Prevalence of Hypertension in a rural community in southeast Nigeria; an opportunity for early intervention.

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Abstract

Background

Hypertension is a leading cause of non-communicable morbidity in Sub Saharan Africa. Recent studies suggest and increase in the prevalence of hypertension in rural Sub Saharan Africa.

Methods

Using a three-phase approach, the WHO STEPS-wise approach to surveillance of noncommunicable diseases was used to determine the prevalence of hypertension in a rural settlement is Enugu State, Southeast Nigeria. Blood pressure measurement was done according to the guidelines of the European Society of Hypertension.

Results

Out of 1576 participants aged 18 years and above, 976 (74.9%) completed the full survey and their blood pressure was measured, and data analysed. The prevalence of hypertension was 27.3%, (95%CI 24.5-30.2); similar in males (28.8, 95%CI 24.1-33.9) and females 166(26.4%, 95%CI 23.0-30.0). p= 0.415. The prevalence of hypertension increased with age reaching a peak of 33.6% (95%CI 25.7-42.1) among people aged 50-59 years. P= 0.06. The age-related increase in the prevalence of hypertension was statistically significant in males (p=0.04) but not in females. (p=0.15). Systolic and diastolic blood pressure levels correlated with older age and higher fasting blood glucose levels while diastolic blood pressure negatively correlated with level of education. Awareness of hypertension was low (7.9%).

Conclusion

The prevalence of hypertension in a rural southeastern Nigeria community is 27.3%, however awareness was very low (7.9%). Most participants had mild hypertension thus offering a window of opportunity for public health educators in preventing the complication of hypertension. There is therefore the need for awareness campaigns to be intensified in rural communities.

Summary Table

What is known about the topic	• High prevalence of hypertension in rural Nigerian communities. • Modest rates of hypertension awareness in rural Nigerian communities. • Higher rates of awareness in females.
What this study adds	• High rates of mild hypertension. • High rates of mild to moderates hypertension offers an opportunity for early intervention especially in middle aged individuals.

Introduction

Hypertension is a leading cause of non-communicable morbidity in Sub Saharan Africa (SSA)[1–8]. The high prevalence of hypertension is reflected in high rates of complications reported in several studies[9–10]. Most recent studies have persistently reported prevalence rates 20 to 50 percent and as some more than 50% in some Nigerian populations[2,3,11–13] with a mean prevalence of 30.6% reported in the country as at 20202[14]. Although the prevalence of hypertension has generally been found to be lower in rural areas and semi urban areas, nevertheless this is also on the increase[1,14]. In one mixed urban and rural study; the prevalence of hypertension was higher in rural compared to urban communities[15]. The burden and treatment of hypertension in SSA is wrought with several peculiarities such as lack of access to medications, the use of substandard and adulterated drugs, use of non-orthodox modes of treatment, late presentation and generally poor knowledge, attitude, and practice of hypertension[5]. These factors are more accentuated in rural areas because of several reasons including lower rates of literacy, lack of access to standard health care and cultural beliefs.[3,4,,14,16,17]

Surprisingly relatively larger number studies have been focused on the prevalence of hypertension in rural compared to urban communities in Nigeria[14]. In a review by Adeloye et al[14] on the prevalence of hypertension in Nigeria; out of 53 studies, 18(34%) were dedicated to rural communities and 13(24.5%) were carried out in mixed urban and rural settings. (See Fig. 1). The mean prevalence of hypertension among rural dwellers based on the review was 24.5% compared to 33.6% in urban centres. There is therefore a general trend of lower prevalence rates in rural compared to urban areas[1,14]. There are also differences between the prevalence of hypertension and practice of hypertension between males and females with females having lower rates and being more aware[16–18].

In Nigeria, the knowledge and practice of hypertension is affected by poor socio-economic status of patients as well as shortage of qualified specialists; hence, treatment is often uncoordinated, and drugs changed as patient moves from one doctor to another[19–21]. It is our hypothesis that since most of the factors that undermine the treatment of hypertension are more acute in rural settings the prevalence of hypertension may be higher than previously reported. The aim of this study was to document the prevalence and pattern of hypertension among a rural settlement in Enugu south Local Government Area in Enugu State, Southeast Nigeria.

Materials And Methods

This study was carried out in Ugwuomu Village in Enugu South Local Government area of Enugu State. There was no reliable data on the population of the village available at the time of the study. The village is located 20 kilometers from the city center and about 4 km from the nearest semi-urban settlement. Ugwuomu has one primary and one secondary school which is also used by people from surrounding villages. There was a health center in the village at the time of the study. Although most health-care needs within the villages are delivered by auxiliary nurses, but many cases people travel to the nearest semi-urban area for their healthcare needs. People can also access care from other government health institution within Enugu metropolis. Sources of drinking water are mainly family wells or streams. Formal

sewage disposal system is non-existent in the village, but several homes have either pit latrines or water closet system.

Study design and recruitment of participants

A three-phase cross-sectional descriptive study was carried out to survey residents of the village. The first phase of the study was sensitization of the community through meetings with elected community leaders. Announcements were also made in churches as well as by town announcer. The first phase of the study was carried in the first wee but also continued into the second phase (3weeks in all)

In the second phase of the study, participants were visited in their homes. During this phase the WHO STEPS instrument[22] was used to collect data on selected sociodemographic characteristics. All consenting individuals were interviewed at their respective homes or offices/place of work. Participants were also invited to come to the clinic on any day of their choice within the stipulated time and when necessary for follow up. This phase of the study started on the second week and lasted till the end of the third week. (2 weeks in all).

The third phase of the study was carried out in a field clinic during the fourth week of the study, however it also overlapped with the last week of the second phase. In this phase, the remaining part of the WHO STEPS instrument[22] on physical measurements of weight, height, blood pressure and fasting blood glucose were carried out. Medical history of hypertension was also obtained from the subjects. The third phase of the survey lasted for one week.

The duration of the study was 4 weeks (1st to the 4th week of August 2019). All consecutive consenting adults 18 years and above were included in the study.

The scope of the present study is limited to behavioral and physical measurements and did not include biochemical measurements (apart from fasting blood glucose).

The study protocol was reviewed on behalf of State (Enugu State) Ministry of Health by the Ethics committee of the Enugu State University of Science and Technology Teaching Hospital and University of Nigeria Teaching Hospital, Enugu. All participants gave their informed consent after reading or having the consent form read for and explained to them.

