Nigerian Journal of Paediatrics, **6** (1), 18–26

Prevalence of Adolescent Hypertension in Nigeria

E. Ayobanji Ayoola

Department of Medicine, University College Hospital, Ibadan, Nigeria

Summary

Ayoola E. A. (1979). *Nigerian Journal of Paediatrics*, **6(1), 18. Prevalence of Adolescent Hypertension in Nigeria.** The frequency distribution of arterial blood presures in 487 Nigerian adolescents is presented. Mean systolic blood pressure (SBP) for this group was 106.5 ± 11.8 mm Hg. while mean diastolic blood pressure (DBP) was 61 ± 9 mm Hg. Adopting values greater than 150/90 mm Hg as elevated blood pressure, one per cent of this population may be considered 'hypertensive'. The prevalence rate rose to 3.3 per cent when elevation of blood pressure was defined as values in excess of 2 standard deviations above the mean blood pressure. It is suggested that a reference blood pressure level be identified for a particular age group, that this level be adopted to define hypertension in such a group, and that frequent school surveys are effective for early detection of hypertension.

It is now well established that systemic hypertension is common in West Africa (Akinkugbe, 1969; Akinkugbe, 1972) and it appears to be one of the most important causes of morbidity and mortality among the adult population (Osuntokun, 1969; Pickering, 1972; Wilber and Barrow, 1972). Yet, a majority of hypertensive patients are presently undetected and untreated (Report of Intersociety Commission, 1972) and in most instances, the exact onset of hypertension is unknown.

Despite several epidemiological reports on detection and prevalence of hypertension in adult population, there is paucity of information on adolescent hypertension in many parts of the world (Loggie, 1974; Kilcoyne, 1975). Few reports from Nigeria have concerned themselves with blood pressure (BP) levels in the adolescents and very often this group of subjects is lumped with adults, and findings interpreted against the background of features of adult blood pressure patterns.

The problem is further complicated by the fact that no 'normal' blood pressure levels have yet been established for adolescents. "Norms" obtained from countries which differ in racial and environmental factors cannot be interchangeable. Therefore, until data obtained from many areas can attain evidence of broad applicability, the characterization of race-sex-age distribution in the frequency distribution of blood pressure in a particular community is germane to the detection of early hypertension, since a group reference level, however imprecise for the individual can be useful for purposes of mass screening.

The specific prevalence rate of adolescent hypertension is unknown. Reported values have varied widely. Factors responsible for this disparity include variation in sample size and age

groups, and the use of arbitrary criteria for defining hypertension. Previous studies have shown that the frequency distribution of blood pressures in normal adolescents is generally lower than in normal adults (Kilcoyne, 1975). Therefore, the criteria selected to define hypertension in a maturing circulation of the adolescent would be more meaningful if related to an observed frequency distribution for the particular group.

The present study was therefore designed to determine the frequency distribution of blood pressures in Nigerian adolescents, and to determine the prevalence rate of elevated blood pressure in this age group.

Subjects and Methods

The study was conducted in Ile–Ife, Oyo State, Nigeria. This University town, about 200 kilometers north-west of Lagos, has a population of about 100,000 people. Most of the inhabitants are farmers, traders and teachers.

Four hundred and eighty-seven adolescents consisting of 294 males and 193 females whose ages ranged between 11 and 19 years comprised the subjects of this study. They were all attending three selected coeducational post–primary institutions situated in the town.

Two visits were made to each class and all investigations were carried out between 0900 and 1300 in quiet non air–conditioned classrooms. On the first visit, the subjects were familiarised with the objective of the study, with the equipment and the investigators. Personal data including age, sex, weight and height were obtained. Significant symptoms, past medical history and family history were noted.

On the second visit, usually two days after the first, blood pressure (BP) readings were taken by one of three observers using a standard sphygmomanometer with a cuff size of 12cm by 25cm. Each measurement was taken in a sitting position on the right arm of the subject, after he had rested for at least 30 minutes. Each reading was repeated three times and the mean was taken as the systemic arterial blood pressure (Armitage *et al.*, 1966).

The systolic blood pressure (SBP) was determined by the appearance of the Korotkoff sound (Phase 1), while the diastolic blood pressure (DBP) was taken at the point of disappearance of the sound (Phase V) in accordance with the recommendation of the American Heart Association (DeGowin and Degowin, 1969). During pre-study trials, there was better agreement between the observers in determing DBP with this point than with phase IV (muffling point of the sound).

