
≥5	1		
Smoking Status			<0.001
Never smoked	1		
Former smoker	1.14	(0.93;1.41)	
Current smoker	1.53	(1.23;1.89)	
Covered by Health Insurance			0.11
Yes	1		
No	1.19	(0.96;1.48)	
Waist circumference (cm)	1.04	(1.03;1.04)	<0.001
Family income to poverty ratio	0.93	(0.87;0.99)	0.02
Total cholesterol (mmol/l)	0.91	(0.84;0.98)	0.02

Adj OR=Odds ratio adjusted for other covariates; CI=confidence interval.

per household were no longer significant, Table 4. The odds of having low HDL-C levels increased significantly from former smoker to current smoker. The association between smoking status and low HDL-C became stronger when the other covariates were considered in the multiple logistic regression than in the univariate, which suggests an effect modification. In the 20-29 and the ≥70 age groups,the odds of having low HDL were smaller than those between 30 and 59-years of age. The odds of developing low HDL-C decreased slightly in the multivariate logistic regression as opposed to the univariate for age, ethnicity and number of children aged 0-18-years per household. The risk of developing low HDL-C was 3.43 higher in males than in females. This was similar to that obtained with univariate model. This implied that the presence of other covariates did not affect the association between low HDL-C and sex. Similarly, the association between HDL-C and family income to poverty ratio or total cholesterol remained similar when the other covariates were considered in the multiple logistic regression.

DISCUSSION AND CONCLUSION

The objective of this study was to determine the prevalence of low HDL-C and to investigate its associated risk factors. The prevalence of low HDL-C in our study was 22.4%. The results obtained from the multiple linear regression indicated that male gender, age, ethnicity, country of birth, number of children aged 0-18-years per household, waist circumference, family income to poverty ratio and total cholesterol were significantly associated with HDL-C. However, marital status, educational level, smoking status, and health insurance coverage were no longer statistically significant in the multiple linear regression model. In the univariate logistic regression model, only country of birth was not statistically associated with low HDL-C. After adjustment in the multiple logistic regression model, male gender, age 30 to 49-years, ethnicity, smoking,enlarged waist circumference, low family income to poverty ratio and high total cholesterol were significantly associated with low HDL-C. In the 20-29 and the ≥50 age groups, the odds ratio of low HDL-C was smaller than in the age group 30-49-years. This means that individuals in the extreme age groups were less likely to have low HDL-C compared to those aged 30-49-years.

A study by Aguilar-Salinas in Mexico reported the prevalence of low HDL-C to be higher in males than in females.[9] This finding is similar to our results, which demonstrated that low HDL-C was predominant in males. It is well-known that HDL-C levels in men and women significantly differ due to the influence of estrogen and testosterone on the activities of hepatic lipase. This enzyme plays a role in HDL-C metabolism and its levels are inversely related with those of HDL-C.[10] Estrogen and testosterone respectively tend to decrease and increase hepatic lipase levels, hence the discrepancies in HDL-C levels.[11] Even though a lower cut off value was used in the Aguilar-Salinas study (<0.9 mmol/L), the prevalence of low HDL-C was still higher in their study than the prevalence obtained in our study (46.2% for men, 28.7% for women, and 36% for both genders).[9] The Mexican population has been shown to have a higher predisposition to metabolic syndrome and dyslipidaemia.[9,12] Genetic and environmental factors are linked to this predisposition.[12] This may have contributed to the high-level of low HDL-C in this Mexican population. In our study, the Hispanic population has a higher prevalence of low HDL-C than other ethnic groups. This result is supported by the findings of Willey et al[7] and Winkleby et al[13] who found that the Hispanic population of the United States have higher-risk factors of CVDs including low HDL-C levels. The authors also reported higher-levels of HDL-C in non-hispanic blacks compared to other ethnic groups.

Ge et al[1] found that low HDL-C is associated with smoking, an enlarged waist circumference and male gender. These findings are similar to the results obtained in our study where cur-

rent smokers, an enlarged waist circumference and male gender are associated with a high prevalence of low HDL-C. Chang et al[14] showed that high HDL-C was associated with total cholesterol. This also corroborates the results obtained in the present study where total cholesterol has a significant, positive association with HDL-C. Total cholesterol is the summation of all types of cholesterol in the blood, including HDL-C. Hence, an increase in HDL-C will likelybe accompanied by an increase in total cholesterol and *vice versa*. An enlarged waist circumference is a sign of abdominal obesity and a risk factor for CVD. A study by Kim et al[15] showed that an enlarged waist circumference is significantly associated with low HDL-C, and that HDL-C levels vary with sex,[15] findings which are similar tothe results obtained in this present study.