Blood pressure measurement

All participants were first interviewed at home, but blood pressure measurement was done in the field clinic. After resting for at least 10 minutes blood pressures was recorded at least 3 times by means of mercury sphygmomanometer according to the guidelines of the European Society of Hypertension.[23] Blood pressure was measured by either a trained nurse or by one of the investigators (the doctors). All the doctors that participated in the study were either senior residents or consultants in the department of

medicine. Blood pressure measurements were obtained from the non-dominant arm using a standard cuff with an inflatable bladder of 22 × 12 cm^2 if the arm circumference was 32 cm, and cuffs with a 35 × 15 cm^2 bladder on larger arms. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were taken at the first and fifth Korotkoff sounds, respectively. The average of the three blood pressure measurements was used for the analysis. Fasting blood glucose was measured using a glucometer (Fine test premium; Infobia Co. Ltd, Dongan-gu, South Korea). The waist and hip circumference were measured using a standard centimeter tape, by standard method.

Definition of terms

Hypertension was defined as an SBP of ⩾ 140mmHg and/or DBP of ⩾90mmHg, and/or reporting use of antihypertensive drug therapy. Awareness was confirmed by asking for past medical history of raised blood pressure recorded by a health professional or identifying those who were taking blood pressure lowering medications. Controlled blood pressure was calculated as the proportion of those with past medical history of hypertension whose blood pressure were within normal range during the study. All new cases of hypertension were started on medications and were referred to the health center of any hospital nearest to them for continued care.

Occupation was defined as the respondent's primary job and or source of income for the month. An artisan was defined as a skilled manual worker in a particular trade or craft, such as masonry, mechanics, tailoring, welding, metal working and other crafts. Professional drivers were also grouped as artisans. Office workers included teachers, civil servant and individual that spend most of their working hours in the office. Level of education was the highest educational attainment (primary education, secondary, and tertiary) at the time of the study.

Sample size

The sample size was calculated using the proportion (23.2%) of a rural population with hypertension in Southeast Nigeria with hypertension.

$N = 1.96^2 \sqrt{p(1-p)} / (0.05)^2 = (1.96^2 (0.232(0.768)) \div 0.0025 = 274.$

Adding 10% of the sample size to mitigate for attrition of participants, we obtained a minimum sample size of 301 participants

Statistical methods

For database management and statistical analyses, we used the SPSS version 26 (IBM Corporation, New York, NY, USA). Data were presented in tables and figures. For continuous variables, mean values and standard deviation were calculated. Prevalence of hypertension was expressed as percentages, and confidence interval (CI) was calculated. Other statistical methods also included Student's Ttest for unpaired observations to compare means. For partial correlations, the variables considered were sex (0, 1

for women and men, respectively), age, waist-Hip ratio, fasting blood glucose, level of education (1 primary, 2 secondary, 3 tertiary). In all, P-value 0.05 was regarded as statistically significant. Conclusions were drawn at the level of significance. The confidence level was kept at 95%.

Results

Characteristics of the participants

Out of 1576 participants aged 18 years and above who were invited for the study, 273(17.3%) were less than 20 years and where not included in the present analysis. Out of the remaining 1303 participants, 976 (74.9%) completed the full survey and their blood pressure was measured, and their data analysed. Females were 629(64.4%) and males 347 men (35.6%). The age distribution of the participants is shown in Fig. 1 and Table 1. The mean age of the participants was 42.9 ± 15.7 years. There was no significant difference in the mean age of female and male participants (p = 0.88). Waist and hip circumferences were larger in females. P < 0.001 respectively (Table 1). The educational attainment of the participants and their occupation are also shown in Table 1. Mean systolic and diastolic blood pressures were similar in both sexes. Fasting blood glucose was higher in females (113.5 ± 5 mg/dl) than in males (107.3 ± 25.1 mg/dl). P = 0.02.

Table 1
Characteristics of participants

Characteristic	Women	Men	Total	*P*-value
N	629(64.4)	347(35.6)	976(100)	< 0.01
Mean age, years	42.8 ± 15.5	43 ± 15.7	42.9 ± 15.7	0.88
Age group, years	-	-	-	-
20–29	127(20.2)	79(22.8)	206(21)	
30–39	186(29.6)	85(24.8)	271(27.8)	
40–49	113(18)	67(19.3)	180(18.4)	
50–59	85(13.5)	52(15)	137(14)	
≥ 60	118(18.8)	64(18.4)	182(18.6)	0.5
Anthropometrics	-	-	-	-
Mean waist circum., cm	76 ± 18.6	70.4 ± 17.2	74 ± 18.3	< 0.01*
Mean hip circum., cm	85.1 ± 20.2	80.4 ± 20.9	83.4 ± 20.6	< 0.01*
Mean waist-Hip ratio	0.91 ± 0.18	0.9 ± 0.21	0.91(5.2)	0.24
Level of education, n(%)	-	-	-	-
Primary	239(38)	138(39.8)	377(38.6)	
Secondary	130(20.7)	74(21.3)	204(20.9)	
Tertiary	17(2.7)	10(2.9)	27(2.8)	
Not indicated	243(38.6)	125(36)	368(37.7)	0.93
Occupation, n(%)	-	-	-	-
Office workers/teachers	76(29.4)	54(11.4)	140(14.3)	
Business	147(23.4)	87(25.1)	234(24)	
Farmers	274(46.6)	116(33.4)	390(40)	
Students	68(10.8)	51(14.7)	119(12.2)	
Artisans	24(3.8)	51(14.7)	45(4.6)	
Unemployed	28(4.5)	15(4.3)	43(4.4)	

Values are mean ± SD. *P*-values are for the sex differences. Peripheral systolic and diastolic blood pressure were the average of 3 consecutive. * Mann-Whitney U Test.

SBP = Systolic blood pressure. DBP = diastolic blood pressure.

Characteristic	Women	Men	Total	*P*-value
Peripheral hemodynamics	-	-	-	-
Mean SBP, mm Hg	127.6.3 ± 17	127.1 ± 17.7	127.3 ± 17.4	0.67
Mean DBP, mm Hg	68.9.6 ± 10.7	68.9 ± 11.7	68.8 ± 11.3	0.88
Measurements on blood				
Glucose, mg/dl	113.5 ± 37.2	107.3 ± 25.1	109.5 ± 30.2	0.02
Values are mean ± SD. *P*-values are for the sex differences. Peripheral systolic and diastolic blood pressure were the average of 3 consecutive. * Mann-Whitney U Test.				
SBP = Systolic blood pressure. DBP = diastolic blood pressure.				

