

## **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

**Title:** Hypertension awareness, treatment and control in Ghana: A cross-sectional study

Olutobi Adekunle Sanuade<sup>a</sup>, Raphael Baffour Awuah<sup>b</sup>, Mawuli Kushitor<sup>b</sup>

<sup>a</sup>Institute of Advanced Studies, University College London, London, United Kingdom

<sup>b</sup>Regional Institute for Population Studies, University of Ghana, Accra, Ghana

**Olutobi Adekunle Sanuade (OAS)**- oluwatobisanuade@gmail.com

**Raphael Baffour Awuah (RBA)**- ralph.awuah1@gmail.com

**Mawuli Kushitor (MK)**- mkushitor@gmail.com

**Corresponding Author: OAS**

***Email:*** oluwatobisanuade@gmail.com

## **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

### **Abstract**

**Objective:** This study assessed the rates of hypertension awareness, treatment and control as well as the socio-economic and demographic correlates in Ghana.

**Methods:** This was a cross-sectional study. We used wave 1 of the World Health Organization (WHO) Study on global AGEing and adult health (SAGE) conducted between 2007 and 2008. The sample was 5526 respondents aged 18 years and above. Descriptive statistics were used to describe the characteristics of the respondents and binary logistic regression was used to determine the correlates of hypertension awareness, treatment and control.

**Results:** The hypertension prevalence was 58.9%. About 19.0% of the individuals living with hypertension were aware of their hypertension; 67.6% of those who were aware of their hypertension were treating the condition, and; 11.6% of those who were on treatment had their hypertension controlled. Age, place of residence, level of education, employment status, ethnicity, and religion were associated with hypertension awareness and treatment. None of the factors was associated with hypertension control.

**Conclusion:** Our study suggests high hypertension prevalence in Ghana, with low rates of awareness, treatment and control. Socio-economic and demographic factors are essential correlates of hypertension awareness and treatment in Ghana. The findings indicate the need to develop pragmatic intervention approaches such as rigorous education programmes and use of the task-shifting system, in addressing hypertension and issues related to it.

**Key words:** socio-demographic, socio-economic, hypertension, awareness, treatment, control, Ghana

# **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

## **Background**

Hypertension represents a huge global public health challenge (Schutte, 2017). Research has shown that the number of people living with hypertension has increased from 600 million in 1980 to 1 billion people in 2000 (Kearney et al., 2005; Chockaligam et al., 2006). This number is projected to increase to 1.56 billion by 2025 (Kearney et al 2005; Chockaligam et al., 2006). The rising burden of hypertension has been attributed to population ageing, urbanization and lifestyle changes (Kaze et al., 2017). Regional estimates have shown that sub-Saharan Africa (SSA) has the highest systolic blood pressure (SBP) globally (Danaei et al., 2011).

Health systems in SSA are already struggling to contain the high burden of infectious diseases that have and continue to plague the continent. The rising burden of hypertension and related complications further challenges the health care system resulting in low detection, awareness, treatment and poor control ( Kayima et al., 2013; de-Graft Aikins et al., 2014; Odusola et al., 2014; Ogedegbe et al., 2014). Also, mortality due to complications of hypertension have increased steadily in SSA (Baatiema et al., 2017; Sanuade et al., 2014; Sarfo et al., 2017a; Sarfo et al., 2017b).

In Ghana, hypertension was described as an epidemic in 1979 (Pobee et al., 1979). Between 1988 and 2004, there was more than ten-fold increase in the incidence of hypertension in hospitals across the country (Ghana Health Service, 2008). Population based studies conducted among different sub-groups in Ghana have reported prevalence rates of 19-48%, amid low levels of awareness, treatment and control (Addo et al., 2012). Even though previous studies have highlighted the burden of hypertension in Ghana, there is a major limitation. Most of these studies were restricted to specific population groups: urban settings (Awuah et al., 2014; Duda et al., 2007); rural settings (Addo et al., 2006; Agyemang, 2006; Kunutsor & Powles, 2009; van de

## **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

Vijver et al., 2013); civil servants (Addo et al., 2007; Addo et al., 2009), and; women (Duda et al., 2007; Hill et al., 2007). These studies can therefore not be generalized to the entire population. In addition, although research has shown ethnic disparities in the utilization of maternal health care services in Ghana (Ganle, 2016), and the important role that culture plays in minimizing the burden of non-communicable diseases (NCDs) in Africa (Airhihenbuwa and Iwelunmor, 2012), there is barely any information on ethnic disparities in hypertension in Ghana. Over the years, there have been calls for the need for nationally representative studies to ascertain the true burden of hypertension and develop appropriate intervention strategies to address the burden (Steward et al. 2010). This study therefore assessed the rates of hypertension awareness, treatment and control, and examined the socio-economic and demographic correlates of hypertension awareness and treatment in a nationally representative sample of Ghanaians.