Economic status is an important determinant of the HDL-C levels. The present study found that family income to poverty ratio has a significant, positive association with HDL-C levels. An increase in family income to poverty ratio is accompanied by an increase in HDL-C levels. This result is similar to that obtained by Kim et al[15] who found that the odds of low HDL-C levels increased significantly among unemployed men. This is pertinent in that the risk of CVD has gradually tilted to those with a low socio-economic status.

This study shows that HDL-C is significantly associated with age and there is a linear increase of HDL-C from age 50-years and older. This is supported by the studies of Cheung et al[16] and Harman et al[17] who found that age has a significant, positive association with HDL-C. In HDL-C studies in other populations however, there was no association of HDL-C with age.[1] Similar differences have been reported and can be explained partly by the study population, study design, laboratory analysis and cut-off values used.

This study brings out pertinent issues regarding risk factors of low HDL-C. Low HDL-C is associated with CVDs, a major cause of non-communicable disease and mortality worldwide. Public health strategies targeting at-risk groups such as those with a low income to poverty ratio, those in the 30-49 age group and Hispanic Americans will be crucial in addressing the problem. The sale of foodstuffs should be continuously monitored, and the production of poor-quality, processed foods should be discouraged. Ingredients of food products should be clearly labelled on food packaging in plain, simple language and prices of HDL-C rich foods should be made affordable and accessible to everyone. Increasing the sensitisation of the public on risk factors of low HDL-C and CVDs is also necessary.

Education programs highlighting high-total cholesterol, smoking, and an enlarged waist circumference as risk factors of low HDL-C and consequently, poor cardiovascular outcomes are also a strategy. Smoking cessation and smoking prevention programs should be made available and accessible. This will help those facing difficulties stopping smoking and prevent new smokers. Interventions aimed at the discussion of health problems associated with smoking, not just the traditional risks that have been well communicated through health campaigns, but also on the higher-risk of CVDs is important and may not be as apparent as other well-known risks of smoking. Encouraging physical exercise and activity is an important element to reduce an enlarged waist circumference, as well as the encouragement of and education on healthy eating choices and habits. Initiatives that consider the cultural habits and language of Hispanics should also be considered.

A strength of this study was that the population included different ethnic groups which are important in demonstrating variation in HDL-C levels. Also, the missing values were less than 8% which is acceptable instatistical analysis. In addition, the wide age range in the study population was suitablefor this study. Lastly, the data was part of repeated cross-sectional study and hence the results can be compared to those obtained in previous years. However, this should be done with caution as it is part of a larger study.

This study acknowledges some limitations. Firstly, important confounders such as diabetes and hypertension were not included in the analysis. Thus, the cause of low HDL-C could have been due to diabetes, hypertension, or other metabolic diseases. In addition, we did not consider cholesterol lowering medications or drugs that could raise cholesterol level in the study. These could also have affected the HDL-C levels.

Future research should take into consideration personal conditions like diabetes, hypertension, used of medications that can affect cholesterol levels. It would also be interesting to carryout similar study in low- and middle-income countries where the double burden of diseases has been noted. This will contribute further evidence and will help shape interventions. The health seeking behaviour of the at-risk population (Hispanics, males and the 30-49-year age group) warrants further research.

In conclusion, this study found the prevalence of low HDL-C was relatively high. Lifestyle modification is important in the prevention of low HDL-C and consequently, CVDs. The results however, should be used with caution as this does not represent the entire U.S. population.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study is based on secondary data analysis of the National Health and Nutrition Examination Survey (NHANES) 2015-2016. This data is available on https://wwwn.cdc.gov/nchs/nhanes/continuousnhanes/default.aspx?BeginYear=2015.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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Hypertension Management in Primary Health Care Centres: Blood Pressure Control and Classes of Antihypertensive Medication, Khartoum State, 2018

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ABSTRACT

Background
In Sudan, the delivery of care based on the primary health care (PHC) level, which is the first contact with the health system. PHC is the level at which the modifiable risk factors for hypertension are addressed together with the treatment of known hypertensive patients.