Blood Pressure.

Figures 2a and 2b show the age distribution of blood pressure measurements in males and females. In females, (Fig. 2a) the mean diastolic blood pressure significantly increased with age reaching a peak of 70.4mmHg in people aged 40–49 years. There were no significant changes in the age distribution of blood pressure measurements in males. Figure 2b. The blood pressure measurement recorded during the study showed that 19.6% had mild elevation in systolic blood pressure and 7% had mild elevation of diastolic blood pressure. Figure 3.

Table 2 shows the age and gender distribution of hypertension. The prevalence of hypertension in this study was 27.3%, (95%CI 24.5–30.2). The prevalence of hypertension was similar in males (28.8, 95%CI 24.1–33.9) and females 166(26.4%, 95%CI 23.0–30.0). p = 0.415. The prevalence of hypertension increased with age reaching a peak of 33.6% (95%CI 25.7–42.1) among people aged 50–59 years. P = 0.06. The age-related increase in the prevalence of hypertension was statistically significant in males (p = 0.04) but not in females. (p = 0.15). Table 2. Systolic and diastolic blood pressure levels correlated with older age and higher fasting blood glucose levels while diastolic blood pressure negatively correlated with level of education. Table 3.

Table 2
Gender distribution of hypertension.

Variable	Female (N %, 95% CI)	Male (N %, 95% CI)	Total(N %, 95% CI)	P-value
Hypertension, n (%)	166(26.4, 95%CI 23.0–30.0)	100(28.8, 95%CI 24.1–33.9)	266(27.3, 95%CI 24.5–30.2)	0.415
History of hypertension, n (%)	12(1.9(26.4, 95%CI 1.0-3.3))	8(2.3,95%CI 1.0-4.5)	20(2.0, 95%CI 1.3–3.1)	0.68
Detected, n (%)	145(92.4)	87(91.3)	246(92.5) **	
Age group (years)				
20–29	29(22.8,95%CI 15.9–31.1)	19(24.1,95%CI 15.1–35.0)	48(23.3, 95%CI 17.7–29.7)	
30–39	48(25.8,95%CI 19.7–32.7)	16(18.8, 95%CI 11.2–28.8,)	64(23.6, 95%CI 18.7–29.1)	
40–49	34(30.1,95%CI 21.8–39.4)	25(37.3,95%CI 25.8–50.0)	59(32.8, 95%CI 26.0-40.2)	
50–59	30(35.3,95%CI 25.2–46.4)	16(30.8,95%CI 18.7–45.1)	46(33.6, 95%CI 25.7–42.1)	
≥ 60	25(21.2,95%CI 14.2–29.7) p = 0.04	24(37.5,95%CI 25.7–50.5) p = 0.15	49(26.9, 95%CI 20.6–34)	0.062

**percentage of those with hypertension.

Table 3
Correlate of systolic and diastolic blood pressure

Variable	SBP* r(p-value)	DBP**r(p-value)
βAge	**0.08(0.02)**	**0.08(0.02)**
μSex	0.02(0.47)	0.02(0.55)
μLevel of Education#	-0.08(0.06)	**-0.15(< 0.01)**
μOccupation##	-0.04(0.33)	0.04(0.29)
βBlood glucose level	**0.1(0.02)**	**0.19(< 0.01)**
βWaist Hip Ratio	0.06(0.08)	-0.05(0.13)
SBP* Systolic Blood Pressure		
DBP** Diastolic Blood Pressure		
Level of Education# (1, primary; 2, secondary; 3, tertiary).		
Occupation## (1, low; 2, moderate; 3 active)		
β Parametric correlations		
μ non-Parametric correlations		

Discussion

The key findings of this study are 27.3% prevalence of hypertension in a rural community most of them detected for the first time (92.1%). The prevalence of hypertension showed two peaks in males (40–49 years; 37.3%, 95%CI 25.8–50.0) and ≥ 60 years (37.5%,95% CI 25.7–50.5). In females the prevalence of hypertension peaked at 50–59 years in females (35.3%,95%CI 25.7–50.5). Systolic and diastolic blood pressure levels correlated with older age and higher fasting blood glucose levels. Diastolic blood pressure negatively correlated with level of education. There was a weak correlation between systolic blood pressure and level of education and waist-hip ratio.

The prevalence of hypertension and its complications are increasing in Africa[1–20, 24]. Across the continent the burden of hypertension is compounded by poor health infrastructure, dearth of manpower and competition for resources with other communicable and non-communicable diseases[25,26]. Hypertension is strongly related to other non-communicable disease such as diabetes, obesity and the metabolic syndrome which in turn lead to a rising incidence and prevalence of stroke, heart disease and renal disease in the country. Reasons for the rapid rise in the prevalence of hypertension among black Africans can be related to urbanization, diet and sedentary lifestyle[24]. There is also the associated increase in rates of alcohol consumption and smoking[27–29]. Overall, the prevalence of hypertension in

Nigeria has remained above 25% in most studies done in Nigeria., with studies from rural setting giving lower prevalence.[114]

The prevalence of hypertension in this study was 27.3%, out of which 92.1% were not aware of their condition. Some studies in Nigeria have reported rates higher than 50% depending on the population studied[3,30–32]. Factors that may lead to lower rates of hypertension in rural areas include vigorous physical activities associated with farming, artisanal work, trekking long distances and possibly undernutrition[33]. Diet may also be contributory because most rural dwellers are less likely to overindulge in refined fatty meals associated with urban dwellers.

It is evident from some recent studies that the differences between rural and urban rates of hypertension in Nigeria may be narrowing[2] which may in turn be related to population movements and changing lifestyles. Factors likely to be associated with the rising burden of hypertension in rural areas in our region are many and includes poor knowledge and practice of hypertension[1] and older age of rural dwellers (retirees)[34,35]. Other factors which are often modifiable and preventable are the same for rural and urban areas.

In Nigeria as well in the rest of the continent the prevalence of hypertension in both rural and urban areas varies widely both within and between regions[36–39]. In the index study, the prevalence of hypertension is similar to some studies that were done among rural dwellers. Adebayo et al[38] reported a prevalence rate of 26.4%. Other studies in the countries have reported rates 13.8%-44.5%[15, 40–45].

