



AGEING, ORTHOSTATIC HYPOTENSION, AND MENTAL HEALTH: A CROSS-SECTIONAL STUDY IN NDOLA CITY OF ZAMBIA

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Abstract:

Background: This study examines the relationship between ageing, standing blood pressure, and mental health in 770 adults from Ndola City, Zambia, focusing on orthostatic hypotension (OH). OH, characterized by a significant drop in blood pressure upon standing, is particularly prevalent among older adults and is associated with mental health disorders such as depression and stress. **Methods:** Using a cross-sectional design, participants were categorized by age, and standard blood pressure measurements were taken to assess OH. Mental health was evaluated using the Depression, Anxiety, and Stress Scale (DASS21) and the General Health Questionnaire (GHQ12). Statistical analyses, including Pearson chi-square tests, were employed to explore associations between age groups, the prevalence of OH, and mental health conditions. **Results:** Results indicated no significant association between age and the occurrence of OH (Pearson $\chi^2(4) = 7.5702$, $P = 0.109$). However, a significant relationship was found between age and depression (Pearson $\chi^2(8) = 23.4265$, $P = 0.003$), suggesting that older age correlates with higher depression levels. In contrast, anxiety did not show a significant association with age (Pearson $\chi^2(4) = 4.5814$, $P = 0.333$). Stress levels were significantly associated with age (Pearson $\chi^2(8) = 37.1247$, $P = 0.000$), as were distress levels (Pearson $\chi^2(4) = 9.9089$, $P = 0.042$). **Conclusion:** While age does not significantly impact the occurrence of OH, it is correlated with increased levels of depression and stress among older adults, highlighting the need for mental health interventions in this population.

Keywords: ageing, orthostatic hypotension (OH), blood pressure, mental health, Africa

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1. Introduction

Ageing is associated with various physiological changes, including alterations in blood pressure regulation (Mancia et al., 2014). Orthostatic hypotension (OH) is common in older populations and can lead to increased morbidity and mortality (Low, 2008). Mental health disorders, particularly depression and anxiety, are critical concerns in geriatric populations, as they can significantly impact quality of life (Kanjwal et al., 2015). This study aims to elucidate the associations between age, OH, and mental health outcomes in the context of Ndola, Zambia.

1.2 Rationale

The current study investigates the complex relationships between orthostatic blood pressure dysregulation and mental health, addressing key questions regarding prevalence, demographic factors, and the connection to mental distress. Research indicates inadequate blood pressure regulation during postural changes can cause symptoms like dizziness and lightheadedness, often linked to mental health issues such as depression and anxiety. Individuals with mental illnesses may experience greater blood pressure fluctuations, increasing cardiovascular risks and target organ damage (Hillebrand et al., 2021). Additionally, blood pressure variability in those with conditions like depression and anxiety may result in adverse cardiovascular outcomes (Roca et al., 2022). The study also aims to identify potential confounding variables affecting these relationships.

The study emphasizes the significance of demographic factors, particularly age and gender, in influencing the prevalence and effects of orthostatic blood pressure dysregulation. Older adults are notably at a higher risk for orthostatic hypotension, with prevalence rates increasing significantly in this demographic (Shibao et al., 2013).

The objectives of this study are as follows:

- 1) Investigate the Prevalence of Orthostatic Hypotension: To determine the prevalence of orthostatic hypotension (OH) in individuals diagnosed with mental health disorders, regardless of age.
- 2) Analyze the Impact of Age on Mental Health: To assess the relationship between age and levels of depression and stress among individuals with OH, with a focus on older adults.
- 3) Examine the Interplay between OH and Mental Health: To explore the nuanced relationship between orthostatic hypotension and mental distress, identifying how variations in blood pressure impact mental health outcomes.

2. Literature Review

The relationship between aging, orthostatic hypotension (OH), and mental health is an increasingly important area of research, particularly as global populations age. Orthostatic hypotension, characterized by a significant drop in blood pressure upon

standing, is particularly prevalent among older adults and can lead to symptoms such as dizziness and fainting. This condition has been linked to various health complications, including falls and cognitive impairment, making it a critical focus for geriatric health (McGowan et al., 2021).