Objective
To assess the management of hypertension in PHC in Khartoum State, 2018.

Material and Methods
The study was a descriptive cross-section, health centre's based that covered six PHC centres in Khartoum State. The study interviewed all diagnosed Sudanese hypertensive patients more than 18-years of age who attended the selected PHC centres. The research team collected data using a structured questionnaire and measuring the blood pressure (BP) with a mercury sphygmomanometer. The study variables were demographic characteristics and disease features as independent variables and hypertension control as the dependent variable. The statistician analyzed the data using the statistical package for the Social Science version 21.0 and the Chi-square (χ) test to obtain the p value to test the association between the addressed variables. The study group adopt ethical considerations throughout the study.

Results
Of the 384 hypertensive patients interviewed in this study, 57% were females and 47.7% were more than 60-years of age. A large percent of the subjects were either primary educated or illiterate (32.6%, 19.8% respectively). More than half of the hypertensive patients (52.1%) were uncontrolled and 52.9% had no comorbidities. Diabetes was predominant (39.3%) among those who had comorbidities. The majority of the patients (92.7%) were adherent to the medication. Of the studied patients, 58.1% used monotherapy. The most controlled patients were the elderly and middle-aged patients and the highly educated patients (p=0.005). Patients with a duration less than five-years were more likely to be controlled (p=0.036). The majority of the patients who used combined treatment were found to be controlled.

Conclusion
This study concluded that the high prevalence of uncontrolled hypertensive patients attending PHC was mainly attributed to the use of monotherapy, presence of comorbidities and medication non-adherence. The latter is related to patients' ignorance, financial constraints and dislike of using many drugs during the day. In addition, the use of combined therapy, elder age and high education were factors for better control.

Keywords
Hypertension control; Antihypertensive medication; Hypertension management.

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BACKGROUND

Globally there are one billion hypertensive patients due to the prevalence of contributing modifiable risk factors. These factors, such as unhealthy diet, physical inactivity, tobacco and alcohol use, and hyperlipidemia–which are not yet well-addressed, will lead to an increasing number of patients. In the Eastern Mediterranean Region, the prevalence of hypertension averages 26% and it affects approximately 125 million individuals.[1]

Hypertension has the highest prevalence among the major non-communicable diseases (NCDs) in Sudan, represented a quarter of NCDs.[2] Hypertension in Sudan is one of the ten leading diseases treated in outpatients of health facilities and also is one of the ten leading causes of death.[3] Proper management of hypertension has been associated with about a 40% reduction in the risk of stroke and about a 15% reduction in the risk of myocardial infarction. Thus, by applying standard management of hypertension, we can reduce the major complications that lead to morbidity, disability and mortality.[4]

The goals for the management of hypertension are well-defined, effective therapies are widely available, and practice guidelines for hypertension have been disseminated extensively. Even with such advances, hypertension control rates are still low.[5]

World Health Organization (WHO) defined medication adherence as "*the extent to which the medication-taking behavior of a patient corresponds with agreed recommendations from a health care provider*".[6] It is important in achieving blood pressure control.[7] Patients who were adherent to the regimen of their hypertension treatment were often significantly less likely to have elevated blood pressures.[8] Unfortunately, poor adherence to medications is widespread especially in the treatment of chronic conditions such as hypertension leading to poor health outcomes and huge medical spending on drug-related morbidity. As reported by the WHO, adherence to medication in patients with chronic diseases averages only around 50% in developed countries. The situation is reported to be worse in developing countries due to poor accessibility to medications and health care services. The asymptomatic nature of the condition intensifies the problem of non-adherence in hypertension.[6,9]

The overall prevalence of hypertension in Sub-Saharan Africa (SSA) is estimated to be 30%, ranging from 16% at the age of 30-years to 44% at the age of 60.[10] About 74.7 million individuals are currently hypertensive in SSA, and this number is expected to increase to 125.5 million individuals by the year 2025. In Sudan, the prevalence of hypertension in urban communities witnessed a dramatic increase from 7.5% in 1990 to 18.2% in 2012.[11,12]

In Sudan, delivery of care has been based on the primary health care (PHC) level which is the first contact of the community with the health system. A high percentage of the population use PHC, as it is more accessible and affordable and hence it has the drive to reach vulnerable populations. The PHC approach, with over 2078 PHC Centres and 380 rural hospitals, distributed all over Sudan supposed to deliver promotive, protective, curative, and rehabilitative services, but have never functioned as such as mentioned in the non-communicable diseases strategy 2010.[13]

PHC Centres are proposed to play an essential role in the provision of continuous, comprehensive care for hypertensive patients.