In the index study the prevalence of hypertension peaked 50–59 years. This is similar to other studies from southeast Nigeria[3,4]. Most of the participants in the index study had mild hypertension and this finding brings to the fore the need for early and multi-dimensional public health programs targeting middle aged and older adults in the prevention of hypertension and its complications.

The correlation between blood pressure and age and blood glucose[3,17,35,46,47] was also confirmed in the index study. The relationship between hypertension and age has been attributable to several factors including higher rates of obesity, glucose intolerance, sedentary lifestyles, and arterial stiffness[3,24].

Awareness of hypertension is defined as a fraction of people who have hypertension in a given population that have been previously diagnosed. Hypertension unawareness (newly diagnosed) in this study was 92.5%. Long distance to hospitals, poor knowledge and practice of hypertension, the severity of hypertension (most participants had mild uncomplicated hypertension). and lack of health workers in the rural areas may be some of the reasons why many cases of hypertension were not detected in the present study. In a previous study among sub-urban dwellers, we reported a 40% rate of hypertension awareness much higher than 8% in the index study[3]. In Sub Saharan Africa, hypertension awareness ranges from 8% in Nigeria to 65% in Seychelles[48]. Okello et al[17] reported an average of 57.2% of hypertension awareness across 7 settlements in Africa. Unlike in most studies, in the index study there was no difference in the rates of hypertension awareness between men and women.

One of the commonest factors leading to complications in hypertension is unawareness. This is primarily because hypertension is largely asymptomatic, therefore, to reduce the complications of hypertension, awareness needs to be increased by carry out checks in adults at every given opportunity. This task should be undertaken by public and private health care providers on regular basis. Awareness of hypertension may be a surrogate for the capacity of the health system to provide diagnostic health services for the general population at all levels because blood pressure measurement is an integral part of all forms of health assessment irrespective the disease or medical subspecialty in question. Unfortunately, our primary and secondary healthcare services are primarily under private health care providers and is largely constrained by communicable diseases and child and maternal disease.

Mean SBP and DBP measurements are similar in males and females in this study, a pattern different from other studies[3,4,14–16]. Over the decades statistics have shown a gradual increase in the mean systolic and diastolic blood pressure values among Nigerians[26,48]. This may be related to the some of the factors earlier stated.

Our study showed a strong correlation between higher diastolic blood pressure and lower level of education. This is also seen with systolic blood pressure although the correlation was weak. This is similar to previous reports[3,17,49]. Several reasons such as income status, knowledge and practice of hypertension are all plausible explanations. For example, it has been suggested that the lower the level of education the less likelihood of implementation of health-related lifestyle changes[50–51] hence adults with higher educational attainment live healthier and longer lives compared to their less educated peers[51]. Understanding the relationship between education and hypertension and the levels in which this occurs will be a key to reducing the prevalence of hypertension especially in poor communities. Specifically in the Nigerian context people's cultural and religious beliefs and orientation increases the likelihood of preferring unorthodox treatment of hypertension; and this probability is likely to be higher among the uneducated. Considering the socioeconomic and the cultural context of our study, it is likely that poorly educated individuals are less likely to accept hypertension as a lifelong disorder and may resort to herbal and other remedies for cure. They may also stop their medication after some time if blood pressure normalizes.

The present study has documented the prevalence of hypertension in a rural setting in southeast Nigeria. Considering that most Nigerians live in rural areas, this survey therefore provides data in an area where hitherto data on the prevalence of hypertension has been lacking. Data on the prevalence of hypertension in rural areas therefore will help to reduce the high burden of hypertension in the country and consequently the rising prevalence of stroke and other complications of hypertension.

Limitations

This study is not without some limitations. The mean age of 42.9 years (median of 42 years) in this study suggests that our findings may reflect the younger age group. This notwithstanding, our tables showed age specific prevalence of hypertension to be similar to previous studies. Secondly, we did not collect

data on risk factors, such as alcohol use, tobacco use and physical activity. The knowledge of the pattern of these risk factors would have helped to explain further the reasons for some of our findings. Thirdly, population dynamics might have affected our findings because some people who were interviewed may work in urban centers, while living in the village, thus some of the factors affecting the prevalence of hypertension in urban areas may also be applicable in this study. Fourthly, the significantly higher proportion of female subjects may also introduce some bias. Lastly data on hypertension awareness were self-reported, and there was no supporting medical records or data accessed. These shortcomings notwithstanding; based on external consistency of our data with those of similar studies, our results may well be a representative of rural areas in Enugu State.

Conclusion

The prevalence of hypertension in a rural southeastern Nigeria community is 27.3%, however awareness was very low (7.9%). Most participants had mild hypertension thus offering a window of opportunity for public health educators in preventing the complication of hypertension. There is therefore the need for awareness campaigns to be intensified in rural communities.

Declarations

Acknowledgement. The author acknowledges the contribution of the community and church leaders during the study.

Author contributions. Birinus A Ezeala-Adikaibe conceptualized the work and wrote the manuscript. All authors contributed financially for the study and also physically collected data and examined the participants. All the authors also revised the manuscript.

Conflict of interest. The authors have no conflicts of interest.

References

1. Adeloye D, Basquill C Estimating the Prevalence and Awareness Rates of Hypertension in Africa: A Systematic Analysis. PLoS ONE 2013;9(8): e104300. doi:10.1371/journal.pone.0104300.
2. Ebirim CIC, Udujih OG, Dozie UW, Agbaka CA, Orji SM, et al. Prevalence of Hypertension among adults aged 40 years and above in Ahiazu Mbaise, Imo State, Nigeria. Arch Community Med Public Health 2018; 4(1): 013–016.
3. Ezeala-Adikaibe BA, Orjioke C, Ekenze O S, Ijoma U, Onodugo O, Chime P et al. Population based prevalence of high blood pressure among adults in an Urban Slum in Enugu, South East Nigeria. J Hum Hypertens. 2015; 1–7. doi:10.1038/jhh.2015.
4. Ulasi, I I, Ijoma, C K Onwubere, B J C, Arodiwe, E, Onodugo, O, Okafor C. High prevalence and low awareness of hypertension in a market population in Enugu, Nigeria. Int J Hypertens 2011, 27(869675):869675