Previous studies have established a connection between OH and psychiatric comorbidities, particularly anxiety and depression. Benrud-Larson et al. (2012) found that patients experiencing orthostatic dizziness reported significantly higher levels of anxiety and depression compared to controls, indicating the psychological impact of this physiological condition. Study done by, Czajkowska et al. (2010) showed that symptoms of orthostatic intolerance are correlated with diminished quality of life and increased depressive symptoms in patients with postural tachycardia syndrome.

The current study expands on this body of literature by examining these relationships specifically within the context of Ndola City, Zambia. By utilizing standardized mental health assessments alongside blood pressure measurements in a diverse adult population, this research contributes valuable insights into how aging interacts with both physiological and psychological health. The findings underscore the importance of recognizing mental health issues in growing adults experiencing OH, emphasizing the need for targeted interventions to improve their overall well-being (McGowan et al., 2021).

3. Material and Methods

3.1 Study Design and Setting

A cross-sectional design was employed to assess 770 participants categorized by age. The study was conducted during September 2023 to June 2024, in Ndola City, Zambia. Subjects were drawn from various health centers, including Peter Singogo Police Clinic, Nkwazi Clinic, Twapia Urban Health Center, Ndeke Clinic, Chipokota Mayamba Urban Health Center, Railway Surgery Clinic, New Masala Clinic, Main Masala Clinic, George compound Clinic, Dag Hammerschold Clinic, Hillcrest Clinic, Itawa Clinic, Kabushi Clinic, Kaloko Clinic, Katondo Clinic, Kawama Clinic, Mapalo clinic, Kansenshi Prisons clinic, Sai Clinic(Pamodzi) and Lubuto Clinic, reflecting the healthcare-seeking population in urban and peri-urban settings of Ndola (Polit & Beck, 2021). Additionally, the inclusion of students from the MCS School of Medicine campus provided insight into a younger, educated cohort. The combination of healthcare center attendees and students contributes to the sample's representativeness of Ndola's demographic diversity, spanning different age groups, socio-economic backgrounds, and healthcare utilization patterns (Creswell & Creswell, 2017).

3.2 Participants

The study included 770 adults from Ndola City, Zambia. To conduct the study, the researcher employed two sampling methods: simple random sampling for medical

students and purposive sampling for subjects from health care centers and residential areas.

3.3 Simple Random Sampling

The researcher obtained a complete list of medical students enrolled at CBU-MCS-SOM for the 2023-2024 period, which served as the sampling frame. Using a random number generator or drawing lots, a subset of students was selected, ensuring each student had an equal chance of being chosen (Creswell & Creswell, 2017).

3.4 Purposive Sampling

Purposive sampling was utilized for subjects from health care centers and residential areas in Ndola City. This non-probability technique involved selecting individuals based on age, gender, and medical history.

3.5 Variables

The study assessed several key variables, including age, orthostatic hypotension (OH), depression, anxiety, and stress.

3.5.1 Orthostatic Hypotension (OH)

Systolic blood pressure at standing, measured when a person is upright and diastolic blood pressure at standing, measured in an upright position (Gibbons & Balady, 2002).

3.5.2 Mental Health Assessments

Depression: Characterized by persistent sadness and lack of interest. Anxiety: Defined as excessive worry or fear. Stress: The body's response to demanding situations. Depression, Anxiety and stress levels were evaluated using the DASS-21 (American Psychological Association, 2022).

3.5.3 Mental Health Score

Assessed using the General Health Questionnaire (GHQ-12). Higher scores indicate greater distress (Goldberg & Williams, 1988).

3.6 Data Collection

Encompass a combination of surveys using DASS 21 and GHQ12 questionnaires. Physiological measurements of supine and standing blood pressure.

3.7 Demographic Data

Data, such as age and gender, are collected to understand the characteristics of the study population.