This study aimed to reveal the control status and treatment compliance among Sudanese hypertensive patients in Khartoum State, for possible public health application of the findings by the Ministry of Health (MOH) targeting at improving the management of hypertension at the PHC level.

MATERIALS AND METHODS

Study Design and Area

The study was a descriptive cross-sectional, health Centre's based study. It was conducted in PHC Centres in Khartoum State in the three major localities; Khartoum, North Khartoum and Omdurman. There are consultants of family medicine in all these Centres. These Centres provided services in form of health education, regular follow-up for patients with chronic diseases, routine blood investigations. These services were provided covered with health insurance (HI), while the medicine included in the HI drug list was provided covered with 75% of the cost. Medicine not included in the HI drug list will be fully paid for by the patients. The study population included hypertensive patients who attended the selected PHC Centres State; it recruited all diagnosed Sudanese hypertensive patients whose age was more than 18-years.

Sample Size and Sampling

The sample size was calculated to be 384 using the formula n=Z2pq/e2, where Z=1.96 (which corresponds to the level of confidence); p=0.5 (estimated proportion of the population with controlled hypertension); Q=1-p=0.5; e=margin of error at 95th confidence interval (C.I) (0.05).

The total sample size was divided equally by the number of centres, and 64 patients were enrolled from each centre. The selection of the Centres was done purposively based on their geographical location, caseload and presence of a family physician as the care provider. Based on that six PHC centres were identified; [(2 in Khartoum (Omer Ibn-Alkhatab and GeraifGhareb Centre, 2 in Khartoum North (Alkhatmeiah and Alenghaz Centres) and 2 in Omdurman (AldawHagog and Wad Nobawie Centres)] The selection of the patients was done following a systematic selection of all diagnosed hypertensive patients who attended the outpatient clinic for follow-up during the study period, till reaching the sample size in each health centre.

Ethical Considerations

Ethical approval was obtained from the institutional review board (IRB) of the Sudan Medical Specialization Board (SMSB). Written consent was obtained from the administration of the six PHC Centres in the study area. Verbal consent was obtained from all

participants through taking their agreement to participate after explaining to them the study objectives and benefits. The participants were informed of their rights that their participation in the study is completely voluntary and confidentially has been considered.

Data Collection Tools and Techniques

The study collected data by interviewing hypertensive patients and measuring their blood pressure (BP). The researcher assisted by twelve medical doctors – who have been trained by the researcher– collected the data using a structured pretested questionnaire developed by the researcher. The questionnaire followed the steps and recommendations of the Sudanese guideline in the management of hypertension. It covered the personal data, disease features, medication compliance and types. The medication compliance was assessed by asking the hypertensive patients about their practice concerning pills taking during the last month.

The BP was measured using a mercury sphygmomanometer; patients were relaxed and seated for five-minutes with uncrossed legs, back and arm supported. The researchers checked the right and left radial pulse, if they were the same then they used the left arm to measure the BP. If they were differed they measured the BP in both arms and took the highest reading. BP was used by placing the middle of the cuff on the upper arm at the level of the heart. One reading of BP was being taken for each patient, but if the BP reading as high as 160/100 the researchers gave the patient another five minutes for rest then measuring BP again and they took a second reading. The study variables included the demographic characteristics (age, gender, educational levels, occupation), disease features (hypertension duration, comorbidities, antihypertensive medications, medication compliance) as independent variables and hypertension control as the dependent variable.

Data Analysis

Data were analyzed by using a statistical package for the Social Science version 21.0. The researchers agreed on the level of 140/90 as the cutoff for the controlled hypertension. A Chi-square test was used to obtain the *p* value to test the association between the hypertension control and other variables.

RESULTS

Sample Coverage and Characteristics of the Study Population

In total, 384 hypertensive patients were interviewed, of them, 57% as females. The age of 47.7% of the studied population was more than 60-years, while only 5.7% were in the age group less than 40-years. A large percentage of the subjects were either primary educated or illiterate (32.6%, 19.8% respectively), whereas those having a post-university education were only (9.6%). Concerning their occupations, the majority were housewives (44%) (Table 1).