### **Methods**

#### ***Study design***

This was a cross-sectional study

#### ***Data source***

Data for this study were drawn from Wave 1 of the World Health Organization (WHO) Study on global AGEing and adult health (SAGE) conducted between 2007 and 2008. Although a total of 5573 respondents aged 18 years and above were interviewed during the survey, 47 respondents did not have information on blood pressure readings and they were excluded in the analysis. Our sample was limited to 5526 respondents who had information on their blood pressure measurements.

## **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

### ***Sampling design***

Ghana SAGE Wave 1 used a stratified, multistage cluster design which was based on the design for the World Health Survey (Biritwum et al., 2013), and this was nationally representative. The primary sampling units were stratified by administrative region and place of residence (urban/rural). Based on this, a total of 20 strata were developed (Biritwum et al., 2013; Minicuci et al., 2014). From each of the strata, 10-15 Enumeration Areas (EA) were selected according to the population size. Household listings were done for each selected EA. Twenty households with persons aged 50 years and above and four households with persons aged 18-49 years were then selected for interview (Biritwum et al., 2013). All persons aged 50 years and above in ‘older’ households (households with at least one person aged 50 years and above) were invited to participate, whereas only one person was randomly selected in ‘younger’ households (households with no person aged 50-plus years). Further, for those who were incapable of completing an interview for reasons of health or cognition, a proxy questionnaire was completed (Biritwum et al., 2013). Standardized training in all aspects of the interview was provided to all interviewers. The questionnaires were translated into respective local languages, following a translation protocol, and modified to take into account the local context where needed (Minicuci et al., 2014). The response rate ranged between 92.1% for women and 97.0% for men (Biritwum et al., 2013).

A request for the Ghana SAGE data was sent to WHO and access was granted after providing necessary information on the study.

### ***Measurements***

Three blood pressure (BP) readings were taken from participants during the WHO SAGE data collection. Blood pressure was measured while the respondents were seated and in a relaxed

## **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

position; it was collected three times with one minute between each measurement. The average of the three readings was used as a measure of blood pressure and this was measured in mm Hg. Hypertension prevalence was defined as a prior diagnosis of hypertension or a systolic BP of  $\geq 140$ , and/or diastolic BP of  $\geq 90$ . Awareness was defined as whether respondents had ever been diagnosed with high blood pressure. Hypertension treatment was defined as the use of medications or other treatments (such as weight loss program or change in eating habits) to manage the condition among those who knew their status. Hypertension control was defined as those treating the condition and who had a systolic blood pressure (SBP) lower than 140 mmHg and diastolic blood pressure (DBP) lower than 90mmHg.

The socio-economic factors examined included: level of education (no education, primary, secondary, and higher); employment status (unemployed or employed). The socio-demographic factors examined were: age (18-49 years, 50-59 years, 60-69 years, 70-79 years, and 80 years and above); marital status (never married, currently married, separated/divorced, widowed); ethnicity (Akan, Ewe, Ga-Adangbe, Gruma and others); religion (no religion, Christianity, Islam, Others), and; place of residence (urban or rural).

Physical activity was measured as the number of days respondents spent doing moderate-intensity activities like sports, fitness, or recreational leisure activities. This was re-categorized into two categories namely: less than 3 times a week and 3 or more times a week. We categorized alcohol consumption into nondrinkers, occasional drinkers and regular drinkers based on the patterns of consumption. Those who had never consumed alcohol were “nondrinkers”; those who consumed alcohol in the last 12 month but not in the last 30 days were regarded as “occasional drinkers”, and; those who consumed alcohol in the last 30 days were referred to as “regular drinkers”. Two questions were used to categorize smoking status. These

## **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

included whether the respondents had ever smoked and if they currently smoke. These were re-categorized into: nonsmokers, previous smokers and current smokers. We calculated BMI by dividing weight (kg) by height (m<sup>2</sup>) and we categorized them into underweight (<19kg/m<sup>2</sup>), normal (19-24.9 kg/m<sup>2</sup>), overweight (25-29.9 kg/m<sup>2</sup>) and obese (≥30 kg/m<sup>2</sup>). The chronic diseases controlled for were stroke, angina and diabetes; the question was based on whether participants had ever been diagnosed with any of these conditions. With respect to the number of times respondents received health care or consultation in the last 12 months prior to the survey, the categories were: none, once and two or more times.

### ***Data Analysis***

We used mean and standard deviations to describe the continuous variables and percentages to describe categorical variables. Binary logistic regression was used to examine the factors associated with hypertension awareness, treatment and control, controlling for BMI, physical activity, smoking, alcohol consumption, other chronic diseases (stroke, angina and diabetes), and number of health care visits in 12 months. Three models with different outcomes (i.e. awareness, treatment, and control) were given and the analysis was stratified by gender. The model for hypertension control was not presented in this analysis because of insignificant results. Appropriate sample weights were applied before the data were analyzed with STATA 12.

