SEASONAL VARIATION IN HOSPITALISATION FOR HYPERTENSION-RELATED MORBIDITIES IN SOKOTO, NORTH-WESTERN NIGERIA

ABSTRACT

Objective. To determine the relationship between hospital admissions of hypertension-related morbidities, seasons and meteorological factors in a tropical climate.

Study Design. Retrospective analysis of hospitalised patients (440) with hypertension-related morbidities including heart failure (36.4 %), stroke (34.8 %), chronic renal failure (7.1 %) and others (21.7 %) from 1995 to 2000. The relationship between hospital admission, seasons and meteorological factors was determined using simple proportions, univariate, multivariate and regression analysis.

Results. The subjects were aged 21-85 years and represented 9.3 % of all hypertensives and 7.0 % of medical admissions. Mean blood pressure was 187.3±34.0/120±23 mmHg. Mild, moderate and severe hypertension occurred in 30 (6.8 %), 59 (13.4 %) and 351 (79.8 %) patients, respectively. The monthly admission rate ranged from 3-11; (mean 6.1±1.9) patients. Admission rates peaked in January/February and August/September, corresponding with the peaks of harmattan and the wet seasons, respectively. Mean monthly admission rates were significantly higher during harmattan than during the hot season (6.7±2 versus 5.2±1.4 patients; p < 0.05), and during wet season than during the hot season (6.4±1.9 versus 5.2±1.4 patients; p < 0.05). Considering the hypertensives as a whole, a significantly higher proportion of patients was hospitalised during the cold season than during the hot season (11% versus 8.2%; odds ratio = 1.34). Linear regression analysis showed that hospital admission was significantly associated with the monthly minimum temperature (p = 0.02) and solar radiation (p = 0.01). Multiple regression analysis revealed that hospital admission was also significantly associated with combined meteorological factors (temperature, radiation, dust haze days and relative humidity) (p = 0.04).

Conclusions. Hospital admissions of patients with hypertension-related morbidities showed seasonal variation. Appropriate clothing and health planning during cold seasons are recommended.

Key words: Hypertension-related morbidity, seasonal variation

S A Isezuo

Department of Medicine,
Usmanu Danfodiyo University
Teaching Hospital,
Sokoto, Nigeria.
INTRODUCTION

Systemic hypertension (hypertension) is common among Nigerians, the prevalence rates being between 10% and 15% (1). Epidemiological and laboratory data suggest that essential hypertension is the dominant form of hypertension in this population. Its pathogenesis is strongly linked with an interplay between genetically determined salt-sensitivity and environmental factors (1, 2). The pressor effect of salt is attributed to volume overload and calcium-induced vascular hyper-reactivity, resulting in increased cardiac output and peripheral resistance, respectively (2). Hypertension is frequently undiagnosed among Black Africans until complications arise. This is because of the asymptomatic nature of hypertension, ignorance and poor access to health care facilities. Hence, hypertension-related conditions, particularly heart failure, stroke, chronic renal failure and, less commonly, coronary artery disease, are frequent indications for hospital admissions (3-6).

Hypertension-related morbidities correlate with blood pressure levels (4-7). Seasonal variations in arterial blood pressure among normotensives and hypertensives have been documented in temperate countries (8). Ambulatory daytime blood pressures are, for example, higher during winter than in the summer (9). In Jos, central Nigeria, blood pressure tends to rise among hypertensives during cold weather (Okeahalam BN, Nigerian Cardiac Society Conference, Enugu, 2000). Seasonal differences in blood pressure have been attributed to cold-induced increases in blood pressure levels. Jansen et al. (10) reported a significant rise in systolic and diastolic blood pressures among normotensives moving from areas of high ambient temperature to cooler areas. Whole body exposure to cold at −15 °C, three times for 15 minutes, with a one-week interval between exposures, resulted in a rise in blood pressure among normotensives (from 119/75 mmHg to 143/96 mmHg) and hypertensives (from 132/85 mmHg to 159/100 mmHg) (11).

The mechanisms underlying cold-induced increases in blood pressure include thermoregulatory vasoconstriction, resulting from increased adrenaline and nor-adrenaline levels and peripheral resistance (12).