Disease Features

Regarding the hypertension control status, more than half of the patients (52.1%) were uncontrolled, whereas the median of systolic blood pressure (SBP) was 135, about one-half (50.3%) of the patients had SBP less than 140. Moreover, the median of diastolic blood pressure (DBP) was 80, where 57% of the patients had DBP less than 90.

Table 1. *Demographic Characteristics of the Hypertensive Patients Who Attended PHC. Khartoum State, Sudan, 2018*

	Hypertension Control		
	Controlled (%)	Uncontrolled (%)	*p* value
Gender			
Male	71 (42.5%)	96 (57.5%)	0.266
Female	113 (52.1%)	104 (47.9%)	
Age (Years)			
<40	5 (22.7%)	17 (77.3%)	
40–60	83 (46.4%)	96 (53.6%)	0.026
>60	96 (52.5%)	87 (47.5%)	
Educational Levels			
Illiterate	21 (27.6%)	55 (72.4%)	
Primary	45 (36%)	80 (64%)	
Secondary	34 (41.5%)	48 (58.5%)	0.005
University	51 (79.6%)	13 (20.4%)	
Post-university	32 (86.5%)	5 (13.5%)	
Occupation			
Worker	27 (35.5%)	49 (64.5%)	
Employee	64 (47.4%)	71 (52.6%)	0.061
Housewife	93 (55%)	76 (45%)	
Student	0 (0%)	4 (100%)	

Table 2. *Clinical Characteristics and Drug Management of the Hypertensive Patients Attended PHC, Khartoum State, Sudan, 2018*

Clinical Characteristics	Hypertension Control		*p Value*
	Controlled (%)	Uncontrolled (%)	
Duration (Years)			
<5	68 (51.9%)	63 (48.1%)	
5-10	62 (44%)	79 (56%)	0.036
>10	54 (48.2%)	58 (51.8%)	
Comorbidities			
Diabetes	73 (48.3%)	78 (51.7%)	0.159
Pervious stroke	4 (26.7%)	11 (73.3%)	0.000
CKD	5 (33.3%)	10 (66.7%)	0.046
None	102 (50.2%)	101 (49.8%)	0.215
Medication Adherence			
Adherent	184 (51.7%)	172 (48.3%)	0.000
Non-adherent	0 (0%)	28 (100%)	
Drugs			
Mono-therapy	84 (37.7%)	139 (62.3%)	0.008
Combined therapy	100 (62.1%)	61 (37.9%)	

According to the hypertension duration, the majority (71%) of the patients had the disease for less than 10-years. More than half of the hypertensive patients had no comorbidities (52.9%). Diabetes was predominant (39.3%) among those who had

comorbidities. The majority of the patients (92.7%) were adherent to the medication (Table 2).

Table 3 displayed the main reasons for non-adherence, where the majority mentioned ignorance of the importance of complying with the drug regimen, thus neglecting taking it regularly. In addition, 34% stated the financial problem as a reason for non-adherence, where they couldn't pay for the cost of the drugs. Few of the study population mentioned that they dislike taking many pills during the day.

Table 3. *Reasons of Non-Adherence among the Non-Adherent Hypertensive Patients (n=28) Attended PHC, Khartoum State, Sudan, 2018*

	N	%
Reasons of non-compliant		
Financial problem	10	35.6
Dislike to take many pills during the day	6	21.4
Ignorance of the importance of drug compliance	12	43%

Concerning hypertension drug management, 58.1% of the studied patients used mono-therapy and the remaining used combined therapy. Calcium channel blocker (CCB) was found to be the common monotherapy used followed by Angiotensin covering enzyme inhibitor (ACEI) then Angiotensin receptor blocker (ARB) and beta-blocker are the least (27.6%, 16.7%, 12%, 1.8% respectively). On the other side the combination of ACEI and CCB was found to be the predominant used by 11.2% of the patients, then CCB and ARB in 9.1% and ACEI and beta-blocker in 5.2% of the patients. A triple combination of CCB, ARB and diuretics was used by 3.4% and ACEI, CCB and beta-blocker in 0.5% of the patients (Table 4).

