**Original Article**

**Total Cardiovascular Risk Assessment of Women in Delta State, Nigeria, Using the World Health Organization/International Society of Hypertension Risk Prediction Chart**

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**Introduction**

Cardiovascular disease is a global public health problem and a burgeoning menace in the African region where most of the black population predominates. Hypertension alongside diabetes mellitus accounts for a substantial proportion of the public health problem posed by noncommunicable diseases (NCDs) internationally. Regardless of the level of economic advancement, all nations are confronted with the burden of NCDs. However, a substantial proportion of NCD-related deaths are recorded in less economically viable republics, especially in sub-Saharan Africa. Africa shoulders greater health-related problems not only due to deprived and weak public health systems but also as a result of inherent, inborn vulnerabilities to cardiovascular diseases.

For example, in the African region, about one-in-two adults aged 25 years and older live with hypertension; the majority of whom are undiagnosed. Evidence suggests that reducing cardiovascular risk (CVR) portends a more promising strategy for cutting down mortality rates than interventions targeted at the treatment of already established disease.

The prevention of a cardiovascular event such as stroke or myocardial infarction may involve treating traditional risk factors such as hypertension, diabetes, hypercholesterolemia, or determination of thresholds for specific interventions based on the likelihood of developing any of these unforeseen adverse incidents. The latter takes into cognizance total CVR defined by individualized risk factors including age, sex, smoking, body mass index (BMI), diabetes, blood pressure levels, and a variety of biochemical indicators. Predicting CVR has been proven to be cost-effective and efficient among high- and low-risk groups.

**Background:** Globally, women are not exempt from the menace of cardiovascular diseases. Increasing age and lower educational levels were significantly associated with a high CVR. Significant associations were observed between CVR and age (<0.001), marital status (P = 0.047), and level of education (P < 0.001).

**Methods:** This cross-sectional study assessed the 10-year cardiovascular risk (CVR) for stroke or myocardial infarction of women aged ≥18 years attending opportunistic medical screening programs in two suburban communities in Delta State, Nigeria. Consenting women were consecutively recruited for the study, and the study instrument was the World Health Organization/International Society of Hypertension prediction chart for Africa (AFR D) without blood cholesterol. Total CVR was graded as low (<10), moderate (10–<20), and high (≥20).

**Results:** Data from 456 women were analyzed; 50.9% were aged >40 years, 9.9% had never married, and 39.9% had a secondary level of education. The mean body mass index (29 vs. 27 kg/m²), systolic blood pressure (140 vs. 121 mmHg), diastolic blood pressure (87 vs. 77 mmHg), and blood glucose (104 vs. 92 mg/dl) were significantly higher among women aged ≥40 years. Smoking, hyperglycemia, and hypertension were noted in 0.0%, 7.0%, and 34.4% of the women, respectively. The 10-year risk of stroke or myocardial infarction was low in 87.7%, moderate in 7.2%, and high in 5.0% of the women. All the respondents with high CVR were aged ≥40 years. Among respondents aged <40 years, 98.2% had low CVR. Significant associations were observed between CVR and age (P < 0.001), marital status (P = 0.047), and level of education (P < 0.001).

**Conclusion:** This study shows that 12.2% of the women have a moderate-to-high 10-year risk of stroke or myocardial infarction. Increasing age and lower educational levels were significantly associated with a high CVR. Educating women indeed have far-reaching benefits on their cardiovascular health.

**Keywords:** Cardiovascular risk assessment, hypertension, women, World Health Organization/International Society of Hypertension risk prediction chart

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Previously, most risk scores were based on findings from research in major world economies and thus were inappropriate for resource-constrained settings. Consequently, the World Health Organization/International Society of Hypertension (WHO/ISH) worked up various sets of region-specific risk prediction charts with fewer risk factors easily usable by all categories of health workers. These risk prediction charts are intended to be used for fast and reliable approximation of total CVR among clients attending a health facility. However, their usefulness can also be applied at the community level for calculating approximately the distribution of CVR among populations in cross-sectional studies.\(^7\)\(^8\)

The risk of cardiovascular disease among females is apparently high. For example, in the United States, cardiovascular disease accounts for a third of mortality among women.\(^9\) Only a few studies have assessed the cardiovascular disease risk of women across a wide age range. This study aimed at assessing the total CVR of Nigerian women from two suburban communities in Delta State using the WHO/ISH risk prediction chart.

**METHODS**

**Study area, population, and design**

In this study, a cross-sectional design was utilized to assess the total CVR among apparently healthy women aged 18 years and older living in Delta State, South-South Nigeria. Delta State has an estimated population of over five million, out of which 40% are women (deduced from 2006 census figures using an annual population growth rate of 3.2%).\(^9\) Two communities were conveniently chosen: Koko, the headquarters of Warri North Local Government Area, and Sapele, the headquarters of Sapele Local Government Area. Both study locations are 53 km apart.

**Sampling technique**

The women were recruited consecutively for the study during opportunistic medical screening programs held at the study locations.

**Data collection**

Homogeneous information on sociodemographic characteristics was obtained from the respondents. Blood pressure was measured with an electronic (automated) sphygmomanometer from the right arm of seated respondents thrice at an interval of 1 min. Weight in kilograms (with light clothing) and height in meters (without cap, hat, headgears, or shoes) were also measured using a mobile stadiometer. The BMI was thereafter computed using the formula: weight/height\(^2\) (expressed in kg/m\(^2\)). Each participant also had point-of-care testing for blood glucose (BG) using capillary blood obtained from the tip of the finger. The WHO/ISH risk prediction chart for Africa (AFR D) where total cholesterol was not measured was applied to determine the total CVR profile among the women.