Information on the variation of hypertension-related morbidities with different climatic conditions is scarce in sub-Saharan Africa. The north-western region of Nigeria (West Africa) is located between latitudes 11:00 °N and 14:00 °N, and longitudes 4:00 °E and 7:00 °E. It is characterized by three distinct seasons, including harmattan...
(November-February), the hot season (March-May) and the wet season (June-October). Extremes of temperatures are recorded. The harmattan and wet seasons are cold, with average monthly minimum temperatures of 15.5 °C and 23.2 °C, respectively. During the hot season, the average monthly minimum temperature is about 30 °C, while the monthly mean maximum is 41.4 °C, but can be as high as 45 °C (13).

Usmanu Danfodiyo University Teaching Hospital, a referral centre in Sokoto, north-western Nigeria, has a catchment population of about 10 million. This study aims to determine the relationship between hypertension-related morbidities and seasons in this centre.

METHODS

The records of 4,731 patients diagnosed as having systemic hypertension in Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria (West Africa), from 1st January 1995 to 31st December 2000, were reviewed for seasonality of hospital admissions for hypertension-related morbidities. A systolic blood pressure ≥ 140 mmHg and/or a diastolic blood pressure ≥ 90 mmHg were required to make a diagnosis of systemic hypertension (14).

Major outcome measures included hospital admission, a hypertension-related condition, elevated blood pressure and climatic conditions during admission. A patient with hypertension as defined above and any of its complications, or conditions (heart failure, stroke, chronic renal failure, hypertensive encephalopathy, transient ischaemic attack and coronary artery disease), was considered to have hypertension-related morbidity, after exclusion of other causes of such conditions. The diagnoses of hypertension-related complications were clinical, except for chronic renal failure, which required biochemical evidence.

Indications for hospital admission included clinical evidence of severe underlying hypertension-related morbidity and an elevated blood pressure (systolic pressure > 140 mmHg and/or diastolic pressure > 90 mmHg). Hypertension was categorised into 3 groups: mild (systolic pressure of 140-159 mmHg and/or diastolic pressure of 90-99 mmHg); moderate (systolic pressure of 160-179 mmHg and/or diastolic pressure of 100-109 mmHg); and severe (systolic
pressure ≥ 180 mmHg and/or diastolic pressure ≥ 110 mmHg) (13). The month of admission was recorded and the season of admission was determined as follows: harmattan (November-February); hot season (March-May) and wet season (June-October).

Meteorological data on temperature, radiation, humidity and the occurrence of dust haze in north-western Nigeria during the study period was obtained from the Meteorological Departments of Sokoto Energy Research Centre, Usmanu Danfodiyo University, Sokoto and Nigerian Aviation Authority, Sokoto, Nigeria. The relationship between hospitalisation rate, seasons and meteorological factors was determined.

Six hundred and eighty-eight (688) normotensives with non-hypertension-related morbidities (peptic ulcer disease and tuberculosis) hospitalised during the same period served as controls. They were matched with the patients by sex and age, using group matching and age intervals of 5 years.

Statistical analyses
Data was fed into an IBM-compatible computer using the SPSS statistical software. Data analysis was performed by simple proportion. Mean values are presented with their respective standard deviations (SD) in brackets. Mean monthly hospital admissions were compared between two groups, and between two or more groups, using student’s t-test and analysis of variance (ANOVA), respectively. The c² test was used to compare proportions between two groups. Association between hospital admission and meteorological factors was tested by regression analysis. A p-value < 0.05 was considered to be statistically significant.

RESULTS

Four thousand seven hundred and thirty-one (4731) patients were diagnosed as having systemic hypertension during the study period. Of these, 440 (9.3 %) were hospitalised for hypertension-related morbidities and elevated blood pressure. This represented 7 % of total medical admissions. Hypertension-related morbidities requiring admission included heart failure 160 (36.4 %), stroke 153 (34.8 %), chronic renal failure 31 (7.1 %), and others (including hypertensive encephalopathy, coronary artery disease and transient ischaemic attack) 96 (21.7 %).
The baseline characteristics of patients and controls are shown in Table I. Of the 440 hospitalised patients, 249 (56.5 %) were previously unknown to be hypertensive. Blood pressures ranged from 90 to 210 mmHg systolic and 76 to 210 mmHg diastolic. Mild, moderate and severe hypertension occurred in 30 (6.8 %), 59 (13.4 %) and 351 (79.8 %) patients, respectively. Mean diastolic blood pressures among patients with mild, moderate and severe hypertension were 90.9 (8.7) mmHg, 100.7 (10.7) mmHg and 119.5 (22.4) mmHg, respectively. The corresponding systolic blood pressure levels were 139.8 (16.7) mmHg, 155.1 (18.1) mmHg and 196.8 (30.2) mmHg, respectively.