5. Odili A N, Chori B S, Danladi B, Nwakile P C, Okoye I C, Abdullahi U, Prevalence, Awareness, Treatment and Control of Hypertension in Nigeria: Data from a Nationwide Survey 2017. Global Heart. 2020; 15(1): 47. DOI: https://doi.org/10.5334/gh.848
6. Odili A N, Thijs L, Hara A, Wei F-F, Ogedengbe J O, Nwegbu M M et al. In collaboration with the International Database on Home Blood Pressure in Relation to Cardiovascular Outcome (IDHOCO) Investigators. Prevalence and Determinants of Masked Hypertension Among Black Nigerians Compared With a Reference Population. Hypertension. 2016;67:1249–1255.
7. Ugwuja E I, Ezenkwa US, Nwibo A N, Ogbanshi M, Idoko O, R Nnabu R. Prevalence and Determinants of Hypertension in an Agrarian Rural Community in Southeast Nigeria Ann Med Health Sci Res. 2015; 5(1): 45–49.
8. Addo J, Smeeth L David A. Leon D A. Hypertension In Sub-Saharan Africa: A Systematic Review. *Hypertension.* 2007;50:1012–1018.
9. Arodiwe EB, Ike SO, Nwokediuko SC: **Case fatality among hypertension-related admissions in Enugu, Nigeria**. Niger J Clin Pract 2009, **12**:153–156.
10. M'Buyamba-Kabangu JR, Biswika RT, Thijs L, Tshimanga GM, Ngalula FM, Disashi T et al. In-hospital mortality among black patients admitted for hypertension-related disorders in Mbuji Mayi, Congo. *Am J Hypertens* 2009, 22:643–648.
11. Ezejimofor MC, Uthman OA, Maduka O, Ezeabasili AC, Onwuchekwa AC, Ezejimofor BC et al. The burden of hypertension in an oil-and gas-polluted environment: a comparative cross-sectional study. *Am J Hypertens*. 2016;29(8):925–933.
12. Olamoyegun MA, Oluyombo R, Iwuala SO, Asaolu SO. Epidemiology and patterns of hypertension in semi-urban communities, south-western Nigeria. *Cardiovasc J Afr*. 2016;27(6):356–360.
13. Amole IO, OlaOlorun AD, Odeigah LO, Adesina SA. The prevalence of abdominal obesity and hypertension amongst adults in Ogbomoso, Nigeria. *Afr J Prim Health Care Fam Med*. 2011;3(1):188.
14. Adeloye D | Owolabi E O D B. Ojji,Auta A Dewan M TOlanrewaju T OOgah O S Prevalence, awareness, treatment, and control of hypertension in Nigeria in 1995 and 2020: A systematic analysis of current evidence. *J Clin Hypertens.* 2021;23:963–977.
15. Effiong E A, Udeme E. Ekrikpo, Aniema I. A. Udo, Bassey E B. Prevalence of Hypertension in Akwa Ibom State, South-South Nigeria: Rural versus Urban Communities Study Int J Hypertens 2015; ID 975819, 5 pages http://dx.doi.org/10.1155/2015/975819
16. Isezuo SA, Opara TC. Hypertension awareness among Nigerian hypertensives in a Nigerian tertiary health institution. Sahel Medical Journal. 2000; 3:93–97.
17. Okello S,, Muhihi A, Mohamed S F, Soter A, Ochimana C, Abayomi O A O. et al. Hypertension prevalence, awareness, treatment, and control and predicted 10-year CVD risk: a cross-sectional study of seven communities in East and West Africa (SevenCEWA) BMC Public Health (2020) 20:1706.
18. van de Vijver S, Akinyi H, Oti S, Olajide A, Agyemang C, Aboderin I et al. Status report on hypertension in Africa - Consultative review for the 6th Session of the African Union Conference of Ministers of

Health on NCD's. Pan African Medical Journal. 2013; 16:38. doi:10.11604/pamj.2013.16.38.3100

19. Ezeala-Adikaibe BA, Nwobodo NN, Okafor H., Orjioke C., Okpara T., Aneke E, et al.. Prescription pattern of antihypertensive drugs in Enugu: A report of the ESUTH research group. Eur j biomed pharmaceut sci 2016; 3:72–77.
20. Isezuo AS, Njoku CH. Blood pressure control among hypertensives managed in a specialized health care setting in Nigeria. Afr J Med Med Sci. 2003; 32:65–70.
21. Etuk E, Isezuo AS, Chika A, Akuche J, Ali M. Prescription pattern of Anti-hypertensive drugs in a Tertiary Health Institution in Nigeria. *Ann of Afri Med.* 2008:*I7(3):128–132*
22. WHO. WHO STEPwise Approach to Chronic Disease Risk Factor Surveillance (STEPS). WHO: Geneva,Switzerland, 2005.
23. Williams B, Mancia G, Spiering W, Enrico A, Michel A et al. 2018 ESC/ESH Guidelines for the management of arterial hypertension: The Task Force for the management of arterial hypertension of the European Society of Cardiology and the European Society of Hypertension. Journal of Hypertension, 36(10):1953–2041.
24. Cappuccio F P, Miller M A, Cardiovascular disease, and hypertension in sub- Saharan Africa: burden, risk and interventions. Intern Emerg Med 2016;11:299–305 DOI 10.1007/s11739-016-1423-9,
25. World Health Organisation. Noncommunicable Diseases Country Profiles. Geneva, Switzerland, 2011.
26. World Health Organisation. Global Health Risks: Mortality and Burden of Disease Attributable to Selected Major Risks. WHO: Geneva, Switzerland, 2009.
27. Global status report on alcohol and health 2018. World Health Organization 2018
28. Onodugo, O.D, Ezeala-Adikaibe, B.A., Anyim, O.B., Ezeme, M., Ijoma, U.N., Obumneme-Anyim, I.N et al. Prevalence and Pattern of Alcohol Use among Adults in an Urban Slum in South East Nigeria. Open Journal of Psych 2019, 9, 179–191. https://doi.org/10.4236/ojpsych.2019.92014
29. Onodugo O D, Orjioke C, Obumneme B A, Ezeala-Adikaibe B A, Chime P, Onodugo P N et al. Correlates of Tobacco and Marijuana Use among Urban Dwellers in Enugu, Nigeria. Open Journal of Preventive Medicine, 2019, 9, 80–94.
30. Amole IO, OlaOlorun AD, Odeigah LO, Adesina SA. The prevalence of abdominal obesity and hypertension amongst adults in Ogbomoso, Nigeria. *Afr J Prim Health Care Fam Med*. 2011;3(1):188.
31. Bello-Ovosi BO, Asuke S, Abdulrahman SO, Ibrahm MS, Ovosi JO, Ogusina MA, et al. Prevalence and correlates of hypertension and diabetes mellitus in an urban community in North-Western Nigeria. *Pan Afr Med J*. 2018;29:97.
32. Olamoyegu MA, Oluyombo R, Iwuala SO, Asaolu SO. Epidemiology and patterns of hypertension in semi-urban communities, south-western Nigeria. *Cardiovasc J Afr*. 2016;27(6):356–360.
33. Sawya A L. Sesso R, Florencio T M, Fernandes M T B, Martins P A. Association between chronic undernutrition and hypertension. 2005 *Maternal and Child Nutrition*, 1, pp. 155–163
34. Okeke C, Uzochukwu B, Nawfal E, Abada E, Uzochukwu B. Prevalence of Hypertension and awareness of the causes and effects of Hypertension in rural and urban communities of Enugu State