## **Results**

### ***Background Characteristics***

Table 1 shows the characteristics of respondents. A total of 5526 were analyzed for the study and almost equal proportion were men and women (50.6% and 49.4% respectively). The mean age was 60.2 years (SD=14.0 years) and ranged from 18-114 years; the largest proportion (33.9%) was aged 50-59 years. The mean systolic and diastolic blood pressures were 134.3 mm Hg and

## **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

68.8 mm Hg respectively. About 60% were living in the rural areas and the highest proportion (61.0%) was currently married. More than half (54.9%) had no education and close to one-fifth (18.9%) had higher education. About half of the respondents (49.2%) were Akan; more than six out of ten (63.9%) were Christians with more being women. Among men, a higher proportion was employed (72.7%) compared to women (58.5%).

With respect to BMI, more than one-fifth of Ghanaians (29.2%) were overweight or obese. Among women, a higher proportion was overweight or obese (36.2%) compared to men (22.9%). Less than one out of ten (7.9%) engaged in moderate physical activities for three or more days a week. Slightly more than one-tenth (11.0%) were current smokers and the rate was higher among men. About 28.0% were regular drinkers and the rate was also higher among men (40.0%). With regard to chronic diseases, less than one-tenth of the respondents were living with stroke, angina and diabetes (4.0%, 2.9%, and 3.5% respectively). The results showed that about 47.0% did not visit the hospital 12 months prior to the survey, 22.0% visited once and 31.1% visited for two or more times.

### ***Prevalence, Awareness, Treatment and Control of Hypertension***

The prevalence of hypertension in the population was 58.9% and a larger proportion of women (63.9%) had hypertension compared to men (54.2%) (Table 2). Also, about 19.0% of the individuals living with hypertension were aware of their hypertension (men=15.3% and women=21.8%); 68% of those who were aware of hypertension were treating the condition. Out of those treating the condition, about 12% had control.



## **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

### *Socio-economic and demographic correlates of hypertension awareness*

The socio-economic and demographic factors associated with hypertension awareness are shown in Table 3. The findings showed that hypertension awareness was significantly higher among women compared to men. Age, place of residence, level of education, employment status, ethnicity and religion were associated with hypertension awareness. The results showed that the odds of hypertension awareness increased with advancement in age; however, there was no significant difference in awareness between those who were 80 years and above and those who were 18-49 years. Among men, those who were 70-79 years significantly had higher odds of hypertension awareness compared to their counterparts (OR=3.18: CI= 1.48-6.81). Among women, hypertension awareness increased with age until age 80 and above where awareness was the same with those who were 18-49 years. Those living in urban areas were twice as likely to be aware of their hypertension compared to those in rural areas (OR= 2.10: CI=1.69 – 2.64).

Overall, hypertension awareness increased with increasing level of education. There was no significant difference in hypertension awareness among men with primary education, secondary education and those with no education; however, those with higher level of education were 71% more likely to be aware of their hypertension compared to those with no education (OR=1.71: CI=1.05-2.77). Among women, hypertension awareness increased with higher level of education. In addition, those who were employed were 42% less likely to be aware of their hypertension compared to their counterparts who were not working. Those who belonged to the Ewe ethnic group were 57% more likely to be aware of their hypertension than those who were Akan (OR=1.57: CI=1.06-2.32). Christians generally had higher odds of hypertension awareness than those with no religion (OR=2.39: CI=1.20-4.78).

## **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

### *Socio-economic and demographic correlates of hypertension treatment*

Table 4 shows that age, place of residence, level of education, ethnicity, religion, and employment status significantly predicted hypertension treatment, after controlling for lifestyle factors, chronic diseases and number of times respondents visited the hospital in the last 12 months preceding the survey. The results showed that those in the older age groups had higher odds of hypertension treatment compared to those who were 18-49 years. Further, those with secondary and higher education had higher odds of treating their hypertension compared to those with no education. Among men, level of education did not predict hypertension treatment. On the other hand, women with secondary and higher levels of education were three times as likely to treat their hypertension compared to those with no education (OR= 3.90: CI= 1.67-9.11 and OR=3.71: CI=2.29-6.04, respectively).

With respect to the relationship between ethnicity and hypertension treatment among men, those who were Ga-Adangbe and those who were Gruma had higher odds of hypertension treatment compared to those who were Akan; among women, there was no significant association between ethnicity and hypertension treatment. Further, while those who were Christians had higher odds of hypertension treatment compared to those with no religion (OR=4.86: CI=1.48-15.89), there was no significant difference in hypertension treatment among those with no religion, Muslims, and those in other religion. Generally, respondents who were employed were 38% less likely to treat their hypertension compared to those who were unemployed (OR=0.62: CI=0.47-0.82). Among men, employment status did not predict hypertension treatment; however, among women, those who were employed had lower odds of hypertension treatment compared to their counterparts.