Table I. Baseline characteristics of patients and controls.

| Characteristics          | Patients          | Controls         |
|--------------------------|-------------------|------------------|
|                          | N(%)              | N(%)             |
| Male                     | 251(57)           | 365(53)          |
| Female                   | 189(43)           | 323(47)          |
| Occupation               |                   |                  |
| Farming                  | 86(19.5)          | 167(24.3)        |
| Trading                  | 93(21.1)          | 150(21.8)        |
| Civil service            | 89(20.2)          | 159(22.1)        |
| House wives              | 167(38.0)         | 201(29.3)        |
| Others                   | 5(1.2)            | 11(1.6)          |
| Mean ± SD                |                   |                  |
| Age (years)              | 52.7 ± 12.5       | 50.7 ± 13.2      |
| Duration of diagnosis of hypertension (years) | 4.0 ± 3.2 | - |
| Systolic blood pressure (mmHg) | 187.3 ± 34.0* | 112.4 ± 8.2 |
| Diastolic blood pressure (mmHg) | 119.5 ± 22.5* | 79.9 ± 4.6 |
| Duration of admission (days) | 9.8 ± 9.7* | 21.2 ± 17.2 |

*p<0.05

Table II. Monthly distribution of admissions of patients with hypertension-related morbidities (1995-2000).

| MONTH      | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | Total |
|------------|------|------|------|------|------|------|-------|
| January    | 5    | 4    | 7    | 6    | 6    | 11   | 39    |
| February   | 9    | 5    | 11   | 5    | 10   | 7    | 47    |
| March      | 7    | 4    | 6    | 4    | 7    | 3    | 34    |
| April      | 4    | 3    | 7    | 5    | 4    | 7    | 30    |
| May        | 4    | 4    | 7    | 5    | 6    | 4    | 30    |
| June       | 5    | 6    | 5    | 7    | 4    | 5    | 32    |
| July       | 5    | 8    | 5    | 10   | 8    | 9    | 45    |
| August     | 5    | 7    | 4    | 6    | 8    | 11   | 41    |
| September  | 5    | 7    | 6    | 4    | 4    | 9    | 35    |
| October    | 5    | 7    | 4    | 6    | 4    | 9    | 38    |
| November   | 5    | 6    | 4    | 9    | 8    | 6    | 36    |
| December   | 5    | 5    | 5    | 6    | 7    | 8    | 36    |
| Total      | 64   | 63   | 73   | 74   | 75   | 91   | 440   |
The monthly distribution of admissions for complications of hypertension over 12 calendar months is shown in Table II. The monthly admission rate ranged from 3 to 11 patients; mean = 6.1 (1.9) patients. Mean monthly admission rates differed significantly ($F = 6.38; \text{df} = 11; p < 0.05$). Two peaks of admission for hypertension-related morbidities (January/February and August/September) were observed (Figure 1).

![Figure 1. Admission patterns of hypertension-related morbidities (1995-2000).](image)

The annual distribution of admissions for hypertension-related morbidities according to seasons is illustrated in Figure 2. Admission rates were consistently higher during the cold seasons (harmattan and wet) than during the hot season. Mean monthly admission rates were significantly higher during harmattan than during the hot season (6.7 (2.1)

![Figure 2. Annual admission rates of hypertension-related morbidities according to seasons (1995-2000). Black: Harmattan (Nov - Feb); Grey: Hot (Mar - May); White: Wet (June - Oct).](image)
versus 5.2 (1.4) patients; (t = 2.63; df = 40; p < 0.5)), and during the wet season than during hot season (6.4 (1.9) versus 5.2 (1.4) patients; (t = 2.48; df = 46; p < 0.05)).