3.8 Data Sources and Measurement

Blood pressure measurements were taken using an Aneroid sphygmomanometer (Picone et al., 2017) to evaluate OH. Mental health was assessed using the DASS21 and GHQ12 scales. These instruments have established psychometric properties within the Zambian community, ensuring their appropriateness for this study (Daza et al., 2002; Ruiz et al., 2017). The General Health Questionnaire (GHQ-12) has been validated in various cultural contexts, demonstrating its reliability in assessing general mental health (Ye, 2009). Similarly, the Depression Anxiety Stress Scale (DASS-21) has shown strong psychometric properties (Antony et al., 1998; Borsa et al., 2012).

3.9 Bias

The study design aimed to minimize bias by using validated measurement tools and standardized protocols. Simple random sampling, as applicable, was used and ensured that the sample is representative of the population of interest.

The study included 770 participants, determined through a systematic sampling approach to ensure statistical validity. The estimated population of Ndola City, covering young adults (ages 16-40) and middle-aged adults (ages 41-60), is approximately 550,000. A confidence level of 95% and a margin of error of 5% were selected, leading to an initial sample size calculation that was rounded up to 770 participants, with equal representation from both age groups (385 individuals each).

A power analysis confirmed that this sample size provided a statistical power of 0.90 (90%) at a significance level of $\alpha = 0.05$, sufficient to detect meaningful effects and minimize Type II errors. This analysis was conducted using G*Power 3.1 (Faul et al., 2009), ensuring that the study was adequately powered to draw reliable conclusions from the collected data.

3.10 Quantitative Variables

Age was categorized into groups for analysis. OH prevalence and mental health scores were compared across age groups.

3.11 Statistical Methods

Chi-square tests were used to determine associations between age groups, the prevalence of OH, and mental health conditions. A cross-sectional design was employed to investigate the relationship between OH and mental health conditions across different age groups. The statistical methods used for analysis included:

3.11.1 Participant Categorization

Participants were categorized into distinct age groups to facilitate the examination of age-related differences in the prevalence of OH and mental health outcomes.

3.11.2 Blood Pressure Measurement

Participants' blood pressure was measured in both supine and standing positions, and a diagnosis of OH was established based on a significant drop in blood pressure upon standing.

3.11.3 Mental Health Assessment

Mental health was evaluated using two validated instruments:

- Depression, Anxiety, and Stress Scale (DASS21): This scale measures the severity of depression, anxiety, and stress symptoms, providing a comprehensive assessment of mental health.
- General Health Questionnaire (GHQ12): This questionnaire assesses general mental health and well-being, allowing for the identification of potential psychiatric disorders.

4. Statistical Analyses

To examine associations between age groups, orthostatic hypotension (OH) prevalence, and mental health conditions, the following analyses were conducted:

- 1) **Pearson Chi-Square Tests.** Assessed the relationship between categorical variables, like age groups and OH prevalence.
- 2) **Descriptive Statistics.** Summarized participant demographics, including age, gender, and prevalence of OH and mental health conditions.
- 3) **Correlation Analysis.** Explored relationships between continuous variables, such as age and scores on the Depression, Anxiety, and Stress Scale (DASS21) and General Health Questionnaire (GHQ12).

4.1 Significance Level

A significance level (alpha) of 0.05 was set for all statistical tests. Results with p-values less than 0.05 were considered statistically significant, indicating a meaningful association between the variables analyzed.

Software utilization: SPSS version 26 was used to interpret the results.

5. Results

CONSORT Flow Diagram Narrative: A total of 786 participants aged 16 to 60 years were assessed for eligibility in this study. Out of these, 16 participants were excluded: 10 due to being outside the specified age range and 6 due to incomplete data. Consequently, a total of 770 participants were included in the study. These participants were then divided into two age groups for analysis: 385 participants aged 16 to 40 years and 385 participants aged 41 to 60 years.