## **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

The results showed that none of the socio-economic and demographic factors was significantly associated with hypertension control.

### **Discussion**

#### ***Hypertension prevalence***

We found a hypertension prevalence of 58.9% among Ghanaians aged 18 years and above; with a higher prevalence among women compared to men. The prevalence of hypertension in our study is higher than rates observed in other African countries with similar age and sex profiles to Ghana's. For example, nationally representative studies in South Africa (Steyn, 2008) and Cameroon (Kamadjeu et al., 2006) reported a hypertension prevalence of 21.0%, 24.1% and 30.6% respectively; much lower than the prevalence found in our study. It has been suggested that rapid population growth and ageing, increased urbanization and an increased uptake of alcohol and tobacco may explain the high prevalence of hypertension in Ghana, and in many African countries (de-Graft Aikins et al, 2010). If these factors continue overtime, the prevalence of hypertension in Ghana may persist or even worsen. Such a situation may further burden the already weak health care system in the country.

#### ***Awareness, treatment and control of hypertension***

Our findings showed that about one fifth (18.8%) of those who were hypertensive were aware of their status. The awareness rate in this study is alarmingly low considering that close to 60% of the total sample were hypertensives. In a systematic review of hypertension awareness rates in Africa (Kayima et al, 2013), a majority of the studies reported higher awareness rates than the rate observed in this study. For example, similar population-based studies in Cameroon (Dzudie et al., 2012), Tunisia (Romdhane, 2012) and South Africa (Steyn, 2008) reported hypertension awareness rates of 37.1%, 38.8% and 54% respectively. However, there are a few studies in

## **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

Africa that have slightly lower rates of awareness than the rate reported in our study. For example, studies conducted in Nigeria (a country with a much higher population size than Ghana) (Oladapo et al, 2010), and Mozambique (a country with an identical population size as Ghana) (Damasceno et al., 2009) reported hypertension awareness rates of 14.2% and 14.8% respectively.

The low awareness rate in our study suggests that there will be a significantly large number of people in Ghana with hypertension who are unaware of their increased risk of hypertension related complications such as stroke and renal failure in the coming years. The low level of awareness could be attributed to the lack of screening opportunities especially among vulnerable groups. Awareness of hypertension to an extent depends on the capacity of the health system to provide diagnostic services to the general population (Pereira et al, 2009). This may also be dependent on the importance attached to knowing one's status which is somewhat associated with one's level of education. There is evidence to show that hypertension awareness and treatment is higher among those with education, because they are more aware of the complications or risks associated with the condition (Tedesco et al., 2001). Our findings support this assertion; as those with formal education were more likely to be aware of their hypertension status than those with no formal education.

The study's findings also showed that more women than men were aware of their hypertension status. A systematic review by Pereira et al. (2009) showed that many of the studies on hypertension awareness in Africa reported higher awareness rates among women than men. A plausible explanation for our finding is that in Ghana, women utilize healthcare services more than men through maternal and child health programs for example; as a result, they are more likely to be aware of their hypertension status (van de Vijver et al, 2013).

## **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

Also, advancement in age, higher levels of education, living in an urban area, belonging to the Ewe or Gruma ethnic group and being a Christian was associated with a higher likelihood of hypertension awareness. The findings relating to age and place of residence in particular are consistent with the results of a systematic review of hypertension awareness in Africa (Kayima et al., 2013). These findings draw attention to the importance of pursuing appropriate intervention strategies in order to improve hypertension awareness. These intervention strategies can draw insights from countries that have improved the rate of hypertension awareness over time. For example, in Europe and North America, most of the improved awareness rates observed overtime have been attributed to rigorous education programmes on hypertension after the realization of the increasing morbidity and mortality due to hypertension, and its resultant health and socio-economic impact (Kayima et al., 2013). Such intervention strategies should also consider the socio-cultural context of Ghanaians especially as ethnicity was found to be associated with hypertension awareness in our study.

Our findings also show that about two-thirds (67.6%) of those who were aware of their hypertension status were treating the condition. The rate of hypertension treatment found in our study is comparable to the rate of 60% found in a similar nationally-representative study in Cameroon (Dzudie A et al., 2012). It is important to note however that considering the rather low rate of hypertension awareness in this study, the treatment rate of hypertension in our study should be interpreted cautiously. An important dimension of hypertension treatment is the associated cost, which remains a major barrier in Ghana and perhaps in other African countries. In Ghana, out-of-pocket spending is the main source of treating hypertension and other chronic conditions (de-Graft Aikins et al., 2014). In the absence of effective strategies to change this, it is likely that there will be further declines in the hypertension treatment rate over time.