Results

Frequency Distribution of Blood Pressures

The mean blood pressure levels are shown in Table I. The pattern of distribution of the SBP and DBP in both sexes are represented in Figure 1. Blood pressures tended to increase gradually with age and assumed adult "patterns" by the age of 19 years.

The frequency distribution of SBP and DBP in males and females is shown in Figures 2 and 3. There was no significant difference between the sexes. Mean SBP values were 106.2 ± 12 mm Hg for males and 106.9 ± 11 mm Hg for females. The mean SBP was 106.5 ± 11.8 mm Hg for both sexes combined. Similar values for mean DBP were 59.9 ± 8.8 mm Hg for males and 62.7 ± 9.5 mm Hg for females. The mean DBP for both sexes combined was 61 ± 9 mm Hg.

Relationship between blood pressure, height and weight

Table II summarises the heights and weights by age and sex. Both parameters tended to increase gradually with increasing age. Males were heavier than females until the age of 17 years when the position reversed. Females were taller between the ages of 12 and 15 years, and the position reversed at ages 18 and 19 years.

TABLE 1

Blood Pressure (BP) Levels according to Age and Sex (Mean ± S.D.)

Age (Years)	*SYSTOLIC B.P. (mm Hg)*			*DIASTOLIC B.P. (mm Hg)*		
	Males	*Females*	*Both*	*Males*	*Females*	*Both*
11	–	(4) 103.8 ±9.6	–	–	(4) 59.5 ± 10.5	–
12	(33) 103.8 ± 10.2	(20) 103.5 ± 12.8	(53) 103.7 ± 11.3	(33) 58.8 ± 10.2	(20) 62.3 ± 10.3	(53) 60.1 ± 10.2
13	(38) 99.7 ± 9.9	(48) 105.1 ± 10.4	(86) 102.7 ± 10.2	(38) 55.7 ± 7.4	(48) 60.7 ± 8.2	(86) 58.5 ± 7.9
14	(56) 104.0 ± 11.9	(42) 105.6 ± 10.2	(98) 104.7 ± 11.4	(56) 57.9 ± 9.6	(42) 58.7 ± 8.7	(98) 58.2 ± 9.2
15	(75) 107.1 ± 14.7	(37) 108.8 ± 11.8	(112) 107.7 ± 13.8	(75) 61.4 ± 9.2	(37) 66.6 ± 10.6	(112) 63.1 ± 9.7
16	(52) 108.5 ± 12.5	(24) 110.0 ± 8.7	(76) 109.0 ±8.1	(52) 60.7 ± 8.1	(24) 64.0 ± 11.2	(76) 62.6 ± 9.2
17	(17) 108.8 ±6.8	(10) 110.0 ± 11.4	(27) 109.6 ±8.8	(17) 62.6 ±6.0	(10) 64.0 ± 9.4	(27) 63.3 ± 7.4
18	(18) 113.6 ±9.4	(3) 106.7 ±9.4	(21) 112.6 ±9.4	(18) 62.2 ± 6.5	(3) 66.7 ± 4.7	(21) 62.8 ± 6.3
19	(5) 125.0 ± 17.3	(5) 113.0 ± 20.5	(10) 119.0 ± 18.9	(5) 74.6 ± 11.9	(5) 65.0 ± 8.9	(10) 69.8 ± 10.5

Figures in parenthesis represent the number of subjects.

The Pearson Correlation Coefficient between the three parameters are presented in Tables III and IV. When all ages were combined there was significant correlation ($p<0.05$) between these parameters, except between diastolic BP and height in females (Table V).

Prevalence rates of adolescent 'Hypertension'

The number of adolescents with raised BP is summarised in Table VI. Defining hypertension as levels greater than 150/90mm Hg (Jagger and Branwald, 1977) 5 of 487 adolescents (1.0 per cent) had elevated SBP while 6 (1.2 per cent) had elevated DBP. However, when elevated levels were taken as values in excess of two standard deviations above the mean blood pressure for each group, 16 adolescents (3.3 per cent) had elevated BP.

Discussion

One of the advantages of studying this particular group of subjects is avoidance of the usual difficulty among Nigerian adults of obtaining exact ages. The introduction of free primary education, and the improvement of maternity and birth registration services over the last two decades have made it relatively easy to ascertain age.

