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Examining the Relationship Between Consumption of a Protein-Based Diet and Hypertension Among Urban Households: A Cross-Sectional Study

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ABSTRACT

Background and Aims: Hypertension continues to be a significant health challenge, contributing to numerous deaths. Dietary factors are key risk factors for hypertension. Evidence indicates that consuming at least four different types of protein each week may help reduce the risk of developing high blood pressure. This study aims to analyze the impact of protein intake on the health status of household members living with hypertension in Gauteng province, South Africa.

Methods: This study applied a cross-section design and stepwise binary logit regression to analyze the protein diet intake of 3278 households with members experiencing hypertension in eight Gauteng municipalities in South Africa. The study utilized nonmedical secondary data from the Gauteng City-Region Observatory Quality of Life survey for 2021/2022, which included 13,168 randomly sampled households.

Results: The findings showed that consuming beans ($B = 0.120$; $p = 0.066$), chicken ($B = 0.349$; $p < 0.001$), tin fish ($B = 0.244$; $p < 0.001$), meat ($B = 0.235$; $p < 0.001$), offal ($B = 0.128$; $p = 0.050$), and dairy ($B = 0.294$; $p < 0.001$) was positively associated with a reduced risk of hypertension. Animal protein was preferred over plant protein. Hypertension was more common in low-income households. Households with food expenditures of R0−R500, R501−R1000, and R1001−R2000 had probabilities of not suffering from hypertension that increased by at least 0.643, 0.799, and 0.826, respectively.

Conclusions: The study showed that consuming various proteins, particularly from beans, chicken, tin fish, meat, offal, and dairy, reduces hypertension health risks. It also shows that households with higher food expenditures experience lower hypertension prevalence, emphasizing the importance of dietary variety and financial resources in maintaining a healthy diet and reducing hypertension.

1 | Introduction

Hypertension, or high blood pressure, is a widespread condition affecting millions globally. It is typically defined as a blood pressure reading of 140/90 mmHg or higher and is often called the "silent killer" due to its lack of symptoms [1]. Many people only realize they have hypertension when complications, such as heart disease or stroke, occur, leading to severe health outcomes, including death and disability [2]. Hypertension accounts for nearly 13% of all deaths worldwide, and by 2034, it is projected to cause 1.57 million deaths from hypertensive heart disease [3].

In South Africa, hypertension poses a major public health challenge, particularly for individuals in lower socioeconomic groups who depend on public healthcare. Approximately 8.22

million South Africans lack private health insurance, exacerbating the financial burden of hypertension [4]. From 2012 to 2016, hypertension rates in South Africa increased from 38.4% to 48.2% [5]. The Heart and Stroke Foundation South Africa reports that nearly one in three adults suffers from high blood pressure, contributing significantly to the country's stroke and heart attack rates [6].

In 2024, Gauteng province reported 4774 diagnoses of noncommunicable diseases, including 1252 cases of hypertension [7]. This highlights the urgent need for improved hypertension management strategies in urban areas. Obesity, diabetes, tobacco use, alcohol consumption, and excessive salt intake are key risk factors for hypertension, with dietary factors, especially protein consumption, emerging as significant contributors [8].

The relationship between dietary protein intake and hypertension is complex. While hypertension primarily affects adults, rising obesity rates and dietary risk factors are increasing cases of high blood pressure among younger populations. This study addresses the following question:

RQ1. *What is the relationship between protein intake, including plant and animal sources, and adverse hypertension health effects among household members residing in Gauteng province, South Africa?*