Nigeria. International journal of scientific and technology research 2017; 6(12):29–31

35. Hendriks ME, Wit FWNM, Roos MT, Brewster LM, Akande TM, de Beer IH et al. Hypertension in Sub-Saharan Africa: Cross-Sectional Surveys in Four Rural and Urban Communities. PLoS ONE 2012;7(3): e32638. doi:10.1371/journal.pone.0032638.
36. Gaye B, Janeczek A-L, Narayanan K, N'Guetta R, Vignac M, Gallardo V et al. Prevalence of severe hypertension in a Sub-Saharan African community Int J Cardiol Hypertens2019; 2: 100016
37. Guwatudde D, Nankya-Mutyoba J N, Kalyesubula R, Carien L, Adebamowo C, Ajayi I, Bajunirwe F et al. The burden of hypertension in sub-Saharan Africa: a four-country cross sectional study BMC Public Health 2015; 15:1211 DOI 10.1186/s12889-015-2546-z
38. Adebayo A A. Balogun M O, Adedoyin R, Oluwayemisi A O. Bisiriyu L A. Abiodun O O. Prevalence of hypertension in three rural communities of Ife North Local Government Area of Osun State, South West Nigeria. Int J Gen Med 2013; 6: 863–868.
39. Isara A R, Okundia P O. The burden of hypertension and diabetes mellitus in rural communities in southern Nigeria. Pan Afr Med J. 2015; 20:103.
40. Orji I A, Ikechukwu-Orji M U. Burden of Hypertension and Associated Risk Factors in Rural Communities of Abuja. Texila Int J Pub Health 2019; 7(1) DOI: 10.21522/TIJPH.2013.07.01.Art004
41. Ibama AS, Uzondu PU, Amadi AN, et al. Prevalence of Hypertension Among Adults in Rural Setting in Nigeria: The Need for Paradigm Shift in Prevention and Control. Med Clin Case Rep. 2021; 1(1): 1–8.
42. Wada OZ, Olawade DB, Afolalu TD, Oluwatofarati AO, Akinwalere IG (2020) Prevalence of Hypertension among Rural Adults and Availability of Management Services in Abimbola Community, Ayedaade Local Government Area, Osun State, Nigeria. J Hypertens Manag 6:046. doi.org/10.23937/2474-3690/1510046
43. Adediran O S, O I Chinyere, Stephen A O, Kayode J A. Hypertension prevalence in an Urban and Rural area of Nigeria. J Med Med Sci 2013; 4(4): 149–154.
44. Ahaneku GI, Osuji CU, Anisiuba BC, Ikeh VO, Oguejiofor OC, et al (2011). Evaluation of blood pressure and indices of obesity in a typical rural community in eastern Nigeria. Ann Afr Med. 10: 120–126.
45. Pereira M, Lunet N, Azevedo A, Barros H. Differences in prevalence, awareness, treatment and control of hypertension between developing and developed countries. J Hypertens 2009; 27: 963–975.
46. Maher D, Waswa L, Baisley K, Karabarinde A, Unwin N. Epidemiology of hypertension in low-income countries: a cross-sectional population-based survey inrural Uganda. J Hypertens 2011; 29: 1061–1068.
47. Kayima J, Wanyenze RK, Katamba A, Leontsini E, Nuwaha F. Hypertension awareness, treatment, and control in Africa: a systematic review. BMC Cardiovasc Disord 2013; 13: 54.
48. WHO 2011,(World Health Organisation. Global Health Risks: Mortality and Burden of Disease Attributable to Selected Major Risks. WHO: Geneva, Switzerland, 2009.).
49. Stamler J, Elliott P, Appel L, Chan Q, Buzzard M, Dennis B, for the INTERMAP Research Group, et al. Higher blood pressure in middle-aged American adults with less education—role of multiple dietary

factors: The INTERMAP Study. J Hum Hypertens 2003; 17: 655–775.

50. Zajacova A, Lawrence E M. The relationship between education and health: reducing disparities through a contextual approach. Annu Rev Public Health. 2018 April 01; 39: 273–289. doi:10.1146/annurev-publhealth-031816-044628.

51. Zimmerman E, Woolf E H. Understanding the Relationship Between Education and Health Discussion Paper June 5 201 4. National Academy of Sciences 2014