## **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

Targeting high risk individuals and groups may be an effective strategy to improve the rate of hypertension treatment (van de Vijver et al., 2013). Our findings showed that individuals at younger ages, and those with no formal education are the most likely groups to not treat hypertension. Additionally, streamlining alternative treatment options as well as improving financial access to health care could be an important strategy for improving the hypertension treatment rate in Ghana.

Also, we found a low rate of hypertension control. About 12% of those who were treating had their hypertension controlled. The hypertension control rate in this study is lower than rates found in national-wide studies in Cameroon (24.6%) (Dzudie A et al., 2012) and South Africa (32%) (Steyn et al, 2008). The low control rate of hypertension in our study is likely due to non-adherence to pharmacological therapy of hypertension, and recourse to alternative medicines (particularly herbal and Chinese medication). In Ghana, these two factors have been identified as the major barriers to low blood pressure control (Harries et al., 2005). Also, in Ghana, lifestyle interventions are not routinely provided as part of hypertension management (Bosu, 2010); this could further reduce hypertension control. The findings showed that none of the socio-economic and demographic factors were associated with hypertension control. This may probably be due to the small number of respondents with controlled blood pressure.

### **Conclusion**

This paper reports a high burden of hypertension in a nationally representative sample in Ghana. The prevalence and complications associated with hypertension are expected to increase further as there is evidence to show that the risk factors of this condition are on the rise (Afrifa-Anane et al., 2015; Agyei-Mensah and de-Graft Aikins, 2010; Awuah, Afrifa-Anane and Agyemang, 2016).

## **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

It has been suggested that to address the rising burden of hypertension in Ghana, the task of uncomplicated hypertension management can be transferred from high level medical professionals (such as specialist doctors) to low tier medical professionals (such as community health nurses). There is evidence to show that well trained Community Health Nurses (CHNs) have the ability to deliver uncomplicated hypertension care (Ogedegbe et al., 2014). Adopting this strategy at the national level has some important advantages: (1) CHNs are more available and are already working with the community; (2) Care can be coordinated closer to people; (3) CHNs have been deployed in health centres all over the country and making use of them can bring about a national impact; (4) CHNs can deliver primary prevention by creating awareness as they interact with community members in their respective duty posts, and; (5) Equipping CHNs with BP monitors can potentially improve the level of awareness in the country.

This study is not without some limitations. While the sample is nationally representative, it is cross-sectional and therefore limited in providing information on a condition that is essentially chronic. In addition, even though the sample cuts across different age groups (18 years and above), there was an over-representation of those who were 50 years and above. This is because while all eligible persons aged 50+ in older households were selected to participate, only one person was randomly selected in younger households (18-49 years). This may have contributed to the high hypertension prevalence that was reported in this study since hypertension increases with age. The findings should therefore be interpreted with caution. Despite these limitations, this study provides useful insights into the social determinants of health and their implications for hypertension awareness, treatment and control in Ghana.

## **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

### **Acknowledgement**

The authors are grateful to the World Health Organization for the kind access granted to the data.

### **Competing interests**

None declared



## Hypertension awareness, treatment and control in Ghana: A cross-sectional study

### References

1. Addo, J., Amoah, A. G. B., & Koram, K. A. (2006). "The changing patterns of hypertension in Ghana: a study of four rural communities in the Ga district". *Ethnicity & Disease*, 16:894–899.
2. Addo, J., Smeeth, L., Leone, D.A. 2007. "Hypertension in sub Saharan Africa: A systematic review". *Hypertension* 50(6): 1012-1018.
3. Addo, J., Smeeth, L., & Leon, D. A. (2009). "Obesity in urban civil servants in Ghana: association with pre-adult wealth and adult socio-economic status". *Public Health* 123:365–370.
4. Addo, J., Agyemang, C., Smeeth, L., de-Graft Aikins, A., Adusei, A. K., & Ogedegbe, O. (2012). "A review of population-based studies on hypertension in Ghana". *Ghana Medical Journal* 46(2):4–11.
5. Afrifa-Anane, E., Agyemang, C., Codjoe, S. N. A., Ogedegbe, G., & de-Graft Aikins, A. (2015). "The association of physical activity, body mass index and the blood pressure levels among urban poor youth in Accra, Ghana". *BMC Public Health* 15(1): 269.
6. Agyei-Mensah, S., & de-Graft Aikins, A. (2010). "Epidemiological transition and the double burden of disease in Accra , Ghana". *Journal of Urban Health: Bulletin of the New York Academy of Medicine* 87(5):879–897.
7. Agyemang, C. 2006. "Rural and urban differences in blood pressure and hypertension in Chockalingam, A., Balaguer-Vintr,o I., Achutti, A., .et al. 2000. "The World Heart Federation's white book: Impending global pandemic of cardiovascular diseases: Challenges and opportunities for the prevention and control of cardiovascular diseases in