Protein plays a crucial role in the body, providing structural support, acting as biochemical catalysts, and regulating cellular functions [9]. In South Africa, protein consumption was expected to reach 1.54 million tons by 2010, with a 24% increase from 2000 to 1.96 million tons by 2020, marking a 58% increase [10]. Population growth has driven demand, with broiler, egg, and pork products increasing protein consumption due to technological advances [10, 11]. While meat and offal provide just 3% of total dietary energy, 11% comes from roots and tubers, and 6% from pulses, nuts, and oilseeds [12, 13]. Plant and animal protein sources may impact blood pressure differently. For example, the African-PREDICT cohort study found that South African adults often follow one of two dietary patterns: one high in animal protein and saturated fats and the other rich in minerals and fiber [14]. Those with a diet high in animal protein had a higher risk of hypertension, possibly due to atherosclerosis related to saturated fat consumption [15]. The African-PREDICT study, which used 24 h dietary recalls and monitored blood pressure over several days, found that participants with low plant and animal protein intake had elevated systolic blood pressure readings. However, after adjusting for confounding factors, no direct relationship was found between overall protein intake and systolic blood pressure [16]. Furthermore, adherence to the Dietary Approaches to Stop Hypertension (DASH) diet was inversely associated with systolic blood pressure, especially among South African women, underscoring the importance of dietary compliance in managing hypertension [8, 17].

This study can help healthcare professionals and policymakers develop effective nutritional campaigns, promote appropriate dietary practices, and improve public health education. Focusing on protein intake and ensuring equitable access to healthcare resources can reduce hypertension rates in urban households, decrease complications like stroke and heart disease, and lower the overall disease burden and economic losses.

2 | Materials and Methods

This section describes the study design, data and sampling, variable selection, and the data analysis technique.

2.1 | Study Design

This secondary study used a data set derived from the results of the Gauteng Quality of Life survey (GCRO QoL), a Round 6 cross-sectional study conducted in Gauteng province, South Africa. The study examined the relationship between protein intake and hypertension-related health issues among household members, focusing on specific plant and animal protein sources. Cross-sectional studies are adequate for population-based surveys and assessing disease prevalence because they are relatively quick and cost-efficient [18]. This design simultaneously measures outcomes and exposures, differentiating it from case-control and cohort studies [18]. The study builds on previous cross-sectional research linking diet to hypertension in different contexts [19, 20].

2.2 | Data

This study utilized secondary data from the GCRO QoL survey, round 6, with survey ID number zaf-gcro-qolsrd-2020-2021-v1 obtained in 2020 and 2021 as a sample frame for the household heads. The GCRO QoL (2020/21) is a publicly available data set from a household-based survey of randomly selected individuals (18+). All respondents were interviewed at their dwellings [21].[1]

Drawing on the GCRO secondary data, 3278 respondents who answered Yes to the question “Have you or any member of your household been diagnosed with hypertension in the last 12 months preceding the survey?” were extracted. These respondents were analyzed against their predetermined intake of protein-based diet. The GCRO QoL survey was conducted as a cross-sectional study rather than a controlled trial. Its purpose was to assess the QoL of the population. It was carried out under nonmedical standards, with Protocol Number H19/11/09. The study ensured informed consent, maintained anonymity, and adhered to ethical data collection practices.

2.3 | Variables

This section presents the variables we used in the study. We drew the variables from the literature and applied them comprehensively in the QoL survey. Table 1 describes the variables in our study.

The dependent variable, hypertension experience, indicates whether any household member has experienced hypertension in the 12 months leading up to the survey. Respondents provide binary answers: either yes or no. According to [22], researchers apply the binary logit model when the dependent variable is binary, which means it has two possible outcomes or categories. These outcomes are often coded as 0 and 1 to represent different choices. The

TABLE 1 | Description of variables.

Variable	Description
Hypertension experience	Binary dependent variable of any household member living with hypertension.
Skip meals	Binary variable showing food distress.
Food satisfaction	Categorical variable indicating household's level of satisfaction with the food consumed.
Protein source diversity	Categorical variable showing various plant and animal protein choices consumed by households.
Food expenditure	Categorical variable showing the monthly food expenditure.

