International Journal of Research in Medical Sciences
Yakubu AS et al. Int J Res Med Sci. 2024 Feb;12(2):374-379
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20240200

Original Research Article

Undiagnosed hypertension and proteinuria in an outpatient population in Northern Ghana

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Received: 03 December 2023
Revised: 04 January 2024
Accepted: 08 January 2024

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ABSTRACT

Background: There is an upsurge in chronic kidney disease incidence worldwide. Late presentation characterises chronic kidney disease in sub-Saharan Africa. Hypertension and proteinuria are independent risk factors for worsening kidney function, irrespective of the cause of the kidney disease. We assessed the prevalence and predictors of hypertension and proteinuria in an outpatient population in Northern Ghana.
Methods: We retrospectively reviewed screening data among adults ≥18 years of age in two of Ghana's Northern regions. The data retrieved included socio-demographic information, blood pressure recordings, urine dipsticks and fingerpick blood glucose levels. The data were analysed for the prevalence of hypertension and proteinuria in the participants. Binary logistic regression analysis was employed to identify the predictors of significant proteinuria in these participants. A *p*-value <0.05 was considered statistically significant.
Results: Total 1018 participants were included in the study, comprising 50.5% males. The prevalence of uncontrolled hypertension was 28.1%, using a blood pressure cut-off value of ≥ 140/90 mmHg. Significant proteinuria (≥ 1+ or 30 mg/dl) was present in 10.7% of the participants. Hypertension (AOR 2.433, 95% CI 1.582-3.742, *p*<0.001) and hyperglycaemia (AOR 2.226, 95% CI 1.159-4.275, *p*=0.016) were independent predictors of the presence of significant proteinuria.
Conclusions: Uncontrolled hypertension and proteinuria were common in this outpatient population in Northern Ghana. The cost-effectiveness of community-based screening for chronic kidney disease and its risk factors in low-resource settings like Ghana, with the aim to treat to improve outcomes, needs to be explored.

Keywords: Chronic kidney disease, Ghana, Hypertension, Proteinuria

INTRODUCTION

In the last decade, there has been an upsurge in chronic kidney disease (CKD) incidence and prevalence, contributing significantly to morbidity and mortality, especially in resource-poor settings.[1] Hypertension and chronic glomerulonephritis are significant causes of CKD in sub-Saharan Africa.[1] Late presentation is a feature of CKD in sub-Saharan Africa, and morbidity and mortality remain high because most affected individuals cannot access renal replacement therapy.[1] This gloomy outlook makes prevention a vital option in the long term and justifies screening programs.[2]

Hypertension and proteinuria are significant independent risk factors for worsening kidney function, irrespective of the cause of CKD, and adequate blood pressure control in patients with proteinuria delays the progression of CKD.[3]

The degree of proteinuria is widely recognised as a marker of the severity of glomerular disease. Population-based studies have identified proteinuria as a predictor of future decline in glomerular filtration rate and the development of end-stage renal disease.[4] The prevalence of CKD and proteinuria in hypertensive patients in Ghana has been estimated to be 46.9% and 28.9%, respectively.[2] Studies on hypertension in West Africa suggest that the prevalence is higher in urban than in rural areas and varies between 16% and 38%.[5-7] In Ghana, the prevalence of hypertension ranged from 19% to 48% between studies.[8]

With the increasing burden of hypertension and kidney disease, it is worrying that awareness of these conditions remains low in many communities and among physicians in low-resource settings like Ghana.[9] Screening and intervention programs have been demonstrated to reduce the incidence of end-stage kidney disease.[10] To create awareness of hypertension and CKD, health education and screening were held in selected localities in Northern Ghana as part of the 2022 World Kidney Day Celebrations. We sought to ascertain the prevalence of undiagnosed proteinuria and hypertension as well as the predictors of proteinuria in this mainly rural population in Northern Ghana.