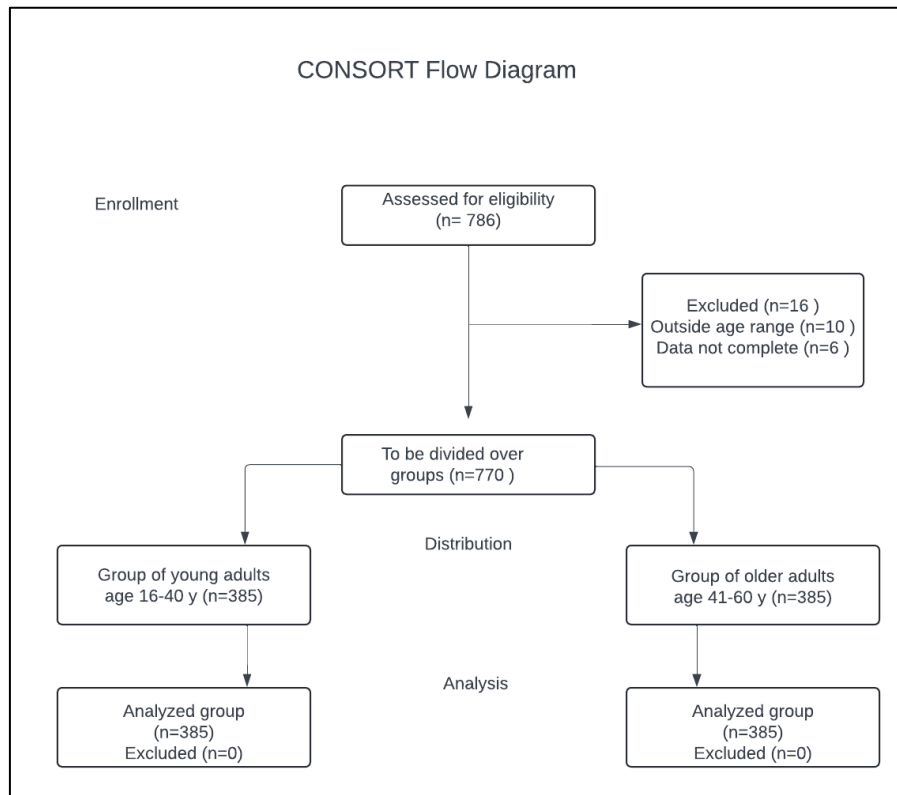


Figure 1: Study Participants Flow Chart

The analysis of the data revealed the following associations between age, orthostatic hypotension (OH), and mental health outcomes:

Table 1: Prevalence of Mental Disorders and Orthostatic Hypotension

	Depression (%)	Anxiety (%)	Stress (%)	Distress (%)	Total
OH	50 (86.2)	1 (1.72)	28 (48.27)	19 (32.75)	58
No OH	147 (20.64)	42 (5.89)	69 (9.69)	63 (8.84)	712
Total	197 (25.6)	43 (5.6)	97 (12.6)	82 (10.6)	770

Data from Table 1 indicates that orthostatic hypotension is linked to increased mental health challenges, particularly depression, stress and distress, in the population. Orthostatic Hypotension (OH): There was no significant association between age and the occurrence of OH, as indicated by the Pearson chi-square test (Pearson $\chi^2(4) = 7.5702$, $Pr = 0.109$). Depression: A significant relationship was identified between age and depression, with older age correlating with higher levels of depression (Pearson $\chi^2(8) = 23.4265$, $Pr = 0.003$) (see Figure 1). This finding aligns with previous research by Kamaruzzaman et al. (2010).