Source: Authors.

regressor variables gather information on whether households consumed a specific list of protein diet foods identified by the Food and Nutrition Technical Assistance (FANTA) protein diet foods [23]. We also explored related socioeconomic variables to gain a deeper understanding of the lived experiences of households with members living with hypertension.

The skip meal variable acts as a binary food distress indicator with two possible values: 0 (no) or 1 (yes), indicating whether any member of the household skipped a meal in the last 30 days leading up to the survey. Food satisfaction measures how satisfied households are with their food and is categorized into five levels: very satisfied, satisfied, neither satisfied nor dissatisfied, dissatisfied, and very dissatisfied. The food expenditure variable captures the approximate monthly amount households spend on food, categorized as follows: R0−R500, R501−R1000, R1001−R2000, R2001−R4000, and R4001+. The protein source diversity variable includes protein-based diets that households consume, such as dry or tinned beans, processed meats (such as Polony/Vienna/bull beef), frozen chicken portions, eggs, tinned fish (such as pilchards/sardines), fresh meats (beef/chicken/fish), chicken feet/gizzards/offcuts/offal, dairy products, and nuts and seeds (including soya products).

2.4 | Empirical Model

The study used the backward stepwise binary logit regression model as the empirical model. This method eliminates variables that are not significant to the explanatory variables one by one to be more effective in determining the best model [24]. The method follows prior studies [25, 26]. Given the nature of the dependent variables, the backward stepwise binary logit regression model was used based on the following formula:

$$\log\left(\frac{1-p}{p}\right) = \beta 0 + \beta 1(\text{Skip meal}) + \beta 2(\text{Food satisfication}) + \beta 3(\text{Food expenditure}) + \beta 4(\text{Protein source diversity})$$

Where:

- p is the probability of experiencing hypertension.
- $\beta 0$ is the intercept of the model.
- $\beta 1, \beta 2, \beta 3 \ldots, \beta 4$ are coefficients representing the changes in the log odds of experiencing hypertension for a one-unit change in the corresponding independent variable.

3 | Results

This section presents the study's results, including descriptive statistics, diagnostic tests, and empirical findings. The study utilized the IBM Statistical Package for the Social Sciences (SPSS) software, 2024 version, for the analysis.

3.1 | Descriptive Statistics

Table 2 presents the descriptive statistics of protein intake and other food-related indicators among the 3278 hypertensive household members in Gauteng, South Africa. Most households (75.9%) report having no hypertensive members, while 24.1% do have them. Similarly, 75.8% of households indicate that no member skips a meal, while 24.2% do. Regarding food satisfaction, 59.4% of respondents express satisfaction with their food situation, and 20.9% feel very satisfied. A smaller percentage remains neutral (5.8%), dissatisfied (11.2%), or very dissatisfied (2.8%). The mean score of 2.16 (out of a 5-point scale) shows that households tend to feel more satisfied than dissatisfied, leaning toward satisfaction. The largest proportion of households (32.3%) spend between R1001 and R2000 monthly on food, while 26.1% spend R1000 or less. A smaller percentage of households spend between R2001 and R4000 (21.2%), and only 6.7% spend more than R4000. The average expenditure Mean of 2.75 (out of 5) indicates moderate food spending.

Chicken ranks as the most consumed food, with a mean consumption of 0.51 and a frequency of use at 50.6%, marking it as a major component in many households' diets. In contrast, nuts have the lowest mean (0.02) and a very low frequency of consumption (2.2%), indicating that they are not significant in most diets. Other food items, such as meat (mean of 0.36), eggs (mean of 0.39), and tinned fish (mean of 0.16), are consumed more moderately. These foods often serve as occasional components of meals rather than daily staples, reflecting a mix of preferences and economic factors that influence food choices.

3.2 | Diagnostic Test Results

3.2.1 | Likelihood Ratio Test

The overall fit of the binary logit model entails assessing how well the model explains the data.

Table 3 presents the likelihood test showing the goodness of fit for the model adopted.