## Hypertension awareness, treatment and control in Ghana: A cross-sectional study

developing countries and economies in transition”. *Canadian Journal of Cardiology* 16:227–229

8. Airhihenbuwa, C., & Iwelunmor, J. (2012). “Why culture matters in reducing the burden of NCDs and CDs in Africa”. *Commonwealth Health Partnerships* 107-111.
9. Awuah, R. B., Afrifa-Anane, E., & Agyemang, C. (2016). Chronic Non-communicable diseases in low- and middle-income countries: Cardiovascular disease, diabetes and established risk factors in low- and middle-income countries. CAB International: United Kingdom.
10. Awuah, R. B., Anarfi, J., Agyemang, C., Ogedegbe, G., & de-Graft Aikins, A. (2014). “Prevalence, awareness, treatment and control of hypertension in urban poor communities”. *Journal of Hypertension* 32(6):1203–1210.
11. Agyemang, C., Addo, J., Bhopal, R., de-Graft Aikins, A., Stronks, K. (2009). “Cardiovascular disease, diabetes and established risk factors among populations of sub-Saharan African descent in Europe: a literature review”. *Globalization Health* 5:7.
12. Baatiema, L., de-Graft Aikins, A., Sav, A., Mnatzaganian, G., Chan, C. K., & Somerset, S. (2017). “Barriers to evidence-based acute stroke care in Ghana: a qualitative study on the perspectives of stroke care professionals”. *BMJ Open* 7(4): p.e015385.
13. Bosu, W.K. (2010). “Epidemic of hypertension in Ghana: a systematic review”. *BMC Public Health* 10:418.
14. Biritwum, R. B., Mensah, G., Minicuci, N., Yawson, A. E., Naidoo, N., Chatterji, S., & Kowal, P. (2013). “Household characteristics for older adults and study background from SAGE Ghana Wave 1”. *Global health action* 6(1):20096.

## Hypertension awareness, treatment and control in Ghana: A cross-sectional study

15. Brundtland, G.H. (2002). “The World Health Report 2002: reducing risks, promoting healthy life”. Geneva: World Health Organization; 2002.
16. Cappuccio, F.P., Micah, F.B., Emmet, L., Kerry, S.M., Martin, P.R. 2004. “Prevalence, detection, management and control of hypertension in the Ashanti, West Africa”. *Hypertension* 43:1017-1022.
17. Chockalingam, A., Campbell, N.R., Fodor, J.G. 2006. “Worldwide epidemic of hypertension”. *Canadian Journal of Cardiology* 22(7): 553–555.
18. Dalal, S., Beunza, J.J., Volmink, J., Adebamowo, C., Bajunirwe, F., Njelekela, M., Mozaffarian, D., Fawzi, W., Willett, W., Adam, H-O., Holmes, M,D. 2011. “.Non-communicable diseases in sub-Saharan Africa: what we know now”. *International Journal of Epidemiology* 40:885–901.
19. Dalal, L., Phadke, G., Gill, A., Tarwater, K., Misra, M., Pele, N., Odum, B. (2011). “A patient with Hemoptysis and renal Failure”. *International Journal of Hypertension* 268370(3).
20. Damasceno, A., Azevedo, A., Silva-Matos, C., Prista, A., Diogo, D., Lunet, N. (2009). “Hypertension prevalence, awareness, treatment, and control in Mozambique”. *Hypertension* 54(1):77-83.
21. Danaei, G., Finucane, M. M., Lin, J. K., Singh, G. M., Paciorek, C. J., Cowan, M. J., et al. (2011). “National, regional, and global trends in systolic blood pressure since 1980: systematic analysis of health examination surveys and epidemiological studies with 786 country-years and 5· 4 million participants”. *The Lancet* 377(9765):568-577.
22. de-Graft Aikins, A., Kushitor, M., Koram, K., Gyamfi, S., & Ogedegbe, G. (2014). “Chronic non-communicable diseases and the challenge of universal health coverage:

## Hypertension awareness, treatment and control in Ghana: A cross-sectional study

Insights from community-based cardiovascular disease research in urban poor communities in Accra, Ghana”. *BMC Public Health* 14(2): S3.