Figures

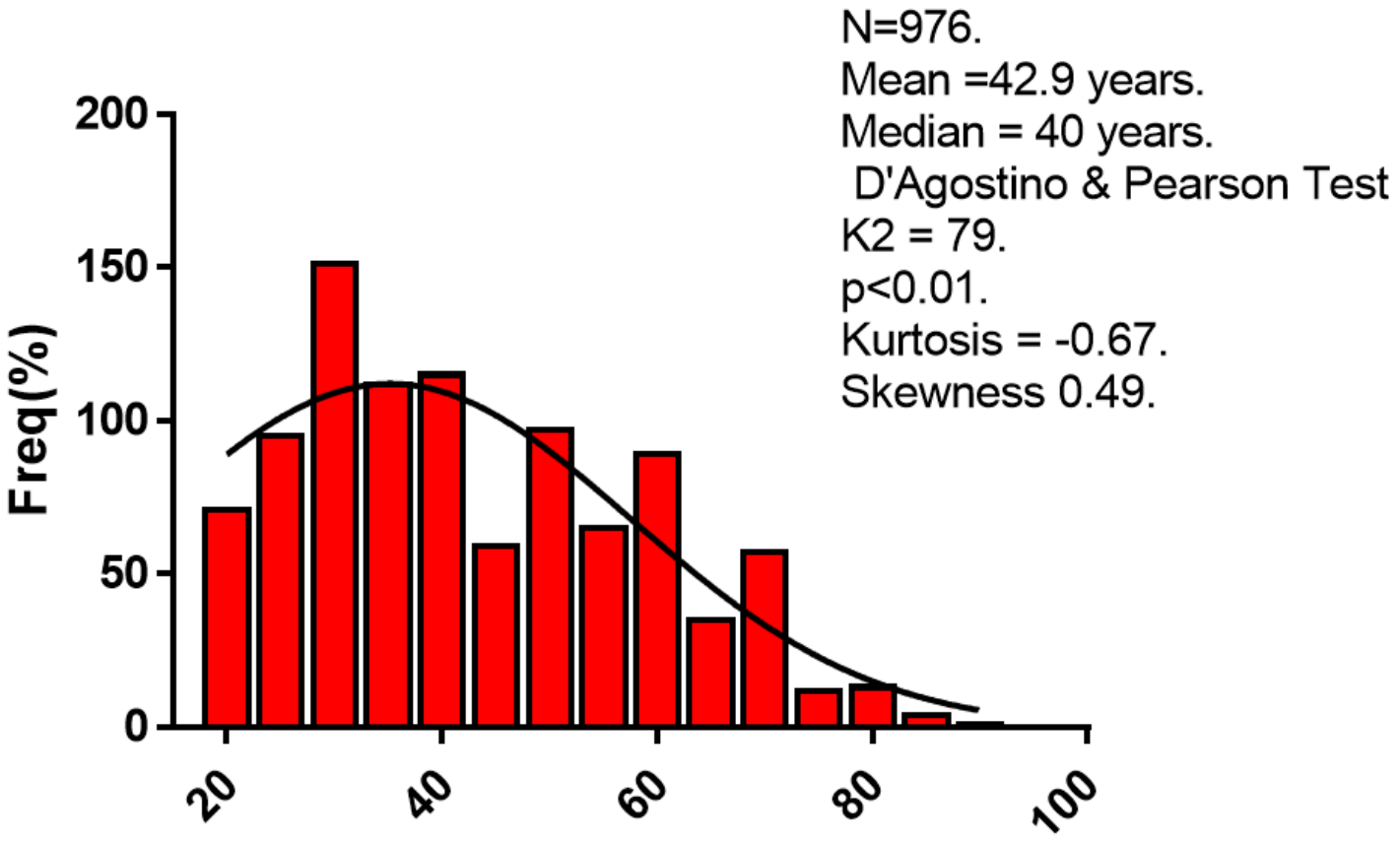

Figure 1

Age distribution of the population.