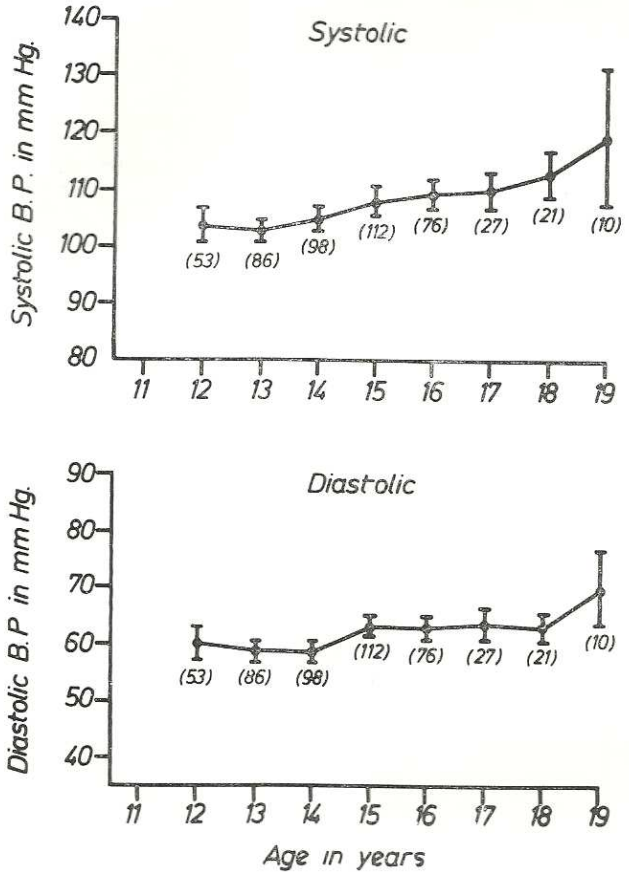

Fig. 1. Mean ± 2SE of Systolic and Diastolic BP according to age. Note the gradual increase in the pressures.

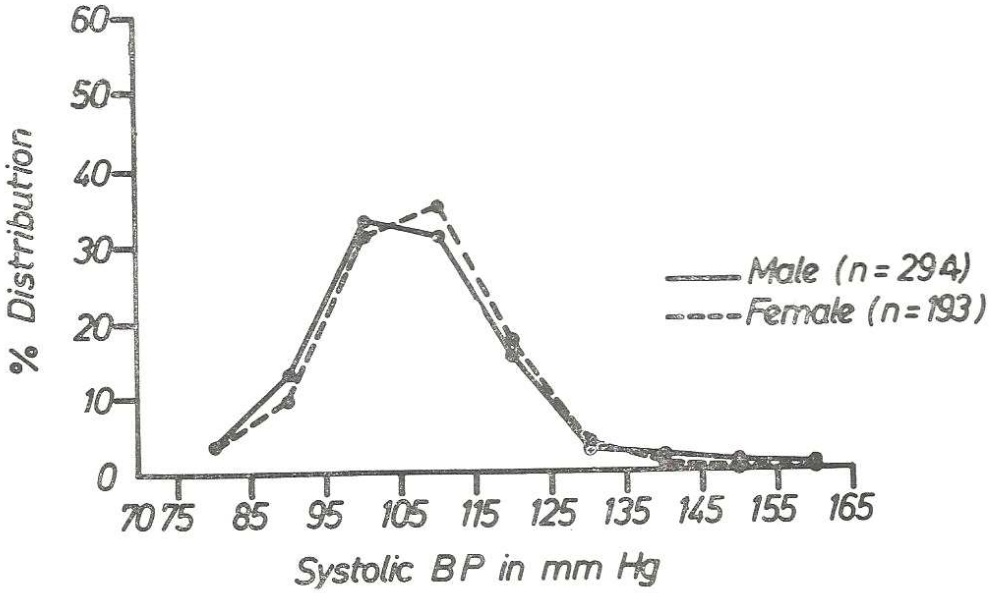

Fig. 2. Frequency distribution of systolic BP in males and females. Note that there is no significant difference between the sexes.