The relationship between admission rates and different climatic conditions is shown in Figure 3. The peaks of hospital admissions for hypertension-related morbidities correspond with peaks of low solar radiation and low temperature. These peaks, in turn, correspond with periods of occurrence of high dust haze during harmattan, and of high humidity during the wet season. Linear regression analysis showed that hospital admission was significantly associated with monthly minimum temperature (SS = 9.85; df = 11; F = 8.3; r² = -0.7; p = 0.02) and solar radiation (SS = 9.85; df = 11; F = 8.7; r² = -0.7; p = 0.01). Multiple regression analysis showed that hospital admission was also

Figure 3a-e. Relationship between admission rates of hypertension-related morbidities and meteorological factors. a: mean admission (No. of patients); b: mean minimum temperature (°C); c: mean solar radiation (W/m²); d: mean dust haze occurrence (days); e: mean humidity (%).
significantly associated with combined meteorological factors (temperature, radiation, dust haze days and relative humidity) \((SS = 9.9; df = 11; F = 4.5; r^2 = 0.7; p = 0.04)\).

In the control group, the admission rate peaked during the months of August-October (Figure 4). This period corresponds with the wet season and the first peak of admission for hypertension-related morbidities. The mean monthly admission rate, as in the patient group, was significantly higher during the wet season, with 10 (3.8) patients, than during the hot season, when 7.6 (3.8) patients were admitted; \((t = 2.4; df = 46; p < 0.05)\). However, contrasting with the patients with hypertension-related morbidities, no peak admission rate was observed during the harmattan period. The mean monthly admission rate was also not significantly different during the hot and harmattan seasons in the control group, 7.6 (3.8) versus 8.7 (3.0) patients \((t = 1.3; df = 40; p > 0.05)\).

![Figure 4. Comparison of admission patterns of hypertension-related (A) and non-hypertension-related (B) morbidities (1995-2000).](image)

There was no difference in mean monthly systolic blood pressures \((F = 1.65, df = 11; p = 0.08)\) or mean monthly diastolic blood pressures \((F = 1.74, df = 11, p = 0.06)\) over the 12 calendar months. However, considering the hypertensives as a whole, 1345, 1237 and 2149 patients were seen during the harmattan, hot and wet seasons respectively. The proportions of patients requiring hospitalisation for hypertension-related morbidities and elevated blood pressure were significantly higher during harmattan 160 (13.5 %) than during the hot (94 ± 8.2 %), or wet seasons (186 ± 8.7 %); \((\chi^2 = 17.3, df = 2, p = 0.0003)\). A significantly higher proportion of patients was hospitalised during the cold (harmattan and wet)
seasons than during the hot season (11% versus 8.2%; odds ratio = 1.34, 95% confidence interval = 1.05-1.71, \( x^2 = 5.5, p = 0.02 \)).

Gender did not influence the admission rates. Of the 251 hospitalised male hypertensives, the admission rates during harmattan, hot and wet seasons were 95 (37.98%), 60 (23.9%) and 96 (38.2%) respectively. The corresponding admission rates among 189 female hypertensives were 65 (34.4%), 34 (18%) and 90 (47.6%); \( x^2 = 4.53, df = 1, p > 0.05 \). The distributions of admission rates during the three seasons did not differ significantly among hypertensives of different age groups \( x^2 = 4.9, df = 5, p > 0.05 \), or occupations \( x^2 = 5.0, df = 4, p > 0.05 \).

**DISCUSSION**

Seasonal variations in the morbidity and mortality due to heart failure and cardiomyopathy have been documented among Nigerians and South Africans, respectively (15, 16). Clustering of hospital admissions of chronic renal failure during the cold months of the year was also recently reported in south-western Nigeria (17). Arterial hypertension is the dominant precursor in the evolution of heart failure, stroke and chronic renal failure among blacks (3-6). This is probably because of late diagnosis of hypertension and severe hypertensive processes, as evidenced in the current report where most of the patients had severe hypertension and a high frequency of undiagnosed hypertension.

The current report also demonstrates increased hospital admissions for hypertension-related morbidities during the cold months of the year. The peaks of hospital admission for hypertension-related morbidities (January/February) and (August/September) occurred during the cold seasons, i.e. harmattan (December-February) and the wet season (June-October), while the period of relatively low admission rates corresponds with the hot season (March-May).

In temperate countries, meteorological correlates with myocardial infarction, stroke and sudden death have been clearly shown (18). Seasonal variation in blood pressure attributable to cold-induced increases in blood pressure levels has also been demonstrated among hypertensives in temperate climates (8-10). Though, data on the influence of changes in tropical climate on blood pressure levels among Africans is scarce, significant increases in blood pressure levels corresponding with a fall in the mean minimum temperature during the
cold seasons, and a fall corresponding with an increased mean temperature during the hot season, have been described among hypertensives in Jos, Central Nigeria (Okeahalam BN, Nigeria Cardiac Society Conference, Enugu, 2000).