23. de-Graft Aikins, A., Unwin, N., Agyemang, C., Allotey, P., Campbell, C., et al. (2010). “Tackling Africa's chronic disease burden: From the local to the global”. *Globalization and Health* 6.
24. Duda, R. B., Kim, M. P., Darko, R., Adanu, R. M., Seffah, J., Anarfi, J. K., & Hill, A. G. (2007). “Results of the Women’s Health Study of Accra: assessment of blood pressure in urban women”. *Int J Cardiol* 117:115–122.
25. Dzudie, A., Kengne, A.P., Muna, W.F., Ba, H., Menanga, A., Kouam, C.K., Abah, J., Monkam, Y., Biholong, C., Mintom, P. and Kamdem, F. (2012). “Prevalence, awareness, treatment and control of hypertension in a self-selected sub-Saharan African urban population: a cross-sectional study”. *BMJ open* 2(4): e001217.
26. Ganle, J. K. (2016). “Ethnic disparities in utilisation of maternal health care services in Ghana: evidence from the 2007 Ghana Maternal Health Survey”. *Ethnicity & health* 21(1): 85-101.
27. Gaziano, T.A., Bitton, A., Anand, S., Weinstein, M.C. (2009). “The global cost of nonoptimal blood pressure”. *Journal of hypertension* 27(7):1472. Ghana, West Africa”. *Journal of the Royal institute of public health* 120:525-533.
28. Ghana Health Service. (2008). Outpatient morbidity in health facilities, Ghana. Ghana Health Service Centre for Health Information Management, Accra.
29. Ghana Health Service. 2011 Annual Report. <https://www.ghanahealthservice.org/downloads/GHS%202011%20Annual%20Report%20Final%2014-8-12.pdf>.

## Hypertension awareness, treatment and control in Ghana: A cross-sectional study

30. Harries, T.H., Twumasi-Abosi, V., Plange-Rhule, J., Cappuccio, F.P. (2005). “Hypertension management in Kumasi: barriers and prejudice?” *Journal of Human Hypertension* 19(12):975-7.
31. Hendriks, M.E., Wit, F.W., Roos, M.T., Brewster, L.M., Akande, T.M., de Beer, I.H., Mfinanga, S.G., Kahwa, A.M., Gatongi, P., Van Rooy, G., Janssens, W. (2012). “Hypertension in sub-Saharan Africa: cross-sectional surveys in four rural and urban communities”. *PloS one* 7(3): e32638.
32. Hill, A. G., Darko, R., Seffah, J., Adanu, R. M. K., Anarfi, J. K., & Duda, R. B. (2007). “Health of urban Ghanaian women as identified by the Women’s Health Study of Accra”. *Int J Gynecol Obstet.* 99:150–156.
33. Kamadjeu, R.M., Edwards, R., Atanga, J.S., Unwin, N., Kiawi, E.C., Mbanya, J.C. (2006). “Prevalence, awareness and management of hypertension in Cameroon: findings of the 2003 Cameroon burden of diabetes baseline survey”. *J Hum Hypertens* 20(1):91–92.
34. Kayima, J., Wanyenze, R.K., Katamba, A., Leontsini, E., Nuwaha, N. (2013). “Hypertension awareness, treatment and control in Africa: a systematic review”. *BMC Cardiovascular Disorders* 13:54.
35. Kearney, P.M., Whelton, M., Reynolds, K., Whelton, P.K., He, J. 2005. “Global burden of hypertension: Analysis of worldwide data”. *Lancet* 365:217–223.
36. Kunutsor, S., & Powles, J. (2009). “Descriptive epidemiology of blood pressure in a rural adult population in Northern Ghana”. *Rur Remote Health* 9:1095.

## Hypertension awareness, treatment and control in Ghana: A cross-sectional study

37. Lawes, C.M., Vander Hoorn, S., Law, M.R., Elliott, P., MacMahon, S., Rodgers, A. (2000). "Blood pressure and the global burden of disease. Part I: Estimates of blood pressure levels". *Journal of Hypertension* 24:413–22.
38. Lawes, C.M., Vander Hoorn, S., Law, M.R., Elliott, P., MacMahon, S., Rodgers, A. (2006). "Blood pressure and the global burden of disease 2000. Part II: Estimates of attributable burden". *Journal Hypertension* 24:423–30.
39. Mensah, G.A. (2008). "Epidemiology of stroke and high blood pressure in Africa". *Heart* 94:697–705.
40. Minicuci, N., Biritwum, R. B., Mensah, G., Yawson, A. E., Naidoo, N., Chatterji, S., & Kowal, P. (2014). "Sociodemographic and socioeconomic patterns of chronic non-communicable disease among the older adult population in Ghana". *Global health action* 7(1): 21292.
41. Ngougou, E.B., Aboyans, V., Kouna, P., Makandja, R., Ecke Nzengue, J.E., Allogho CN., et al. (2012). "Prevalence of cardiovascular disease in Gabon: a population study". *Arch Cardiovasc Dis* 105(2):77–83.
42. Odusola, A. O., Hendriks, M., Schultsz, C., Bolarinwa, O., Akande, T., Osibogun, A., et al. (2014). "Perceptions of inhibitors and facilitators for adhering to hypertension treatment among insured patients in rural Nigeria: A qualitative study". *BMC Health Services Research* 14(1): 1–16.
43. Ogedegbe, G., Plange-Rhule, J., Gyamfi, J., Chaplin, W., Ntim, M., Apusiga, K., et al. (2014). "A cluster-randomized trial of task shifting and blood pressure control in Ghana: study protocol". *Implementation Science* 9(1): 73.

