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ORIGINAL CONTRIBUTION

# Differences Risk Factors for Hypertension Among Elderly Woman in Rural and Urban Indonesia

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**Introduction**: Hypertension is a major risk factor for cardiovascular disease. A high prevalence of hypertension is found in elderly women. Rural areas have different characteristics from urban areas. Therefore, it is necessary to identify risk factors for hypertension in rural and urban elderly women for optimal therapy management. **Methods**: This cross-sectional study was conducted in rural (Banyuwangi district) and urban (Surabaya city) areas, East Java, Indonesia. The study was carried out in 2015-2016 in women aged ≥45 years, residing in an area for ≥10 years, and willing to collect urine for 24 hours. Respondents consisted of 54 older adults from rural areas and 51 older adults from urban areas who actively participate in the integrated healthcare center for the elderly. The independent t-test and multivariate logistic regression were used to analyze the data. **Results**: The prevalence of hypertension in the rural area was 27.8% and in the urban area was 37.25%. The risk factors for hypertension in the urban area were urine sodium level (AOR=1.02, 95% CI=1.001-1.04, p-value=0.043), urine potassium level (AOR=0.88, 95% CI=0.78-0.999, p-value=0.022), and Body Mass Index (AOR=1.26, 95% CI=1.06-1.49, p-value=0.008). Meanwhile, the factor associated with hypertension in the rural area was age (AOR=1.08, 95% CI=1.003-1.16, p-value=0.042). **Conclusion**: The prevalence of hypertension in the urban area was higher than in the rural area. There were differences in risk factors for hypertension that occurred both in rural and urban areas. However, risk factors in both areas are equally important to overcome. Collaboration from multiple stakeholders and sectors is urgently needed, such as the Public Health Center, Integrated Assistance Post for Non-Communicable Diseases, and the local health office.

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Abbreviations: AOR, Adjusted Odds Ratio; BMI, Body Mass Index; CI, Confidence Interval; SD, Standard deviation; SE, Standard error.

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## INTRODUCTION

Hypertension is called the "silent killer" because most people with hypertension are not aware of the problem [1]. Hypertension is the strongest indicator leading to cardiovascular disease [2]. Hypertension also has a role in changes in cerebrovascular structure and function that underlie its pathological effects on the brain, which is the most common cause of vascular dementia [3,4]. Hypertension is also known as the leading cause of premature death worldwide [1]. It is estimated that 1.13 billion people worldwide suffer from hypertension, most (two-thirds) live in low- and middle-income countries [1], including Indonesia.

One of the global targets for non-communicable diseases is to reduce the prevalence of hypertension by 25% by 2025 (baseline 2010) [1]. Hypertension is a major risk factor for cardiovascular disease, characterized by systolic blood pressure ≥140 mm Hg and diastolic ≥90 mm Hg, or receiving antihypertensive drugs [5]. In Indonesia, Basic Health Research in 2018 shows that the national prevalence of hypertension is around 34.1% of the total adult population [6]. In addition, research using the Indonesia Family Life Survey (IFLS 5) finds that the prevalence of hypertension in Indonesia has reached 33.4% [7].

The risk factors causing hypertension arise due to differences in the characteristics of the communities and regions, such as people living in urban and rural areas [8-12]. In Indonesia, the prevalence of hypertension is high in the elderly who lived in urban areas. In contrast to urban areas, rural areas of Indonesia had a lower prevalence of hypertension [13]. In addition, another study finds different results, which states that hypertension in urban areas is slightly higher than in rural areas, namely 49.8% and 46.4%, respectively [14]. Other studies have also found that the prevalence of hypertension varies between urban and rural areas [15].

In general, risk factors for hypertension are divided into two categories, namely non-modifiable factors including genetics, age, and sex, and secondly, modifiable factors that are associated with obesity, lack of physical activity, sodium intake, and potassium intake [1,5]. Several studies have stated that there are differences in factors that influence hypertension in people living in urban areas and people living in rural areas [16-20]. The main risk factors for hypertension in rural areas are more related to non-modifiable factors, such as age and sex, whereas in urban areas, modifiable factors are the dominant risk factor [16-20]. Differences in risk factors between urban and rural populations should be considered for further intervention.