Three distinct climates occur in north-western Nigeria (13). The months of December to February are dominated by a dry, cold, dusty and hazy north-east trade harmattan wind, blowing from the high-pressure belt (Sahara desert) across West Africa to the low-pressure belt (Atlantic ocean). The average monthly minimum temperature ranges from 14 °C to 15.5 °C. The low temperature during this period is attributed to the cold harmattan wind and to the thick atmospheric dust haze that scatters, reflects and blocks solar radiation from the earth. The average monthly radiation and the occurrence of dusty hazy days during harmattan are 13.5 w/m² and 18.7 days, respectively.

Furthermore, there are fluctuations in the intensity and frequency of harmattan dust haze. This results in diurnal variations of temperature, which may rise to 20 °C during the day and drop rapidly to below 14 °C at night. This diurnal temperature variation may be associated with cold-induced increases in blood pressure, simulating a rise in blood pressure associated with movement from an area of high ambient temperature to a cooler area in temperate countries (10).

Rainfall peaks in July/August. This period is characterized by high humidity and a thick cloud cover that absorbs solar radiation. The average monthly temperature is 28.4 °C, while the mean monthly minimum temperature is about 23.2 °C.

The hot season, on the other hand, is characterized by a thin atmospheric cloud cover and by the absence of dust haze. Solar radiation is therefore high. The average monthly temperature is 34.3 °C, while the average monthly maximum temperature is 41.4 °C. Temperatures can, however, be as high as 45 °C.

Hypertension-related morbidities correlate with blood pressure levels (7), which, in turn, vary with climatic changes. It is therefore probable that seasonal variation in hospital admissions for hypertension-related morbidities observed in the current report are linked with variations of blood pressure with different climatic conditions in the tropics. This is suggested by the significantly higher proportion of the overall hypertensive population requiring hospi-
talisation for hypertension-related morbidities and elevated blood pressure during the cold seasons than during the hot season.

However, seasonal differences in blood pressure among hypertensives could not be demonstrated. This may be explained by several factors. Firstly, the study group is a subpopulation of hypertensives who are homogeneous in the sense that they all presented complications that are primarily related to elevated blood pressure. Hence, irrespective of the season of hospitalisation, all the patients expectedly had raised blood pressure levels. Secondly, blood pressure levels might have been influenced by measurements made after a period spent indoors in the hospital, when the patient was warm. Finally, blood pressure levels may be influenced by some hypertension-related morbidities. Heart failure, for example, is known to cause a reduction in cardiac output, with a consequent fall in blood pressure to values below the levels preceding the heart failure (19).

The cold-induced increase in blood pressure is a neurally and hormonally mediated thermoregulatory response. It is associated with increased adrenaline and nor-adrenaline levels that result in vasoconstriction and increased peripheral resistance (11). The consequent variation in disease occurrence might reflect cold-induced endogenous physiologic rhythms, surges in blood pressure, tachycardia and haemoconcentration (20).

The increase in hospital admissions among the control group during the wet season may be attributable to increases in the net income of the population arising from farming and the sale of farm products. The increased food supply during the wet season could also reduce expenditure on food items by all categories of the population. Ultimately, a financial motivation for patronizing orthodox health care services is provided. This economic factor might also have contributed to the increase in hospital admissions for hypertension-related morbidities during the wet season.

A previous report demonstrated no significant difference in blood pressure reactivity among active and inactive African Americans subjected to cold pressor tests (21). The current study similarly showed no difference in the seasonal distribution of hospital admissions among hypertensives of different occupations that are presumably associated with different degrees of physical activity.

In conclusion, hospital admissions of hypertension-related morbidities show seasonal variation. This may be related with seasonal
changes in blood pressure with tropical climates. This information necessitates appropriate health planning, appropriate clothing (increased number of clothing layers and thermal insulation) and drug compliance during the cold season.

Acknowledgement
I am grateful to Abdulraheem Marouf and Alfa Adamu Ismaila of Department of Geography, Usmanu Danfodiyo University, Sokoto, for giving me access to the meteorological data of the Sokoto Energy Research Centre.