## Hypertension awareness, treatment and control in Ghana: A cross-sectional study

44. Oladapo, O.O., Salako, L., Sodiq, O., Shoyinka, K., Adedapo, K. and Falase, A.O. (2010). "A prevalence of cardiometabolic risk factors among a rural Yoruba southwestern Nigerian population: a population-based survey: cardiovascular topics". *Cardiovascular journal of Africa* 21(1):26-31.
45. Opie, L.H., Seedat, Y.K. (2005). "Hypertension in sub-Saharan African populations". *Circulation* 112:3562–3568.
46. Pereira, M., Lunet, N., Azevedo, A., Barros, H. (2009). "Differences in prevalence, awareness, treatment and control of hypertension between developing and developed countries". *J Hypertens* 27:963–975.
47. Perkovic, P., Huxley, P., Wu, Y., Prabhakaran, D., MacMahon, S. 2007. "The Burden of Blood Pressure-Related Disease: A Neglected Priority for Global Health". *Hypertension* 50:991-997.
48. Pobee, D., Ikeme, A. C., Pobee, J. O. M., Larbi, E., Williams, H., & Blankson, J. (1979). "The Mamprobi Survey - a screening survey for cardiovascular disease and risk factors in Africa: methodology and validity". *Bull WHO* 57:81–87.
49. Romdhane, H.B., Ali, S.B., Skhiri, H., Traissac, P., Bougatef, S., Maire, B., Delpuech, F. and Achour, N. (2012). "Hypertension among Tunisian adults: results of the TAHINA project". *Hypertension Research*, 35(3):341-347.
50. Sanuade, O. A., Anarfi, J. K., de-Graft Aikins, A., & Koram, K. A. (2014). "Patterns of cardiovascular disease mortality in Ghana: A 5-year review of autopsy cases at Korle-Bu Teaching Hospital". *Ethnicity and Disease* 24:55.
51. Sarfo, F. S., Jenkins, C., Singh, A., Owolabi, M., Ojagbemi, A., Adusei, N. et al., (2017a). "Post-stroke depression in Ghana: characteristics and correlates". *Journal of the*

## Hypertension awareness, treatment and control in Ghana: A cross-sectional study

*Neurological Sciences* 379: 261–265.

52. Sarfo, F. S., Ovbiagele, B., Akassi, J., & Kyem, G. (2017a). “Baseline prescription and one-year persistence of secondary prevention drugs after an index stroke in Central Ghana”. *eNeurologicalSci* 6:68–73.
53. Schutte, A. E. (2017). “Global, regional, and national age-sex specific mortality for 264 causes of death, 1980-2016: a systematic analysis for the Global Burden of Disease Study 2016”. *The Lancet* 390:10100.
54. Steyn, K., Bradshaw, D., Norman, R. and Laubscher, R. (2008). “Determinants and treatment of hypertension in South Africans: the first Demographic and Health Survey”. *SAMJ: South African Medical Journal* 98(5):376-380.
55. Tedesco, M.A., Di Salvo, G., Caputo, S., Natale, F., Ratti, G., Iarussi, D., et al. (2001). “Educational level and hypertension: how socioeconomic differences condition health care”. *Journal of Human Hypertension* 15(10):727-731.
56. Ulasi, I.I., Ijoma, C.K., Onwubere, B.J., Arodiwe, E., Onodugo, O., Okafor, C. (2011). “High prevalence and low awareness of hypertension in a market population in Enugu, Nigeria”. *Int J Hypertens* 27(869675):869675.
57. Unwin, N. (2001). “Commentary: Non-communicable disease and priorities for health policy in sub-Saharan Africa”. *Health policy and planning* 16 (4):351.
58. van de Vijver, S.J., Oti, S.O., Agyemang, C., Gomez, G.B., Kyobutungi, C. (2013). “Prevalence, awareness, treatment and control of hypertension among slum dwellers in Nairobi, Kenya”. *J Hypertens.* 31(5):1018-24.
59. Williams, E.A., Keenan, K.E., Ansong, D., Simpson, L.M., Boakye, I., Boahen, J.M., Awuah, D., Nkyi, C.A., Nyannor, I., Arhin, B., Alder, S., Benson, S., Dickerson, T.T.



## **Hypertension awareness, treatment and control in Ghana: A cross-sectional study**

2013. “The burden and correlates of hypertension in rural Ghana: A cross sectional survey”. *Diabetes and Metabolic syndrome: Clinical research and reviews* 7: 123-128.
60. World Health Organization (2005). “Preventing chronic diseases: a vital investment”. World Health Organization.
61. World Health Organization. “Global Burden of Disease. Projections of mortality and burden of disease, 2002–2030”. [http://www.who.int/topics/global\\_burden\\_of\\_disease/en/](http://www.who.int/topics/global_burden_of_disease/en/).