TABLE 2 | Descriptive statistics results.

Variable	Response	Minimum	Maximum	Mean	Standard error	Standard deviation	Frequency	%
Households with hypertensive members	No	0	1	0.24	0.004	0.428	10,338	75.9
	Yes						3278	24.1
Skipped a meal	No	0	1	0.24	0.004	0.428	2485	75.8
	Yes						793	24.2
Food satisfaction level	Very satisfied	1	5	2.16	0.008	0.971	685	20.9
	Satisfied						1947	59.4
	Neutral						190	5.8
	Dissatisfied						367	11.2
	Very dissatisfied						92	2.8
Household monthly expenditure on food	R0−R500	0	5	2.75	0.011	1.240	446	13.6
	R501−R1000						856	26.1
	R1001–R2000						1059	32.3
	R2001–R4000						695	21.2
	R4001+						220	6.7
Beans	No	0	1	0.14	0.003	0.342	2832	86.4
	Yes						446	13.6
Polony	No	0	1	0.11	0.003	0.311	2921	89.1
	Yes						357	10.9
Chicken	No	0	1	0.51	0.004	0.500	1619	49.4
	Yes						1659	50.6
Eggs	No	0	1	0.39	0.004	0.487	2009	61.3
	Yes						1269	38.7
Tin fish	No	0	1	0.16	0.003	0.364	2763	84.3
	Yes						515	15.7
Meat	No	0	1	0.36	0.004	0.481	2082	63.5
	Yes						1196	36.5
Offal	No	0	1	0.14	0.003	0.347	2819	86.0
	Yes						459	14.0
Dairy	No	0	1	0.17	0.003	0.373	2731	83.3
	Yes						547	16.7
Nuts	No	0	1	0.02	0.001	0.145	3205	97.8
	Yes						72	2.2

Source: Authors.

The Cox and Snell R^2 value of 0.523 and the Nagelkerke R^2 value of 0.712 indicate a good model fit. The test assesses whether removing predictor variables improves the model's performance, with a Nagelkerke R^2 value of greater than 0.6 indicating a good model fit [27].

3.2.2 | Omnibus Test

Table 4 presents the omnibus test used to evaluate the hypothesis, highlighting goodness of fit when the chi-square value is less than 0.05.

TABLE 3 | Likelihood ratio test.

Step	−2 Log likelihood	Cox & Snell R^2	Nagelkerke R^2
6	14.605	0.523	0.712

Source: Authors.

TABLE 4 | Omnibus test.

Omnibus tests of model coefficients				
		Chi-square	df	Sig.
Step 6	Step	112.784	19	< 0.001
	Block	112.784	19	< 0.001
	Model	112.784	19	< 0.001

Source: Authors.

TABLE 5 | Hosmer and Lemeshow test.

Step	Chi-square	df	Sig.
6	21.937	8	0.115

Source: Authors.

Results show that the chi-square had a value of 112.784 and was statistically significant at the 1% level, confirming the goodness of fit for the adopted model.

3.2.3 | Hosmer and Lemeshow Test

The Hosmer and Lemeshow test is a statistical test used to assess the goodness of fit of a logit regression model. It evaluates how well the model's predicted probabilities match the actual outcomes (i.e., the observed data). Table 5 presents the Hosmer and Lemeshow test.

A high *p*-value suggests a good model fit, while a low *p*-value suggests a poor fit. The *p*-value of 0.115 suggests that the model fits the data well because it is greater than the 0.05 significance level.

3.3 | Stepwise Binary Logit Analysis

The stepwise binary logit regression model was used to examine the impact of a protein diet on reducing the adverse health effects of hypertension in household members. The findings were reported following the Statistical Analyses and Methods in the Published Literature (SAMPL) [28]. Table 6 shows the stepwise binary logit findings.