METHODS

Study design and setting

This retrospective cross-sectional study examined the records of 1018 outpatients obtained during a health screening exercise conducted on the 10th and 11th of March 2022 to mark World Kidney Day in the Tamale Teaching Hospital and Bolgatanga Regional Hospital in Northern Ghana.[11,12] The Northern region is the largest in Ghana in terms of land area, and it shares boundaries with the Upper East and Upper West regions to the north. The population is mainly rural with most of its people engaged in agriculture.[11]

Study population and sample size determination

The study population comprised all adults who presented for the screening exercise at the Tamale Teaching Hospital and Bolgatanga Regional Hospital premises. Inclusion criteria were consenting adults ≥18 years of age. We excluded participants with known chronic kidney disease. All 1018 participants who met the inclusion criteria and had no exclusion criteria were included in the data analysis.

Data collection

Anonymized data were extracted from a Microsoft Excel database created for the screening exercise. Permission to use the data was granted by the Tamale Teaching Hospital Research and Development Unit. Data retrieved included socio-demographic information, comorbidities, automated blood pressure measurements, urine dipstick for protein, and finger prick random blood glucose (RBS) levels. The blood pressure was recorded in the seated position using an oscillometric sphygmomanometer after each participant had rested for at least 5 minutes. Three consecutive readings were taken at 1-2-minute intervals and the average of the second and third readings recorded as the blood pressure. Hypertension was defined as a systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg.[13] Midstream urine samples were collected for dipstick analysis and semiquantitative screening for proteinuria. The Siemens Multistix 10 SG reagent strips were read visually 1 minute after the dipstick based on a colour scale that quantified proteinuria as absent, trace, 1+, 2+, 3+ or 4+ proteinuria.[14] Significant proteinuria was defined as urine protein ≥1+, which corresponds to proteinuria of more than 30 mg/dl (Table 1).[15]

Table 1: Dipstick-detected proteinuria and corresponding concentrations.

Urinalysis reading	Corresponding concentration
Absent	<10 mg/dl
Trace	10-20 mg/dl
1+	30 mg/dl
2+	100 mg/dl
3+	300 mg/dl
4+	1000 mg/dl

Statistical analysis

The data were analysed for the prevalence of hypertension and significant proteinuria in the participants. Categorical variables were presented as numbers and percentages and compared using the Chi-square (χ^2) or Fisher's exact test as appropriate. Continuous variables were presented as their means with standard deviation, and the means of two groups of continuous variables were compared with the independent sample Student's t-test. Univariate and multivariate binary logistic regression analysis was employed to identify the predictors of significant proteinuria in these participants. The odds ratios (OR) and their 95% confidence intervals (CI) were computed. All tests were two-tailed, and a *p*-value <0.05 was considered statistically significant. The results were presented in tables and charts as appropriate. Data transformations and analysis were performed with the Statistical Package for the Social Sciences version 21 software (SPSS, IBM Corporation, Armonk, NY, USA).

RESULTS

A total of 1018 participants in included in the study, comprising 514 (50.5%) males (Table 2). The mean age of the participants was 41.1±14.1 years, with an age range of 18 to 94 years. The mean diastolic and systolic blood pressures were 77.9±14.2 mmHg and 126.9±21.5

mmHg, respectively. Using a blood pressure cut-off of 140/90 mmHg, 28.1% of participants had hypertension. The hypertension prevalence was 50.7% if a more stringent cut-off value of 130/80 mmHg was used. There were no gender differences in the baseline characteristics of the participants. Hyperglycaemia, defined as an RBS ≥11.1 mmol/l was present in 6.7% of those screened. No information was available on whether these participants had previously been diagnosed with diabetes mellitus.

Table 2: Baseline characteristics and prevalence of hypertension.