Table 4. *Distribution of Controlled and Uncontrolled Hypertensive Patients with the Types of Mono and Combined Therapy among Patients Attended PHC, Khartoum State, Sudan, 2018*

	Hypertension Control		
	Controlled (%)	Uncontrolled (%)	*p* value
Mono-therapy			
Beta-Blocker	4 (57.1%)	3 (42.9%)	0.001
ACEI	25 (39.1%)	39 (60.9%)	
ARB	36 (78.3%)	10 (21.7%)	
CCB	55 (51.9%)	51 (48.1%)	
Combined Therapy			
ACEI+Beta-Blocker	5 (45%)	11 (55%)	0.000
ACEI+CCB	18 (41.9%)	25 (58.1%)	
ACEI+Diuretic	0 (0%)	13 (100%)	
ACEI+ARB	0 (0%)	2 (100%)	
Beta-Blocker+Diuretic	0 (0%)	6 (100%)	
Beta-Blocker+CCB	4 (44.4%)	5 (55.6%)	
Beta-Blocker+ARB	5 (41.7%)	7 (58.3%)	
Diuretic+ARB	5 (100%)	0 (0%)	
CCB+ARB	18 (51.4%)	17 (48.6%)	
CCB+Diuretic	0 (0%)	1 (100%)	
ACEI+CCB+Beta-Blocker	0 (0%)	2 (100%)	
CCB+ARB+Diuretics	9 (69.2%)	4 (30.8%)	

DISCUSSION

The study revealed that females were more affected by hypertension than males (57% *vs.* 44% respectively) with a ratio of 1.3:1 and about half of the hypertensive patients (47.7%) had aged more than 60-years, this is consistent with a study conducted by Eltagi et al[14] in Khartoum, which showed a positive increase of hypertension with age, the prevalence reached 100% among those above 60-years and 51.7% among those in age group (46-60-years), also they found that the females were commonly affected by hypertension than males (53.5% *vs.* 46.5%). This is also in line with other studies where the risks of hypertension increase with age.[15-17] This confirms that the prevalence of hypertension is affected by age and gender.

This study showed that diabetes was predominant in (39.3%) patients followed by previous stroke (3.9%) and chronic kidney disease (CKD) (3.9%). Also, Eltagi et al[14] revealed that diabetes and kidneys' problems were the main comorbidities in hypertensive patients. Also, the results showed that diabetic patients had five-four times more likely to have hypertension compared to those who have no history of diabetes OR 5.44 (95% CI 1.89-15.69, p=0.017).[14] Also, Balla et al noticed that in Sudan among rural population diabetes and hypertension are closely interrelated.[18] Another study that was carried out in Ethiopia revealed that self-reported diabetes was a significant predictor of hypertension.[15]

Also, the current study demonstrated that 52.1% of the patients were uncontrolled, this was lower than what was reported by Abdulmohsin et al[19] which was 60%, and the Canada Heart Health Survey that found only 13% of Canadians with hypertension were adequately controlled,[20] and higher than what reported by Al-Shammari et al[21] which was 28.8%, and the international study conducted by Birtwhistle et al[22] which revealed 20%. This result also was even higher than the US National Health and Nutrition Examination Survey (NHANES III) that 25% were uncontrolled.[23] Also the percentage of uncontrolled hypertensive patients was more than what reported in Addis Ababa, Ethiopia (40.1%) and Gondar, Ethiopia (46.6%).[24,25] These variations might be attributed to the differences in origins, geographical areas, physical activities, biological and genetic factors.

In medication adherence, the results showed that 92.7% of the studied hypertensive patients were adherent. These findings were consistent with the study conducted by Inkster et al[26] reported a 91% level of adherence among hypertensive patients in primary care. However, the findings were much higher than those reported in the Ethiopian study (60.5%),[27] and the United Arab Emirates (54.4%),[28] this may be attributed to the presence of comorbidities and health education levels of the patients in the other studies, which may significantly affect medication adherence.

Though the Sudanese guidelines in the management of hypertension promote combination therapy, the present study revealed that 58.1% of the patients used monotherapy drugs, indicating that the medical practitioners still prescribing or otherwise adopting their prescription. The combination therapy drugs are

more expensive and few of the patients don't like to use more than one drug, stated by the non-adherent patients. The most frequent monotherapies were CCB and ACEI. These results went in the same line with Abdulaziz et al,[29] who found that the majority of the subjects were on mono (70%) and the most frequent mono anti-hypertensive therapies were beta-blockers (34%) and ACEI (25%). In addition, CCB with ARB (9.1%) and ACEI with beta-Blocker (5.2%) were the frequent dual combined therapy.