The emergence of various differences in previous research findings is important for research to compare the characteristics of the community on hypertension in rural and urban areas in Indonesia and the influencing factors. Through this research, we hope that the community will be able to control the various risk factors that occur so that hypertension can be reduced, especially in rural areas of Indonesia where the disease is still underdiagnosed.

## MATERIALS AND METHODS

### Study Design

This study analyzed the data taken from the results of a cross-sectional survey that assessed the relationship between sodium, potassium, and blood pressure in elderly adults in the coastal areas of Surabaya and Banyuwangi. The research was conducted at Kenjeran beach, Surabaya city, and Santen beach, Banyuwangi district, East Java, Indonesia in 2015-2016. Surabaya, which is the capital city of East Java, represents an urban location, while Banyuwangi is a growing eco-tourism district which represents a rural area.

### Population and Sample

The study population was women aged ≥45 years in the coastal areas of Surabaya and Banyuwangi. The inclusion criteria were respondents who have lived in that location for greater than or equal to 10 years and were willing to collect urine over a 24-hour period. Respondents who had impaired kidney function, were pregnant or became pregnant during the study, smoked cigarettes, consumed supplements containing sodium and potassium, experienced vomiting and diarrhea during urine collection, and/or collected <500 ml of urine could not be recruited as subjects in this study [21,22]. Respondents were selected by purposive sampling from people who actively participate in the integrated service post for the elderly. After eliminating participants who did not meet criteria (all respondents: 135 respondents in urban areas and 74 respondents in rural areas following the strict screening stage), the selected respondents (51 subjects in urban areas and 54 subjects in rural areas) met the study criteria.

### Data Collection and Data Management

Data collection were carried out primarily by research enumerators. The questionnaire was used to conduct interviews with respondents. Anthropometric measurements, blood pressure, and urine sample collection were performed to collect data. The dependent variable in this study was hypertension status. The independent variables measured were age, length of residence, BMI, urine sodium concentration, and urine potassium concentration.

BMI was measured by electronic scale which was calibrated, and weighing was performed by trained per-

**Table 1. Distribution of Hypertension, Age, Length of Residence, BMI, Sodium, and Potassium Urine Variables in Rural and Urban Areas**

| No | Variables | Urban (n=51) n (%) or Mean±SD[a] | Rural (n=54) n (%) or Mean±SD[a] |
|---|---|---|---|
| 1 | **Hypertension status** | | |
| | Yes | 19 (37.30%) | 15 (27.80%) |
| | No | 32 (62.70%) | 39 (72.20%) |
| | Systolic blood pressure | 132.25±17.78 | 128.44±20.17 |
| | Diastolic blood pressure | 83.62±10.30 | 77.89±10.39 |
| 2 | Age (years) | 56.98±5.70 | 56.54±10.93 |
| 3 | Length of residence (years) | 52.78±12.57 | 47.35±17.37 |
| 4 | BMI ($kg/m^2$) | 25.96±4.85 | 24.81±5.52 |
| 5 | Urine sodium (mmol/d) | 104.75±59.24 | 134.39±47.26 |
| 6 | Urine potassium (mmol/d) | 20.52±9.72 | 57.11±24.88 |

[a]Standard deviation

sonnel. BMI was calculated as the ratio of weight (kg) per square height ($m^2$). A stethoscope (Litmann) and a mercury sphygmomanometer (Riester) were used to measure blood pressure and were placed on a flat surface. Blood pressure measurements were taken in the morning at rest and before the respondent did physical activity. The measurement was repeated two times in 5-minute intervals to get the average value of the two measurements. The measurement was taken again if there were two different measurements >5 mm Hg. Then, the average of these measurements was calculated. Blood pressure was categorized into hypertension and not hypertension (normal). Hypertension was defined by "JNC 7" (Seventh Report of the Joint National Committee on Prevention, Detection, Prevention, Evaluation, and Treatment of High Blood Pressure) as a systolic blood pressure ≥140 mm Hg or a diastolic blood pressure ≥90 mm Hg, or a self-report of taking antihypertensive medication or previously diagnosed by a physician.

A urine sample was taken to determine urine sodium and potassium levels. Before collecting the urine sample, respondents were given information about the procedure to collect a 24-hour urine sample. We used the Ion-Selective Electrode (ISE) to determine the sodium and potassium levels in the urine. Potassium and sodium levels obtained from 24-hour urine collection were measured based on mmol per day.