Figure 2a Mean Blood pressure measurement in Females

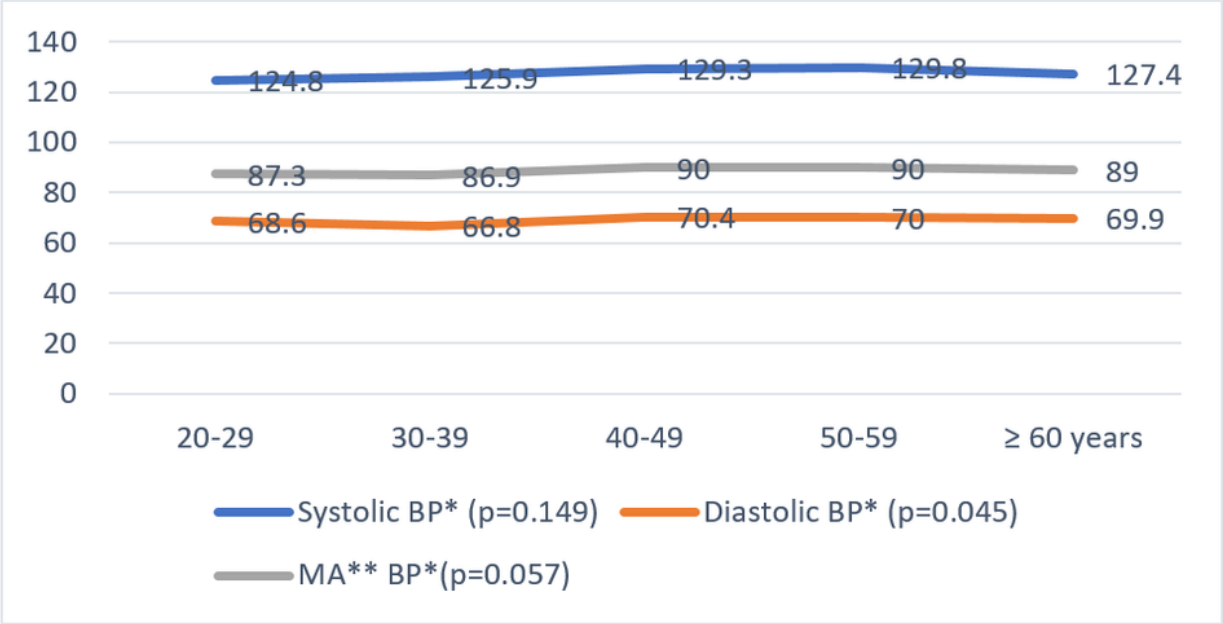

Figure 2b. Figure Mean Blood pressure measurement in Males

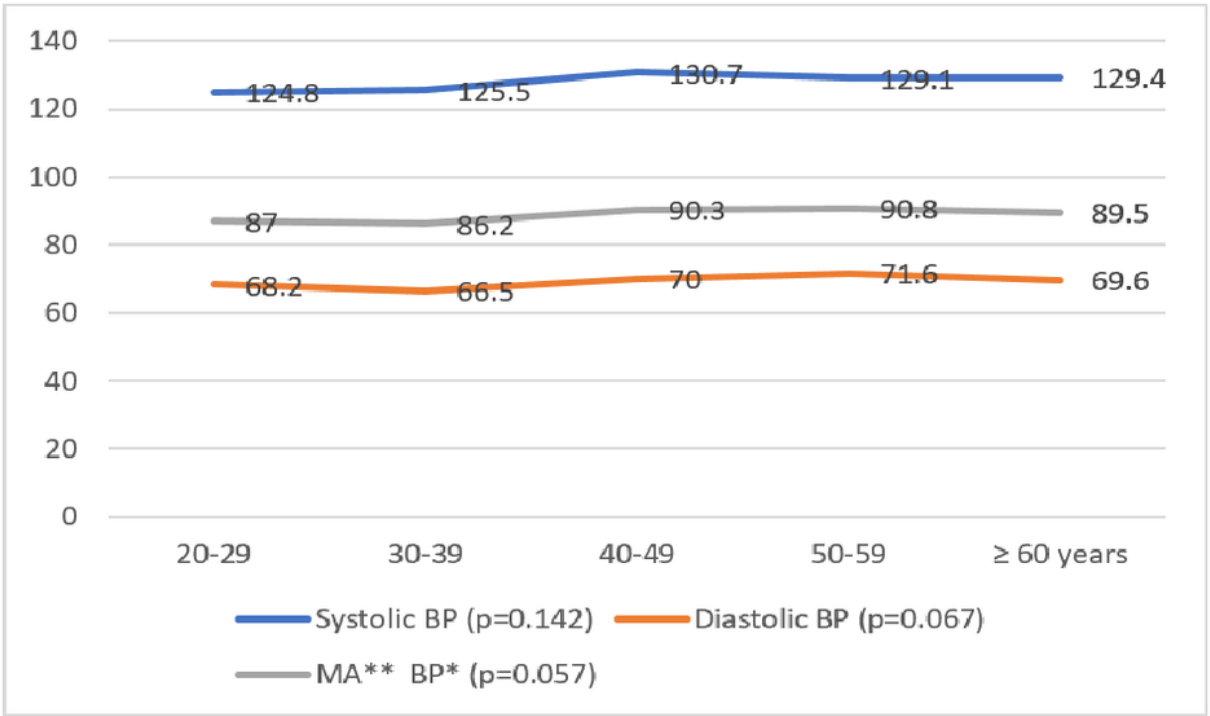

Figure 2

Age distribution of blood pressure measurements among the population.

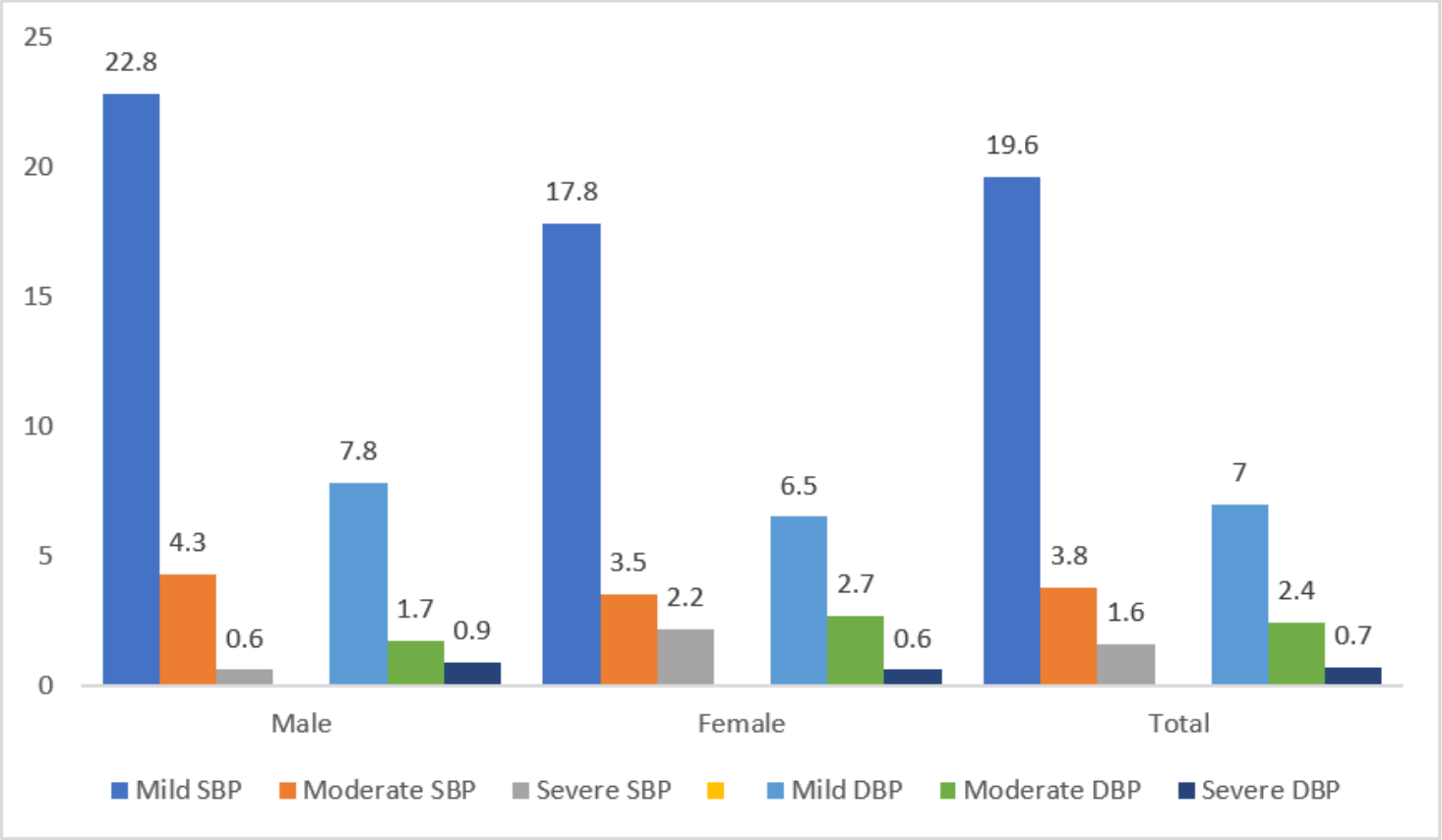

Figure 3

Distribution of blood pressure measurements by severity.

Supplementary Files

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- Flowchart.png