	Males n=514 (50.5%) (%)	Females n=504 (49.5%) (%)	Total N=1018 (100.0%) (%)	p-value
Age (years)	40.8±13.7	41.3±14.5	41.1±14.1	0.556
DBP (mmHg)	78.6±14.7	77.2±13.8	77.9±14.2	0.110
SBP (mmHg)	128.1±22.0	125.7±21.0	126.9±21.5	0.076
Hypertension (WHO/ISH)	157 (30.5)	129 (25.6)	286 (28.1)	0.086
Hypertension (ACC/AHA)	270 (52.5)	246 (48.8)	516 (50.7)	0.261
Proteinuria	51 (9.9)	58 (11.5)	109 (10.7)	0.413
RBS (mmol/l)	6.6±3.2	6.8±3.2	6.7±3.2	0.472
RBS ≥11.1 mmol/l	32 (6.2)	36 (7.1)	68 (6.7)	0.568
Weight (kg)	71.2±15.3	70.9±15.4	71.1±15.4	0.815

ACC, American College of Cardiology; AHA, American Heart Association; DBP, diastolic blood pressure; ISH, international society of hypertension; RBS, random blood sugar; SBP, systolic blood pressure; WHO, World Health Organization

The 29.2% of participants had varying degrees of proteinuria (≥ trace). Significant proteinuria (≥ 1+ or 30 mg/dl) was present in 10.7%. The degree of proteinuria did not differ by gender (p=0.514) (Figure 1). No participant had nephrotic-range (≥3+) proteinuria. In addition, 3.9% (21/542) had at least trace glucosuria on urinalysis.

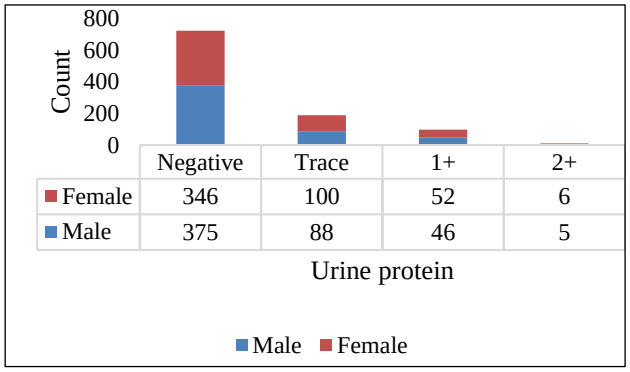

Figure 1: Distribution of proteinuria in study participants.

Table 3: Predictors of proteinuria.

Variable	OR (95% CI)	p-value
Hypertension ISH/WHO	2.410 (1.607-3.612)	<0.001*
Gender (Female)	1.181 (0.793-1.758)	0.414
RBS ≥11.1 mmol/l	2.584 (1.400-4.769)	0.002*
Age ≥40	1.735 (1.161-2.594)	0.007*

ISH, international society of hypertension; OR, Odds ratio; RBS, random blood sugar; WHO, World Health Organization

* p-value is statistically significant

Univariate and multivariate binary logistic regression analysis was performed to identify the predictors of the presence of significant proteinuria (Table 3). Both hypertension (AOR 2.433, 95% CI 1.582-3.742, p<0.001) and high RBS (≥11.1 mmol/l) (AOR 2.226, 95% CI 1.159-4.275, p=0.016) were independent predictors of the presence of proteinuria on multivariate analysis, after adjusting for other variables.

DISCUSSION

In this study, significant proteinuria and uncontrolled hypertension were diagnosed in 10.7% and 28.1% of asymptomatic volunteers, respectively. Hypertension and hyperglycaemia were independently associated with the presence of significant proteinuria in these participants. This finding was not unexpected, as systemic hypertension and diabetes mellitus are among the most common causes of CKD worldwide.[16] No gender differences were noted in hypertension and significant proteinuria prevalence.

The burden of cardiovascular diseases (CVDs) and their risk factors, like hypertension, has been on the ascendency in Sub-Saharan Africa over the past few decades.[17] However, many of those with hypertension remain undiagnosed and undertreated.[18] Hypertension is a significant public health problem in Ghana, even in rural communities with a population prevalence of 25-30%.[18,19] However, this high prevalence of hypertension is often associated with low hypertension awareness and poor blood pressure control.[17,20] Some studies in Ghana have suggested that hypertension is twice as high in the coastal and middle geo-ecological belts as in the northern belt.[18] In this study in Northern Ghana with a primarily rural population, we found a hypertension prevalence of 28.1%, suggesting that hypertension is at least as

common in Northern Ghana as in other parts of the country.