REFERENCES

1. Kadri S, Walker O, Salako BL, Akinkugbe OO. Blood pressure, hypertension and correlates in urbanized workers in Ibadan: a revisit. J of Human Hypertension 1999; 13(1): 23-27.
2. Sofola OA, Obiefuna PCM. Salt and hypertension-an update. Nigerian Medical Practitioner 1992; 24:3-6.
3. Akinsola WO, Oguntiyi JO, Ladipo GO. Diseases causing renal failure in Nigeria-a prospective review of 100 cases. Afr J Med Med Sci 1989;18:131-135.
4. Broderick J, Brott T, Kothen R, Miller R, Khourly J, Pancioli A, et al. The Greater Cincinnati/Northern Kentucky Stroke Study Preliminary first year and total incidence rates of stroke among Blacks. Stroke 1998; 29:415-421.
5. Isezuo AS, Omotoso ABO, Gaye A, Corrah T, Aroaye MA. One-year survival among Subsaharan Africans with hypertensive heart failure. Trop Cardiol 2000; 26(13): 57-59.
6. Toure LA, Salissou O, Chapko MA. Hospitalisation in Niger (West Africa) for arterial hypertension Am J Hypertens 1992; 5: 322-344.
7. MacMahon S, Peto R, Cutler J, Collin R, Sorelie P, Neaton J, et al. Blood pressure, stroke and coronary artery disease. Prolonged differences in blood pressure: prospective observational studies corrected for regression. Lancet 1990; 332:765-774.
8. Brenman PJ, Greeberg G, Mall WE, Thompson SG. Seasonal variation in arterial blood pressure. BMJ 1982; 285: 919-923.
9. Goodwin J, Pearce VR, Taylor RS, Read KL, Powers SJ. Seasonal cold and circadian changes in blood pressure and physical activity in young and elderly people. Age Ageing 2001; 30(4): 311-317.
10. Jansen PM, Leineweber MJ, Thien T. The effect of a change in ambient temperature on blood pressure in normotensives. J Hum Hypertens 2001;(2): 113-117.
11. Komulainen S, Tahtinen T, Rintamaki H, Virokannas H, Keinanen-Kiukaanniemi S. Blood pressure responses to whole-body cold exposure: effect of carvedilol. Eur J Clin Pharmacol 2000; 56 (9-10): 637-642.
12. Andersson J, Schagatay E, Gislen A, Holm B. Cardiovascular responses to cold-water immersions of the forearm and face, and their relationship to apnoea. Eur J Appl Physiol 2000; 83(6): 566-577.
13. Abdulmajid NA. The occurrence of harmattan haze and its impact on weather pattern in Sokoto, Nigeria. B Sc Dissertation. Department of Geography, Usmanu Danfodiyo University, Sokoto, 1992.
14. WHO/International Society of Hypertension. Guideline for the Management of Hypertension. J Hypertens 1999; 17: 151-183.
15. McGlashan ND. South African cardiomyopathy in the Republic of South Africa. (1978-1980) Afr J Med Sci 1988; 17: 17-33.

16. Parry EHO, Davidson MCD, Ladipo GOA. Seasonal variation of cardiac failure in Northern Nigeria. Lancet 1977; 1: 1023-1025.

17. Kadri S, Arike A. Temporal variation and meteorological factors in hospital admissions of chronic renal failure in Southwestern Nigeria. WAJM 1999; 18: 49-51.

18. Bull GM. Meteorological correlates with myocardial and cerebral infarction and respiratory disease. Br J Prev Soc Med 1973; 27: 108-113.

19. Araoye MA, Olowoyeye O. The clinical spectrum of hypertensive heart failure: A point score system for solving an old problem. East Afr Med J 1984; 61: 306-315.

20. Johansson B. Cold and ischaemic heart disease. Int J Circumpolar Health 2000; 59(3-4): 188-191.

21. Bond VR, Adams RG, Vaccaro P, Blakely R, Franks BD, Williams D, Obisesan TO, Millis R. Physical activity and blood pressure responsiveness to the cold pressor test in normotensive young adult African-American males. Ethn Dis 2001; 11 (2): 219-223.

22. Donaldson GC, Rintamaki H, Nayha S. Outdoor clothing: its relationship to geography, climate, behaviour and cold-related mortality in Europe. Int J Biometrol 2001; 45 (1): 45-51.

Dr S A Isezuo
MBBS (Ibadan),
FMCP (Nigeria); Consultant Physician/Cardiologist
Department of Medicine
Usmanu Danfodiyo University Teaching Hospital
PMB 2370
Sokoto, Nigeria.
Email: sisezuo@skannet.com