Eating beans slightly increases the likelihood of reducing the adverse health effects of hypertension by 12.8% (Exp [B] = 1.128). This result is marginally significant at a 10% level ($p = 0.066$). In other words, bean consumption is 1.1 times more likely to help reduce hypertension-related health effects. Chicken consumption also plays a significant role in reducing the adverse health effects of hypertension. The odds of this outcome are 1.4 times higher with chicken consumption (Exp [B] = 1.417), and the result is highly significant ($p < 0.001$). Households that consume tin fish experience a 27.7% higher likelihood of reducing hypertension-related health effects (Exp [B] = 1.277), with this finding being highly significant ($p < 0.001$). Meat consumption increases the odds of reducing hypertension-related health effects by 26.5% (Exp [B] = 1.265). The odds ratio indicates that meat consumption is 1.3 times more likely to help alleviate these health effects, which is highly significant ($p < 0.001$). Offal consumption is positively associated with reduced adverse hypertension health effects, increasing the odds by 13.7% (Exp [B] = 1.137). This result is marginally significant at a 10% level ($p = 0.050$).

Dairy consumption boosts the odds of reducing hypertension-related health effects by 34.1% (Exp [B] = 1.341), with the result being highly significant ($p < 0.001$). The odds ratio shows that dairy consumption is 1.3 times more likely to reduce the health effects of hypertension.

Households that spend less than R200 per month on food are less likely to experience hypertension-related health effects, with the odds of this outcome being 35.7% lower (Exp [B] = 0.643, $p < 0.001$). Similarly, households that spend between R501 and R1000 per month on food also have 20.1% lower odds of experiencing hypertension health effects, and this finding is significant at the 5% level ($p = 0.011$). Findings on households with food expenditure between R2001 and R4000 or higher (R4001+) were statistically insignificant ($p = 0.440$). Neither skipping meals nor satisfaction with household food entered the stepwise binary logit model.

4 | Discussion

The study employed a stepwise binary logit model to examine how a protein-based diet impacts the health status of households with hypertension in the Gauteng province of South Africa. The results show a significant positive relationship between protein intake and reduced negative health effects of hypertension within this group. Households commonly consume foods like beans, chicken, tinned fish, various meats, offal, and dairy products. This aligns with studies which found a strong relationship between protein consumption and hypertension incidence among Black South African children [29].

The analysis highlighted a positive relationship between the intake of beans, chicken, tinned fish, fresh meat, offal, and dairy products and decreased hypertension prevalence. The relationship is particularly strong for chicken, dairy, tinned fish, and meat. These foods likely help stabilize blood pressure levels. Specifically, the findings regarding dairy align with [30], who observed that Black South Africans with moderate hypertension, who consume about 500 milliliters of fermented milk daily, experience a significant blood pressure reduction.

Studies by Aljuraiban et al. [31] and Vasei et al. [32] also emphasize beneficial dietary patterns, such as the DASH, which promotes a healthy lifestyle. Concurrently, other studies suggest that high protein intake does not increase cardiovascular risks, suggesting that protein can be safely included in a balanced diet

TABLE 6 | Stepwise binary logit findings.

Variable	B	Sig.	Exp(B)	95% CI for exp (B)	
				Lower	Upper
Constant	−1.529	< 0.001	0.217***		
Beans	0.120	0.066	1.128***	0.992	1.281
Chicken	0.349	< 0.001	1.417***	1.284	1.564
Tin fish	0.244	< 0.001	1.277***	1.132	1.441
Meat	0.235	< 0.001	1.265***	1.141	1.403
Offal	0.128	0.050	1.137*	1.000	1.292
Dairy	0.294	< 0.001	1.341***	1.194	1.506
Food expenditure (R0−R500)	−0.442	< 0.001	0.643***	0.515	0.802
Food expenditure (R5001−R1000	−0.224	0.011	0.799*	0.673	0.949
Food expenditure (R1001−R2000)	−0.192	0.025	0.826*	0.698	0.977
Food expenditure (R2001−R4000)	0.016	0.857	1.016	0.854	1.209
Food expenditure (R4001+)	0.084	0.440	1.087	0.879	1.345
Constant	−1.400	< 0.001	0.247		

Note: *p*-significance level: 1%***, 5%**, and 10%*.
Source: Authors.