Chronic kidney disease is a growing problem worldwide. It is a common yet costly condition to treat, which is associated with adverse health outcomes. The morbidity and mortality associated with CKD in sub-Saharan Africa are considerable because the healthcare systems are poorly resourced to manage them, and renal replacement therapies are not readily accessible.[2,21] In addition, management of CKD in this region is limited by low awareness and delayed presentation for clinical care. Proteinuria is identified as an important and independent risk factor for kidney and cardiovascular outcomes, and these relationships are independent of the glomerular filtration rate.[22,23] It is associated with incident CKD, the progression of kidney disease and is a marker of cardiovascular and all-cause mortality.[22,23] The level of proteinuria is a predictor of future decline in glomerular filtration rate and the development of end-stage renal disease and can thus be used as a surrogate marker for chronic kidney disease.[4,24] Since relatively inexpensive interventions can slow the rate of renal function loss, early detection of CKD with the aim to treat and improve outcomes is particularly attractive in low-resource settings like Ghana. We identified an overall proteinuria rate of 10.7% in our participants and a rate of 17.5% (50/286) among those with hypertension. These rates are less than that previously reported by Osafo et al in Ghana, likely attributable to the method of estimation of proteinuria.[2]

As a result of its long preclinical latency, screening of asymptomatic individuals for CKD with the goal of reducing its progression and complications has been considered a potentially useful strategy for reducing the disease burden of CKD.[25,26] Whilst there is consensus on the utility of screening for proteinuria in at-risk groups, evidence to justify screening of the general population, especially in young adults, is less conclusive.[25,27] However, in low-resource settings where the awareness of CKD and its risk factors is low, this population-based screening strategy may be justified.[27,28] The Kidney Disease Improving Global Outcomes (KDIGO) Controversies Conference recommends screening for CKD in at-risk individuals, including diabetics, hypertensives, and those from low-socioeconomic backgrounds.[26] Although measuring albuminuria is the preferred method for defining and staging CKD, dipstick protein is often measured instead because it is a relatively inexpensive and easy test to perform. Urine dipstick has shown moderate sensitivity and high specificity for detecting proteinuria and is, therefore, an acceptable screening method in resource-constraint areas for early detection of CKD.[29,30] Using a point-of-care CKD screening strategy has been shown to identify high-risk persons who would then require confirmatory kidney function testing.[31] Urine dipstick for proteinuria is a relatively inexpensive test that can be incorporated at any point of contact with the health care system as part of a strategy to identify and treat kidney disease at an early stage.[25]

The retrospective study design and non-probability sampling methods are limitations to the generalizability of the study results. A more quantitative urine protein assay would have produced more accurate results for proteinuria. In addition, we could not exclude the effect of postural/orthostatic proteinuria. Despite these limitations, the relatively large sample size makes this study, to the best of our knowledge, the largest of its kind in this part of Ghana and serves as a useful "snapshot" of the prevalence of proteinuria and hypertension in this population.

CONCLUSION

The relatively high prevalence of uncontrolled hypertension and proteinuria in this study provides some justification for a population-based screening strategy in our setting. Early detection of CKD and its risk factors through community-based screening with the aim to treat and improve outcomes may be feasible in low-resource settings like Ghana and may help ease the current burden of CKD and CVDs on an already weak and under-resourced healthcare system. The cost-effectiveness of such a strategy needs to be explored.

ACKNOWLEDGEMENTS

Authors would like to thank Adam Wanzam Yahaya and Mohammed Kamil Tamimu, both of the dialysis unit of Tamale Teaching Hospital, for their role in the data collection process.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee of Tamale Teaching Hospital Research and Development Unit (TTH/R&D/SR/251)

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Cite this article as: Yakubu AS, Adam A, Ahadzi D. Undiagnosed hypertension and proteinuria in an outpatient population in Northern Ghana. Int J Res Med Sci 2024;12:374-9.