The 24-hour urine sample was collected in a container over a full 24-hour period. In the first day, respondents were asked to urinate into the toilet when they got up in the morning and to discard it. Afterwards, all urine for the next 24 hours, including the first morning of the day after, was collected. At the time of collecting urine samples, respondents were asked to recount the urine collection process and whether any urine was discarded. Researchers recorded the total daily urine volume and then brought it to the laboratory for testing of sodium and potassium levels.

### *Data Analysis*

Data were analyzed descriptively. Independent t-test and multivariate logistic regression were used to examine the relationship between risk factors and outcome variables. All statistical analyses was performed with Statistical Package for Social Science (SPSS) version 21 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.).

### *Ethical Approval*

This research passed the approval of the Ethical Commission of the Faculty of Public Health, Universitas Airlangga No 505-KEPK and 610-KEPK.

## RESULTS

Of the 51 respondents who live in urban areas, around 37.3% of respondents had hypertension. Meanwhile, in rural areas, out of 54 respondents, around 27.8% respondents had experienced hypertension. The mean age of respondents in urban areas was 56.98 ± 5.70 years, with an average length of residence of 52.78 ± 12.57 years. The mean BMI of the respondents was 25.96 ± 4.85 $kg/m^2$. The mean urine sodium value was 104.75 ± 59.24 mmol/d, and the urine potassium value was 20.52 ± 9.72 mmol/d. The mean age of respondents in rural areas was 56.54 ± 10.93 years, with an average length of residence of 47.35 ± 17.37 years. The mean BMI of the respondents was 24.81 ± 5.52 $kg/m^2$. The mean urine sodium value was 134.39 ± 47.26 mmol/d, and the urine potassium

**Table 2. Factors Associated with Hypertension in Rural and Urban Areas**

| No | Variables | Hypertension | Urban | | | | Rural | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | SD[a] | SE[b] | P value | Mean | SD[a] | SE[b] | P value |
| 1 | Age (years) | Normal | 57.25 | 6.76 | 1.20 | 0.61 | 54.77 | 10.69 | 1.71 | 0.05 |
| | | Hypertension | 56.53 | 3.34 | 0.77 | | 61.13 | 10.52 | 2.72 | |
| 2 | Length of residence (years) | Normal | 52.44 | 13.64 | 2.41 | 0.80 | 45.79 | 15.75 | 2.52 | 0.29 |
| | | Hypertension | 53.37 | 10.86 | 2.49 | | 51.40 | 21.09 | 5.45 | |
| 3 | BMI (kg/m$^2$) | Normal | 24.26 | 3.73 | 0.66 | <0.001 | 25.42 | 5.45 | 0.87 | 0.20 |
| | | Hypertension | 28.83 | 5.25 | 1.20 | | 23.23 | 5.54 | 1.43 | |
| 4 | Urine sodium (mmol/d) | Normal | 95.38 | 40.08 | 7.08 | 0.22 | 139.79 | 47.77 | 7.65 | 0.18 |
| | | Hypertension | 120.53 | 81.03 | 18.59 | | 120.33 | 44.36 | 11.45 | |
| 5 | Urine potassium (mmol/d) | Normal | 21.12 | 10.18 | 1.80 | 0.57 | 61.22 | 25.87 | 4.14 | 0.05 |
| | | Hypertension | 19.50 | 9.08 | 2.08 | | 46.44 | 18.89 | 4.88 | |

[a]Standard deviation, [b]Standard error

value was 57.11 ± 24.88 (Table 1).

Based on Table 2, before controlling for other variables, the factor associated with hypertension in urban areas was BMI. Meanwhile, the factors related to hypertension in rural areas were age and urine potassium value.

After controlling for other variables, factors associated with the incidence of hypertension in urban areas were urine sodium, urinary potassium, and BMI. For each increase of 1.02 mmol/d of respondent's urine sodium (AOR = 1.02, 95% CI 1.001-1.05), 0.88 mmol/d of respondent urine potassium (AOR = 0.88, 95% CI 0.78-0.999), and 1.26 kg/m$^2$ of respondent's BMI (AOR = 1.26, 95% CI 1.06-1.49) would be followed by an increase hypertension in urban areas. The factor related to hypertension in rural areas was age. Every increase of 1.08 years in the respondent's age (AOR = 1.08, 95% CI 1.003-1.16) would be followed by an increase hypertension in rural areas (Table 3, see also Appendix A).