[33]. Nevertheless, high-fat dairy and meat consumption might replace healthier food choices, exacerbating food insecurity [34]. This view is supported by Delgado-Pando et al. [35] and Allen et al. [36], who noted that processed red meat, with its high sodium content, may increase hypertension risk. Strauss-Kruger et al. [16] further confirmed that diets high in animal protein and low in plant protein can lead to higher body mass index and increased hypertension risk.

Chicken, as a primary protein source, is related to reduced hypertension-related health issues. The rise in chicken consumption is due to its high protein content, affordability, and health benefits [11]. Although there has been a noticeable shift toward white meat over red meat, various factors such as dietary preferences, standard of living, and the economic context shape this trend. Limited research exists on the relationship between chicken and hypertension in South Africa. However, Mphekgwana et al. [37] suggested that meat consumption, including chicken, may contribute to hypertension among semi-urban and rural populations.

Bean consumption was positively related to reduced hypertension effects. This was supported by Strauss-Kruger et al. [16], who found that individuals on plant-based diets had lower hypertension levels. Beans, an excellent plant protein source, are important in managing metabolic syndrome. Replacing animal protein with plant-based options is crucial for managing hypertension, which is a key element of metabolic syndrome and heightens the risk of chronic illnesses and mortality [38]. However, the fat content in protein-based diets, particularly total and saturated fats, can influence health outcomes and disease risk related to hypertension [39–41].

The study also examined the economic context of dietary patterns. Most households reported spending between R1001 and R2000 on food monthly, with a significant amount spent between R501 and R1000. This low food expenditure stems from limited income and rising living costs. Mulamba [42] found that for every one-rand increase in household income, there was a 2% decrease in the allocation for food, with an inverse relationship. This suggests that households prioritize other needs, reducing the quality of their diet. Nenguda and Scholes [43] noted that low-income households in South Africa often rely on social grants to meet nutritional needs. They found that households receiving monthly stipends between US$32 and US$136 experience low living standards, poor dietary quality, and food insecurity. On the other hand, high-income households have better access to nutritious food, setting them apart from their lower-income counterparts [44]. Recognizing the broader health implications of dietary patterns is essential. Studies by Aljuraiban et al. [31] and Vasei et al. [32] demonstrate that dietary changes at the community and individual levels can help reduce hypertension prevalence and improve overall health. These insights are crucial for health policymakers, nutritionists, and community organizers working to combat hypertension and improve public health outcomes in similar regions.

The study also highlights the importance of specific protein sources, like beans, chicken, and dairy, in alleviating hypertension, especially in South Africa. However, these foods may be less accessible or culturally preferred in other regions, such as Western countries, where fish or plant-based proteins are more common. The availability of fresh, protein-rich foods also varies, and processed alternatives may have different health effects [45]. These findings may be less applicable in areas with predominantly plant-based diets, where legumes and grains are prioritized [46].

5 | Conclusions and Recommendations

This study provides significant insights into the relationship between protein intake and the health status of household members experiencing hypertension in Gauteng, South Africa.

The findings show a positive relationship between consuming protein-rich foods such as beans, chicken, tin fish, meat, offal, and dairy and reduced hypertension health effects. This suggests that dietary interventions incorporating a variety of protein sources could help manage and mitigate hypertension, a major risk factor for cardiovascular diseases. These results align with broader research, including the DASH diet, which emphasizes the importance of dietary patterns in controlling hypertension. The DASH plan recommends eating vegetables, fruits, whole grains, fat-free or low-fat dairy, fish, poultry, beans, nuts, and vegetable oils while limiting foods high in saturated fat, like fatty meats, full-fat dairy, and tropical oils, as well as reducing sugar-sweetened beverages and sweets.