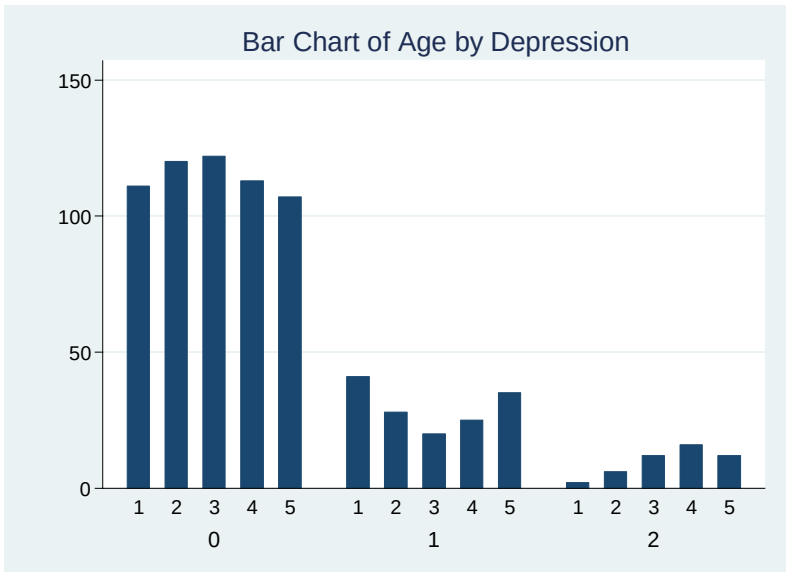


Figure 2: Relation between Age Groups and Depression Grades

In Figure 2, the chi-square test results indicate a significant association between age groups (1 to 5) and depression grades among adults in Ndola City. Both the Pearson chi-square test and the likelihood-ratio chi-square test yield p-values well below the 0.05 threshold, signifying that age is an important factor in understanding depression levels within this population. Mild depression was seen to be in age group 1 of 16 to 26 years and age group 5 of 57 to 60 years, while moderate depression was seen more in age group 4 of 47 to 56 years. The Cramér's V value, although indicating a small to moderate association, supports the presence of a relationship between these variables.

Anxiety: Anxiety levels did not show a significant association with age (Pearson $\chi^2(4) = 4.5814$, $Pr = 0.333$) (see Figure 2).

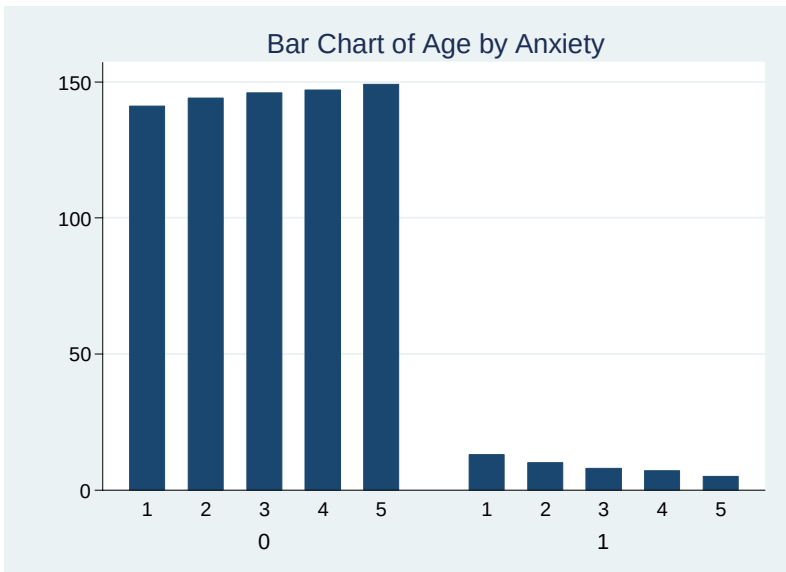


Figure 3: Relation between Age Groups and Anxiety Grades

In Figure 3, the chi-square test results indicate no significant association between age groups (1 to 5) and anxiety grades among adults in Ndola City. Both the Pearson chi-square test and the likelihood-ratio chi-square test yield p-values well above the 0.05 threshold. The Cramér's V value also supports the presence of a very weak relationship between these variables.

Stress: Stress levels were found to be significantly associated with age, as demonstrated by the statistical analysis (Pearson $\chi^2(8) = 37.1247$, $Pr = 0.000$) (see Fig 3).