## DISCUSSION

Research showed that there were differences in risk factors for hypertension that occur in both rural and urban areas. The prevalence of hypertension in rural areas was 27.8% and in urban areas was 37.25%. The risk factors for hypertension in urban areas were urine sodium value, urine potassium value, and BMI. Meanwhile, the risk factor associated with hypertension in rural areas was age, after controlling for other variables.

Hypertension has the same public health impact in urban and rural areas in Indonesia. The results showed that the prevalence of hypertension was higher in urban areas (37.25%) compared to rural areas (27.8%), but both of them had a high prevalence. It was in line with research conducted in rural Guangzhou and urban Beijing, China, which stated that high hypertension occurred in urban areas (15.6%) and low hypertension occurs in rural areas (4.9%) [23]. This was also supported by research findings in the urban area of India [10]. However, this was different from the research in Tanzania which showed that the prevalence of hypertension in urban and rural areas was the same [24].

Our results might be due to the lack of access to health services [25]. Community behavior in seeking health services, both for prevention and treatment, might have played an important role [26,27]. People in the countryside or rural areas were less likely to seek health services. Other factors might also be caused by poor perceptions of health, socio-economic status, and the level of public education [14,28]. Hypertension in women might be influenced by poor standard of living. In addition, the occupation of fish seller was related to the tradition of salting and drying fish to preserve fish so that people who lived in this coastal area had a high risk of developing hypertension [22]. Most of the respondents lived with children and their families who had high levels of needs, causing high levels of stress to their caregivers. Stress levels are associated with chronic diseases such as hypertension [29]. However, one of the limitations of this study is that it did not measure levels of stress.

Age had a significant relationship with hypertension in rural areas. In contrast to the results in urban areas, age did not have a significant relationship. The results were in line with research conducted in southern Ethiopia [9], a district in northern India [30], and in Indonesia [31]. Research conducted in rural coastal areas in Banyuwangi

**Table 3. Multivariate Logistic Regression Analysis on Factors Related to Hypertension in Urban and Aural areas**

| No | Variables | Urban | | | | Rural | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | AOR[a] | 95%CI[b] | | P value | AOR[a] | 95%CI[b] | | P value |
| | | | Lower | Upper | | | Lower | Upper | |
| 1 | Age (years) | | | | | 1.08 | 1.003 | 1.16 | 0.042 |
| 2 | Length of residence (years) | | | | | 0.97 | 0.93 | 1.02 | 0.269 |
| 3 | BMI (kg/m$^2$) | 1.26 | 1.06 | 1.49 | 0.008 | | | | |
| 4 | Urine sodium (mmol/d) | 1.02 | 1.001 | 1.04 | 0.043 | 0.99 | 0.97 | 1.003 | 0.102 |
| 5 | Urine potassium (mmol/d) | 0.88 | 0.78 | 0.999 | 0.049 | 0.96 | 0.92 | 1.002 | 0.065 |

[a]Adjusted odds ratio, [b]Confidence interval

district, Indonesia also found that as age increases, so does blood pressure [32]. Increasing age is followed by structural changes in the heart, like artery walls lose their flexibility and become stiffer. As a result, the systolic and diastolic blood pressures increased because they decreased the pulsation of the artery walls [33]. Several studies have shown that the prognostic significance of systolic pressure increases with age, at around 60 years, there is hardening of the large arteries resulting in a decrease in diastolic pressure and an increase in pulse rate [34,35]. In this study, the age of women with hypertension in urban areas is younger than in rural areas, which is under 60 years on average. At a younger age, the diameter and stiffness of muscular arteries is more affected by increased BMI than age-related factors [36].

Research conducted in Indonesia using IFLS 5 data also stated that overweight and obesity were associated with hypertension [7,37]. It was supported by other studies which found that BMI was an important factor in increasing or decreasing blood pressure [38,39]. BMI was an important risk factor associated with hypertension in a large urban slum in Nairobi, Kenya [11,12]. Another study in Papua New Guinea stated that a high BMI (overweight and obesity) was significantly associated with increased systolic blood pressure [40]. A study in Papua New Guinea also suggested that obesity was a problem in urban areas but not in rural areas [41].