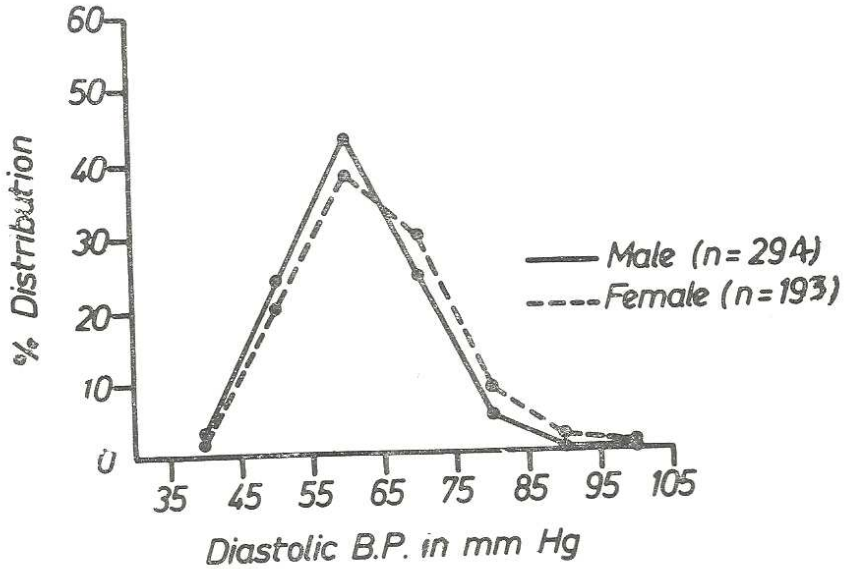

Fig. 3. Frequency distribution of diastolic BP in males and females. There is no difference between the sexes.

TABLE II

Weight (Kgs) and Height (cms) by Age and Sex (Mean ± SD)

Age (Years)	*Weight (Kg)* *Males*	*Females*	*Both*	*Height (cm)* *Males*	*Females*	*Both*
11	–	35·3 (3) ± 2.6	–	–	142.4 (3) ±4.4	–
12	34·9 (32) ± 5·9	38.3 (18) ± 5.8	36.1 (50) ± 5·9	140.2 (32) ±9.6	143.8 (18) ± 7.5	141.5 (50) ±7.6
13	36.8 (37) ± 7.5	40.5 (47) ± 5.6	38.9 (84) ± 6.5	141.4 (37) ±8.9	146.4 (47) ±6.7	144.2 (84) ±7.7
14	38.5 (51) ± 7.6	41.9 (41) ± 5.4	40.0 (92) ± 6.7	143.6 (51) ±12.4	146.2 (41) ±8.9	144.8 (92) ±11.0
15	43.0 (67) ± 6.7	45.9 (32) ± 8.0	43.9 (99) ± 7.1	150.0 (68) ±9.1	149. (33) ±9.09	150.0 (101) ±9.1
16	45.7 (46) ± 8.2	48.7 (16) ± 4.1	46.5 (62) ± 7.4	152.2 (48) ±11.8	152.0 (17) ±5.4	152.1 (65) ±11.5
17	49.5 (13) ± 8.3	47.9 (9) ± 6.9	48.8 (22) ± 7.8	154.7 (140) ±8.7	151.0 (9) ±9.9	153.3 (23) ±9.2
18	53.6 (16) ± 8.1	50.7 (3) ± 3.1	53.1 (19) ± 7.5	160.0 (16) ±9.2	154.7 (3) ± 3.8	159.2 (19) ±8.6
19	56.6 (5) ± 4.7	57.0 (4) ± 5.2	56.8 (9) ± 4.9	158.7 (5) ±4.8	155.6 (4) ±5.6	157.3 (9) ±5.2

Figures in parenthesis represent the number of subjects.

TABLE III

Pearson Correlation Co-efficient (r) between Systolic (SBP), Diastolic (DBP) Blood Pressures (mm Hg) and Weight (Kg)

Age (Years)	*Males* *No. of Subjects*	*SBP*	*DBP*	*Females* *No. of Subjects*	*SBP*	*DBP*
	n	*r*	*r*	*n*	*r*	*r*
11	–	–	–	3	0.85	0.63
12	32	0.53*	0.36*	18	0.36	0.43
13	37	0.11	0.20	47	0.57*	0.42*
14	51	0.44*	0.44*	41	0.38*	0.25
15	67	0.27*	0.04	32	0.36*	0.32
16	46	0.54*	0.41*	16	0.10	–0.02
17	13	0.44	0.12	9	0.72*	0.79*
18	16	0.44	0.38	3	–0.38	–0.99
19	5	0.45	0.32	4	0.37	0.06
All ages	268	0.44*	0.35*	173	0.35*	0.36*