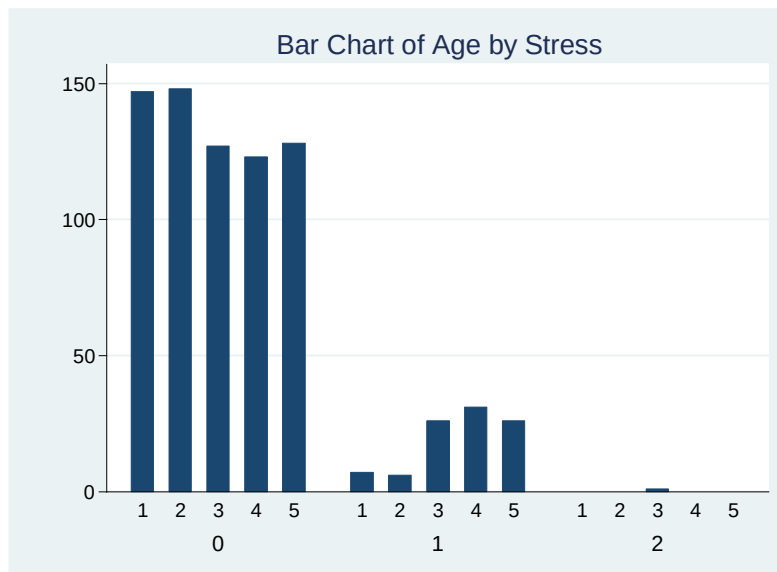


Figure 4: Relation between Age Groups and Stress Grades

In Figure 4, the chi-square test results clearly demonstrate that age groups (1 to 5) are associated with different levels of stress among adults in Ndola City. Mild stress levels were shown by adults of age groups 3,4 and 5. But only age group 3 of 37 to 46 years has moderate stress levels. Both the Pearson chi-square test and the likelihood-ratio chi-square test indicate highly significant associations. The Cramér's V value, although indicating a moderate effect size, supports the conclusion of a significant relationship.

Distress: Similarly, distress levels showed a significant association with age (Pearson $\chi^2(4) = 9.9089$, $Pr = 0.042$) (see Fig 4).

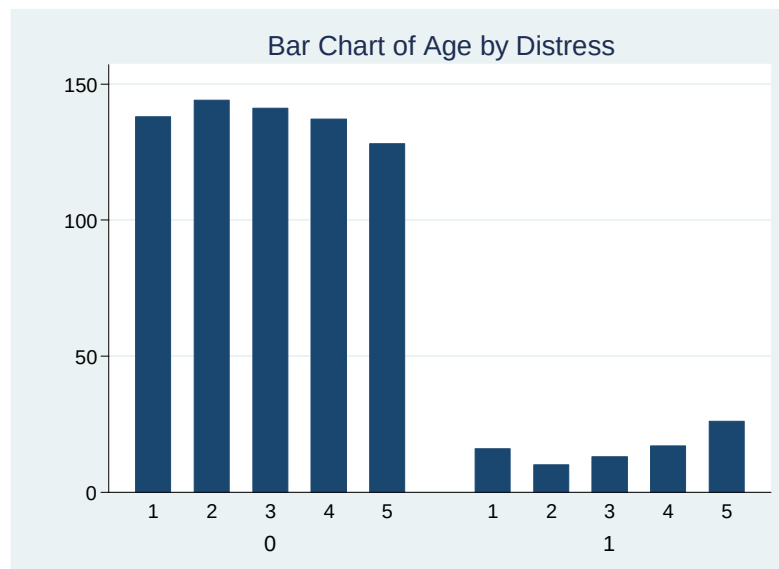


Figure 5: Relation between Age Groups and Distress Grades

In Figure 5, the chi-square test results indicate that age groups significantly influence distress levels among adults in Ndola City. Both the Pearson chi-square and likelihood-ratio chi-square tests provide evidence of this association with mild distress in group 5 made of adults of age 57 to 60 years. The Cramér's V value suggests a moderate effect size, highlighting the relevance of age in explaining variations in distress among the study population.