The difference in yield in rural and urban areas might be related to the sedentary lifestyle of the people, resulting in a decrease in physical activity in urban communities [35]. Changing eating habits, an increase in the fat content of food, and a low in physical activity lead to increased obesity in society [35,42]. Changes in diet, work, and lifestyle were some of the possible contributors to the increase of hypertension in urban areas [43]. Overweight and obese women adopted a sedentary lifestyle and consumed a high-energy diet that increased the risk of hypertension in urban areas [12]. Surabaya is one of the metropolitan cities, where access to a variety of food is easier, and there are many shopping centers in urban areas like Surabaya city. The coastal areas of our research site is currently in the process of development for eco-tourism. This encouraged changes in people's lifestyles and these changes could affect a person's blood pressure [44]. Especially foods whose high in calories, high sodium, and low potassium were linked to non-communicable diseases [45,46].

The results of urine sodium and urine potassium tests also showed a significant correlation with hypertension in urban areas. In contrast to the results found in rural areas, urinary sodium and urinary potassium were not associated with hypertension. The results of this study were in line with research conducted in Taiwan, Indonesia, and Hong Kong that stated that urinary sodium excretion was associated with the risk of hypertension [21,47-50].

Differences in diet among rural and urban communities could be the cause of these differences. Indirectly, it was influenced by socioeconomic factors. Financial limitations hindered the variety of their diet. A high social economy was a strong predictor of hypertension [51].

Urban communities had a high dietary intake of sodium. It was associated with high blood pressure in these communities [52]. The increase in hypertension could also be influenced by the total ratio of sodium/potassium intake in the community. Intake of sodium and potassium was very important as a preventive step towards increasing blood pressure. Consumption of foods with high potassium and low sodium was important to keep blood pressure within normal limits [53]. Sodium and potassium played an important role in the pathogenesis of hypertension. A study stated that replacing regular sodium salt with low sodium, high potassium, high magnesium mineral salts could lower blood pressure in older people with mild and moderate hypertension [54].

Assessment of sodium and potassium intake in this study used the 24-hour urine collection method. This method was considered reliable and used in many clinical and epidemiological studies. In addition, a 24-hour urine collection was considered the "criterion standard" method to assess salt intake in the population [55].

One limitation of this study is it could only include female respondents due to the available population of the integrated post service (women >80%). In addition, a 24-hour urine collection was not possible for male respondents due to occupational factors. In this study, the consumption of foods containing sodium and potassium and the intake of other nutrients such as energy, fat, and carbohydrates were not explored in detail. This study did not measure other comorbidities and stress levels in respondents. Furthermore, implementing the 24-hour urine collection method in the community was very difficult. Many respondents failed to collect urine for 24 hours. Despite researchers offering to correctly collect the participants' urine, most respondents refused to do it again due to inconvenience and hassle. Furthermore, because the sampling technique was purposive sampling and a small sample size, our results could not be applied to the general population, but could be generalized only to populations with specific characteristics such as elderly women who live in urban and rural areas. In addition, the study design was cross sectional so that it could not analyze the causality.

Hypertension is a dangerous condition if not handled properly, in some cases leading to death. Rural and urban areas have equally important risks to overcome. Collaboration from various sectors is urgently needed, such as the public health center, the integrated healthcare center for elderly, and even the local health office. Therefore, efforts are needed to strengthen existing strategies and develop innovative approaches to address the burden of hypertension in communities. It is imperative to raise awareness of blood pressure and prevent hypertension in the population, namely by encouraging the adoption of healthy lifestyles and increasing opportunistic screening of the hypertensive in rural and urban areas. One healthy lifestyle change that can be implemented is replacing regular sodium salt with low sodium, high potassium, and high magnesium mineral salts. This can lower blood pressure in older people with mild and moderate hypertension. The government must increase access to diagnosis and treatment by emphasizing the quality of health services provided; especially at the primary health care level where poor hypertension management is found.