The study indicates that dietary choices in Gauteng households can significantly influence hypertension outcomes. Specifically, foods such as chicken, dairy, tin fish, and meat appear to have the most noticeable effects in lowering hypertension risk. These foods may help regulate blood pressure by improving the body's metabolic processes. Chicken, particularly, stands out as an affordable and high-protein food, making it a vital dietary option for households, especially those in low-income settings. Additionally, beans, a plant-based protein, also showed a positive impact on reducing hypertension risk, underscoring the role of both animal and plant-based proteins in managing blood pressure.

The study also highlights the influence of socioeconomic factors on dietary choices. Low to moderate-income households often face budget constraints that lead to poor nutrition, reliance on social grants, and increased health risks, including hypertension. The relationship between income and dietary quality points to the need for policies that address these disparities.

Based on these findings, several policy recommendations can help tackle hypertension in Gauteng, South Africa. The provincial government and municipalities should promote affordable access to diverse protein sources, including both animal- and plant-based options, to ensure balanced nutrition for low-income households. Subsidizing healthier protein-rich foods, like chicken, beans, and dairy products, could make these items more accessible. Furthermore, increasing social grant programs would support households living with hypertension, helping them meet their nutritional needs, reduce food insecurity, and improve health outcomes. Integrating dietary education programs that emphasize the benefits of the DASH diet could raise awareness about hypertension prevention, with adaptations for local cultural preferences and economic realities. Finally, encouraging urban agriculture initiatives could boost local food production, reduce costs, and promote sustainable food practices, particularly in Gauteng's urban settings.

6 | Study Limitations

This study is important because it highlights the potential role of dietary habits, particularly protein intake, in managing hypertension, a leading cause of cardiovascular diseases and premature deaths worldwide. However, the study has limitations. Its cross-sectional design and reliance on secondary data while validated by prior studies and aligned with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines—means it cannot establish a causal relationship between protein intake and hypertension, unlike controlled trials that follow the CONSORT guidelines. Additionally, the study's geographic focus on Gauteng, South Africa, limits its ability to be generalized to other regions or countries with different dietary patterns and healthcare systems. Future studies should conduct trials using the CONSORT guidelines across the country's population, based on the DASH variables, to assess healthy dietary intake among households experiencing hypertension.

Author Contributions

Adrino Mazenda: conceptualization, data curation, funding acquisition, investigation, methodology, project administration, supervision, resources, writing – original draft, writing – review and editing, validation, visualization. **Chenaimoyo Lufutuko Faith Katiyatiya:** data curation, software, formal analysis, writing – original draft. **Ni Putu Wulan Purnama Sari:** project administration, resources, writing – review and editing, writing – original draft. All authors have read and approved the final version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

Guideline Adherence

The STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines were followed when writing the manuscript.

Data Availability Statement

The data is obtained from the Gauteng City-Region Observatory (GCRO) Quality of Life (QoL) 2020/2021 survey, Round 6, survey ID number: zaf-gcro-qolsrd-2020-2021-v1 (Gauteng City-Region Observatory, 2022). The data set is accessible at: https://doi.org/10.25828/3v4h-7n43.

Transparency Statement

The lead author, Adrino Mazenda, affirms that this manuscript is an honest, accurate, and transparent account of the study being reported, that no important aspects of the study have been omitted, and that any discrepancies from the study as planned (and if relevant, registered) have been explained.

Endnotes

[1]The GCRO QoL survey permitted a random sample of 13,616 respondents from 529 wards in the Gauteng City Region (i.e., City of Ekurhuleni; City of Johannesburg; City of Tshwane; Emfuleni; Lesedi; Merafong; Midvaal and Mogale). All data from the QoL surveys is publicly available under a CC BY-SA 4.0 license.

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