* = $p < 0.05$

TABLE IV

Pearson Correlation Coefficient (r) between Systolic (SBP), Diastolic (DBP) Blood Pressures (mm Hg) and Height (cm)

	Males			*Females*		
Ages (Years)	*No. of Males*	*SBP*	*DBP*	*No. of Females*	*DBP*	*SBP*
	n	*r*	*r*	*n*	*r*	*r*
11	–	–	–	3	0.39	0.06
12	32	0.45*	0.41*	18	0.46	0.24
13	37	0.36*	0.03	47	0.29	0.06
14	51	0.40*	0.46*	41	0.38*	0.26
15	68	0.29*	0.07	33	0.17	0.02
16	48	0.47*	0.27	17	–0.36	0.31
17	14	0.07	0.18	9	0.45	0.14
18	16	–0.19	–0.25	3	1.00	0.50
19	5	–0.35	0.37	4	–0.04	–0.20
All ages	272	0.39*	0.29*	175	0.29*	0.18

* = P<0.05

TABLE V

Summary of Pearson Correlation (r) between Blood Pressure, Weight and Height by Age and Sex in Nigerian Adolescents

	Systolic BP and		*Diastolic BP and*	
	Weight	*Height*	*Weight*	*Height*
Male (n=272)	0.44*	0.39*	0.35*	0.29*
Female (n=175)	0.35*	0.29	0.36*	0.18

* = p<0.05

TABLE VI

Number and percentage of Nigerian Adolescents with raised BP

		SYSTOLIC BP				*DIASTOLIC BP*			
		BP > 150mm Hg		BP > $\bar{x}$ + 2SD		BP > 90mm Hg		BP > $\bar{x}$ + 2SD	
	No. of Subjects	*No*	*Percent of total*	*No*	*Percent of total*	*No*	*Percent of total*	*No*	*Percent of total*
Males	294	4	1.4	10	3.4	2	0.7	10	3.4
Females	193	1	0.5	6	3.1	4	2.1	6	3.1
Total	487	5	1.0	16	3.3	6	1.2	16	3.3

$\bar{x}$ = mean; SD = Standard Deviation

It is not yet universally agreed whether the muffling (phase IV) or the disappearance (phase V) of Korotkoff sound truly represents the diastolic blood pressure. This has led to the suggestion that both points should be recorded (DeGowin and Degowin, 1969). In the pre-study trials however, a better agreement was found among observers when phase V was taken as the diastolic BP.

There are very few reports from Nigeria of blood pressure which include the adolescent group (Akinkugbe, 1969; Akinkugbe, 1972; Etta and Watson, 1976). Several factors including small sample size, the use of different phases to determine diastolic blood pressure and variation in the age definition of adolescence have made comparative analysis difficult. Correcting for these factors, the frequency distribution of blood pressures in the present series is comparable to the findings in previous reports from Nigeria (Akinkugbe, 1969; Akinkugbe, 1972; Etta and Watson 1976) and elsewhere (Loggie, 1974; Kilcoyne, Ritcher, and Alsup 1974; Heyden, *et al.*, 1969).

Both systolic and diastolic BP levels rose with age in the present study. This is in agreement with previous observation in a Nigerian community (Oyediran, *et al.*, 1976). In contrast to the observation of Akinkugbe (1969), definite relationship was found between blood pressure, heights and weights except between height and diastolic blood pressure in females. The latter observation cannot be easily explained although it is possible that the growth spurt at puberty may dissociate from a steady maturation of adolescent circulation.

Reported rates of adolescent hypertension vary from 0 - 36 per cent (Akinkugbe, 1972; Kilcoyne 1975; Etta and Watson, 1976; Heyden *et al.*, 1969; Kotchen, Schwertman, Kuller, 1974). Apart from factors discussed above, differences related to race, sex, age and environmental factors may further contribute to this wide disparity. Furthermore, the use of adult criteria—an arbitrary dividing line — to define hypertension may indeed underestimate the true prevalence of adolescent hypertension. The latter problem is emphasised by the present study where the prevalence rate of hypertension increased significantly when group reference level was used to define elevation. It also minimises the usually over-emphasised differences in rates between the two sexes.