These results indicate that while age does not significantly affect the occurrence of OH, it is associated with increased levels of depression, stress, and distress among older adults in the study population.

6. Discussion

The findings of this study highlight the complex interplay between ageing, orthostatic hypotension (OH), and mental health outcomes in older adults. While no significant association was found between age and the occurrence of OH, the results indicated a concerning correlation between age and increased levels of depression and stress. Specifically, older participants exhibited significantly higher levels of depression (Pearson $\chi^2(8) = 23.4265$, $Pr = 0.003$) and stress (Pearson $\chi^2(8) = 37.1247$, $Pr = 0.000$), aligning with previous research that emphasizes the heightened vulnerability of older adults to mental health disorders (Kamaruzzaman et al., 2010; Dani et al., 2021). The lack of a significant relationship between age and anxiety (Pearson $\chi^2(4) = 4.5814$, $Pr = 0.333$) suggests that while depression and stress are critical concerns, anxiety may not be as directly influenced by ageing in this population. These findings are consistent with literature indicating that OH is prevalent among older individuals and is often associated with adverse health outcomes, including cognitive decline and increased risk of falls (Safarpour et al., 2019; Saedon et al., 2020).

7. Conclusion

This study emphasizes the significant relationship between aging and mental health outcomes, particularly depression and stress, in older adults from Ndola City, Zambia. Although no link was found between age and orthostatic hypotension (OH), older individuals exhibited higher levels of depression and stress, negatively impacting their overall well-being. These findings highlight the need to address mental health issues in the geriatric population, as they affect quality of life and health outcomes.

8. Implications of the Study

Integrate Mental Health Assessments, such as the DASS21 and GHQ12, into adult care at community-level medical centers with age-friendly health policies to facilitate early identification and intervention.

Conduct Further Research to explore the mechanisms linking age, orthostatic hypotension, and mental health, as well as evaluate the effectiveness of interventions over time.

9. Limitations

The study's cross-sectional design limits the ability to draw causal inferences. Additionally, the reliance on self-reported mental health assessments may introduce biases (Xin et al., 2014). Future research should consider longitudinal designs and explore additional factors. Reliance on self-reported measures for mental health assessment, while validated, may introduce bias due to subjective interpretations of symptoms.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript, and no images were manipulated using AI.

Ethical Approval Statement

The study was conducted as part of D.Sc doctoral project, after getting approval from the National Health Research Authority, Lusaka, on 29 September 2023 with Ref No: NHRA0001/29/09/2023.

Declaration of Patient Consent

The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship

Nil.

Data Availability

The datasets analysed during the current study are available from the corresponding author on reasonable request.

Acknowledgements

The authors would like to express their gratitude to the staff of the Michael Chilufya Sata School of Medicine at Copperbelt University and urban medical centers in Ndola City for their assistance in participant recruitment and data collection. We also thank the participants for their time and willingness to contribute to this research.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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Dr. Kartheek R. Balapala is a unique doctoral research scholar in clinical/medical sciences, at Michael Chilufya Sata School of Medicine, Copperbelt University, Zambia. His research interests span postural changes in blood pressure, mental stress and family scapegoating abuse, together with their impacts on human behaviour. Over two decades ago, he graduated as a medical doctor, published over 49 papers in global medical and education journals, and challenged himself to think about both sides of scientific aphorisms. A firm believer in contemplation with academic tenacity. A renowned translational researcher, Dr. Kartheek Balapala Ranganayakulu advocates the concept of visualization in medical sciences for better comprehension at medical institutions around the globe and serves as an Associate editor and board member for international medical research journals. He has been mentoring medical graduates, for the past 18 years across the globe and Africa. He published nearly 50 paper publications in peer reviewed indexed journals and over 25 books on medical concepts in eight different languages across the European Union and the globe with LAP Lambert Academic Publishers. His book on the mind mapping techniques for medical concepts, based on Leonardo da Vinci's concept of mind mapping, implied for medical students, is remarkably a novel contribution to twenty-first century medical knowledge.

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