The results of the present study showed that most controlled patients were found in older (52.5%) and middle-aged patients (46.4%), and most of younger age (77.3%) were found to be uncontrolled (*p* 0.026). These findings are consistent with the study of Solomon et al.[27]

Regarding the levels of education and the hypertension control, most post-university (86.5%) and university educated (79.6%) patients were found to be controlled, while illiterate (72.4%) and primary educated (64%) patients were found to be uncontrolled (*p* value=0.005). this indicated that A high-level of education was associated with better blood pressure control.[30] In a study conducted on 184 patients with free access to care, Paulsen et al identified that patients with less than 10-years of education were less likely to achieve blood pressure control compared to those with more than 10-years levels of education.[31] In the analysis of the NHANES1999-2004, Ostchega et al[31] found that hypertensive patients with lower-levels of education and in the low socio-economic class were more likely to have uncontrolled blood pressure. Sandoval et al[32] found that low education was associated with poor blood pressure control. Wong et al[33] found that individuals with lower education backgrounds had 3.5 times higher uncontrolled BP than those with higher education.

According to the association between the hypertension control status and the clinical characteristics of the patients, duration of hypertension showed a significant relationship with control status; the patients with duration less than 5-years (51.9%) more tendered to be controlled and those had duration >10-years (51.8%) were uncontrolled patients (*p* value=0.036). additionally, the majority of patients without comorbidities (50.2%) were controlled.

Not surprisingly; all non-compliant patients were found to be uncontrolled. For no doubt, this indicated that; adherence to the medication is a key factor for controlling hypertension (*p* value=0.000), however, some of the adherent patients were still uncontrolled, this was mainly attributed to the presence of comorbidities which significantly affected the controlling of hypertension. (*p*=0.000). In addition, the use of monotherapy was another factor, where the study demonstrated that most of the patients who received monotherapy (62.3%) were uncontrolled, especially ACEI (60.9%), CCB (48.1%) and beta-blockers (42.9%) (*p* value=0.008) while most of the patients who received combined treatment (62%) were found to be controlled, especially those who used diuretic+ARB (100%), CCB+ARB+diuretic (69.2%) and CCB+ARB (51.4%).

Recent clinical trials have shown that effective BP control can be achieved in most hypertensive patients, by two or more antihypertensive drugs for most patients.[34-36] As stated by Moser et al,[37] 30% to 60% of patients will be controlled with a single drug regimen, while two drugs in combination are likely to improve control rates by 80 to 85%; three or more drugs will provide control in 90 to 95% of patients.

In the association of controlled and uncontrolled hypertensive patients regarding the types of mono and combined therapy; the majority of the patients who used ACEI drug as monotherapy (60.9%) were uncontrolled and most of those used ARB (78.3%) were controlled (*p*=0.001). on the other side, all the patients who used ACEI+Diuretic, ACEI+ARB, Beta-Blocker+Diuretic, CCB+Diuretic and ACEI+CCB+Beta-Blocker in combination were uncontrolled, while all the patients who used Diuretic+ARB and most of the patients (62.9%) who used CCB+ARB+Diuretics in combination were controlled (*p*=0.000).

RECOMMENDATIONS

Information, education and culture materials are recommended for hypertensive patients to improve their adherence to medication and the control of their BP. The MOH has to avail the recommended types of antihypertensive medication in PHC Centres, maybe by including them in the HI drug list to overcome the financial problem as a reason for non-adherence. The MOH has to foster the protocols and guidelines for hypertension treatment, which is crucial to avoid the practice of doctors of prescribing a monotherapy and contraindicated combination of antihypertensive medication. Future research needs to disclose the noncompliance of doctors with Sudanese guidelines for the management of hypertension and the causes of uncontrolled hypertension among the younger age group of patients.

CONCLUSION

This study concluded that the high prevalence of uncontrolled hypertensive patients attending PHC was mainly attributed to use of monotherapy, presence of comorbidities and medication non-adherence. The latter is related to patients' ignorance, financial constraints and dislike of using many drugs during the day. In addition, the use of combined therapy, the elderly and highly educated patients were factors for better control.

STRENGTH AND LIMITATIONS OF THE STUDY

In the centers, there were no specific day or examination room for hypertensive patients, so that the data collection took a long time. But what facilitates our data collection is the cooperation of the medical doctors and family physician.

CONSENT FOR PUBLICATION

Not applicable.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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