Although serial measurements appear to be more accurate in detecting hypertensive adolescents and defining prevalence rates (Kilcoyne, Ritcher and Alsup, 1974), individuals with significant elevation of BP on a casual observation deserve further longitudinal evaluation. Such repeated screening may indeed provide further information on the evolution of hypertension which may have its onset in adolescence.

Hypertensive adolescents tend to suffer higher morbidity from uncontrolled hypertension on a long term follow-up (Heyden, *et al.*, 1969). Therefore, no efforts should be spared in detecting and treating adolescent hypertension in any community. It is suggested that routine blood pressure screening within the school system would appear to be an effective means for early detection of hypertension. This screening method should be adopted in Nigeria using a group reference level to determine blood pressure elevation.

Acknowledgements

The statistical analysis in this paper was performed by Dr O. Ayeni of the Medical Statistics Unit, Department of Preventive and Social Medicine, University College Hospital, Ibadan. To him I express my deepest gratitude. I am grateful to Dr (Miss) A. A. Adeniyi, Mrs J. Osinowo R.N., Mrs Akintuyi R.N., and Medical Students of the Faculty of Health Sciences, University of Ife, for their assistance. I thank Miss A. O. Ayoade for her secretarial assistance.

References

Akinkugbe, O. O. (1969). School Survey of Arterial Pressure and Proteinuria In Ibadan, Nigeria. *E. Af. Med. J.* **46**, 257–261.

Akinkugbe, O. O. (1972). In: High Blood Pressure in the African. 1st ed., pp 31–80. Churchill Livingstone, Edinburgh & London.

Armitage, P., Fox, W., Rose, G. A. and Tinker, C. M. (1966). The Variability of Measurements of casual blood pressure. *Clin. Science*, **20,** 331–334.

DeGowin E. L. and DeGowin R. L. (1969). Measurement of Arterial Blood Pressure: In Bedside Diagnostic Examination 2nd ed. pp. 378–382. The Macmillans C. London

Etta, K. M., and Watson, K. M. (1976). Casual Blood Pressure and their possible relation to age, body weight, Quetelet's index, Serum Cholesterol, percentage of body fat and mid-arm muscle circumference in three groups of northern Nigerian residents. *Afr. J. Med. Sci.*, **5,** 255–262.

Heyden, S., Bartel, A. G., Hames, G. G., and McDonough, J. R. (1969). Elevated Blood Pressure levels in Adolescents, Evans County, Georgia, *JAMA*, **209,** 1683–1689.

Jagger, P. and Braunwald, E. (1977). Hypertensive vascular disease. In Principles of Internal Medicine. 8th ed. pp 1307–1318. McGraw - Hill Int.

Kilcoyne, M. M. (1975). Adolescent Hypertensive (Editorial). *Am. J. Medicine*, **58,** 735–739.

Kilcoyne, M. M., Richter, R. W. and Alsup, P. A. (1974). Adolescent Hypertension 1. Detection and prevalence. Circulation, **50,** 758–764.

Kotcher, T. A., Schwertman, N. C. and Kuller, L. H. (1974). Blood Pressure Distribution of Urban Adolescents. *Am. J. Epidemiol.*, **99,** 315–324.

Loggie, J. M. H. (1974). Hypertension in Children and Adolescents: Causes and Diagnostic Studies. *J. Pediatrics*, **74,** 331–355.

Osuntokun, B. O. (1969). Non-Embolic Ischaemic Cerebrovascular Disease in Nigerians. *J. Neurol. Sci.* **9,** 361–388,

Oyediran, A. B. O. , Osuntokun, B. O., Akinkugbe, O. O., Carlisle, R., Bademosi, O., and Olatunde, I. A. (1976). Community Control of Hypertension. Results in Epe of Blood Pressures and Urinary Survey, and Preliminary Response to Control Measures. *Nig. Med. J.*, **6,** 248–253.

Pickering, G. (1972). Hypertension - Definitions, Natural Histories and Consequences. *Am. J. Med.*, **52,** 570–583.

Report of Intersociety Commission for Heart Disease Resources: Guidelines for the detection, diagnosis and management of hypertensive population (1971). Circulation, **44,** A237.

Wilber, J. A. and Barrow, J. G. (1972). Hypertension–A Community Problem. *Am. J. Med.*, **52,** 653–663.