In conclusion, the prevalence of hypertension in urban areas was higher than in rural areas. However, hypertension is still an important problem for people, both living in urban and rural areas. There were differences in risk factors for hypertension that occurred both in rural and urban areas. The age factor played an important role in the occurrence of hypertension in rural areas. High BMI, sodium, and potassium urine were risk factors for hypertension in urban areas. Cooperation from various sectors is needed to reduce the prevalence of hypertension in the community.

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Appendix A

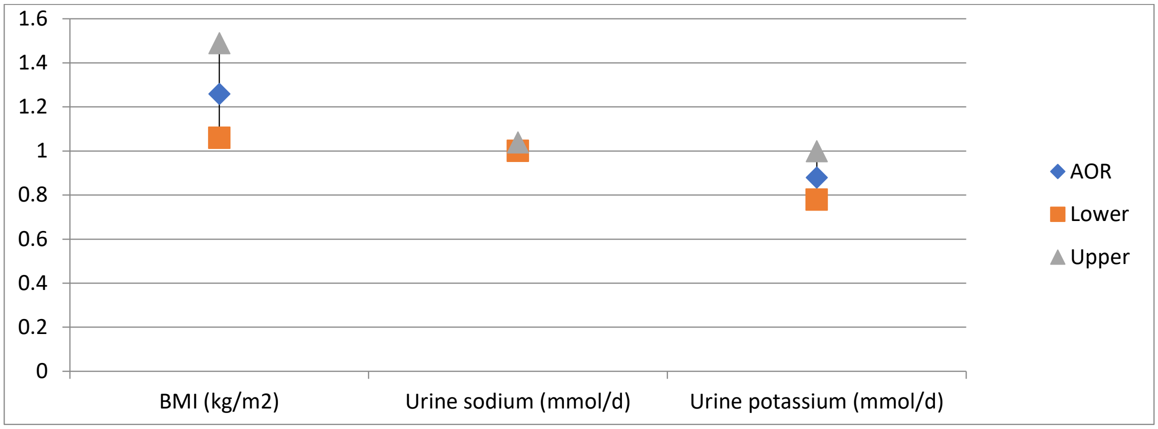


Figure 1. 95% AOR of hypertension in urban areas

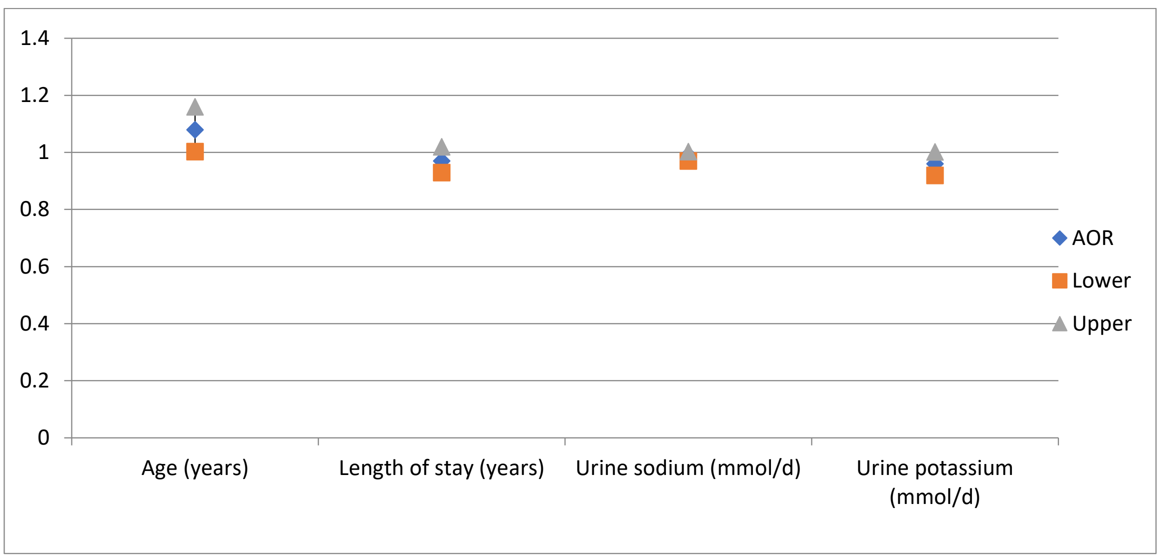


Figure 2. 95% AOR of hypertension in rural areas