**Definitions**

1. Using the WHO Classification, BMI >25.0 kg/m\(^2\) was categorized as high (overweight: 25.0–29.9 kg/m\(^2\), Obese: ≥30 kg/m\(^2\))\(^11\)
2. Using the Joint National Committee-7 report, systolic blood pressure (SBP) ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg was regarded as hypertension\(^12\)
3. Using the WHO classification, hyperglycemia was defined as fasting BG ≥126 mg/dl or random BG ≥200 mg/dl\(^13\)
4. 10-year CVR prediction using the WHO/ISH prediction chart for Africa (AFR D) was graded as low (<10), moderate (10–<20), and high (CVR: ≥20)\(^3\)

**Statistical analysis**

Data were put into a spreadsheet and analyzed with the Statistical Package for Scientific Solutions version 22 International Business Machines Statistical Package for Scientific Solutions (IBM SPSS) for Windows, version 22.0. Armonk, New York: IBM Corp. Age was summarized as a mean with standard deviation and categorized into six age ranges and then into dichotomous groups: ≥40 years and <40 years. Categorical variables such as marital status and level of education were expressed as frequency and percentages. Association between sociodemographic indices and CVR profile was elicited using the Chi-square test. \(P < 5\% (<0.05)\) was regarded as statistically significant.

**Ethical consideration**

The Health Research Ethics Committee of Delta State University Teaching Hospital, Oghara, Nigeria, provided ethical approval for the study. The permission of the organizers of the medical screening programs was also sought and obtained. Group counseling was offered to all respondents before informed consent was obtained from willing participants. The participation of the women in the study was entirely voluntary without threat, inducement, or coercion. No direct identifiers were obtained from the respondents. Respondents’ CVR profile was communicated to them, and those with hypertension and hyperglycemia were appropriately referred for care.

**Results**

A total of 469 women were recruited for the study. However, 13 (2.8%) women did not know their actual ages and were excluded from the study. About half (232; 50.9%) of the respondents were aged 40 years and above. The mean age (standard deviation [±SD]) of the respondents was 41.1 (±12.62) years. A vast majority of the women were married, and singles constituted just under one-tenth (9.9%). While about a quarter of the respondents had tertiary education, secondary-level education was the most predominant educational status attained (39.9%). More than half (54.2%) of the study population were engaged in semi-skilled and unskilled jobs [Table 1].

None of the respondents had ever smoked tobacco.

The mean BMI of the respondents was 27.8 (±6.45) kg/m\(^2\). Most of the respondents (60.7%) had a high BMI of at least 25.0 kg/m\(^2\), overweight (121, 26.5%), and obese (156, 34.2%).

The mean (±SD) SBP and DBP were 130.6 (±23.99) mmHg and 81.9 (±14.95) mmHg, respectively. One hundred and fifty-seven (34.4%) respondents had their blood pressure readings in the hypertensive range.
The mean BG level for the respondents was 98.2 (±36.05) mg/dl. Hyperglycemia was noted in 32 (7.0%) respondents.

The total 10-year CVR for stroke or myocardial infarction among the respondents was predominantly low [Figure 1].

All the respondents with high (≥20%) CVR were aged 40 years and above. On the other hand, a substantial proportion (98.2%) of the women below 40 years had a low (<10%) CVR. Figure 2 shows the distribution of CVR profile by age group.

The mean BMI, SBP, DBP, and BG levels were significantly higher among the older age groups. The mean BMI, SBP, DBP, and BG levels were 2.2 kg/m², 18.8 mmHg, 10.1 mmHg, and 11.52 mg/dl significantly higher among respondents aged at least 40 years, respectively [Table 2].

The association between age group and 10-year predicted CVR was statistically significant (P < 0.001) [Table 3].

One-in-twenty respondents who had ever married had high CVR. The proportion of respondents with low CVR was higher among respondents who had never married. The association between marital status and CVR was statistically significant [Table 3].

The probability of having a high CVR increased with a lower level of education. Whereas one-fifth respondents with primary education had high CVR, it was 1-in-25 respondents with higher levels of education, P < 0.001[Table 3].

The association between occupational groups and CVR was not significant; the distribution of low CVR was similar for all job categories, P = 0.095 [Table 3].

**DISCUSSION**

The index study is one of the few studies that predicted the 10-year risk of fatal/nonfatal stroke or myocardial infarction exclusively in women across a wide age range. For low resource settings like ours, the WHO/ISH risk prediction tool has been validated for use. This tool combines multiple CVR factors (age, sex, tobacco smoking, hypertension, and diabetes mellitus) to predict myocardial infarction or stroke event.

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**Table 1: Sociodemographic and clinical profile of the respondents (n=456)**

| Variables | Categories | Frequency, n (%) |
|-----------|------------|------------------|
| Age (years) | ≤19 | 8 (1.8) |
|           | 20-29 | 72 (15.8) |
|           | 30-39 | 144 (31.6) |
|           | 40-49 | 132 (28.9) |
|           | 50-59 | 57 (12.5) |
|           | ≥60 | 43 (9.4) |
| Marital status | Never married | 45 (9.9) |
|               | Married* | 324 (71.1) |
|               | Not indicated | 87 (19.1) |
| Education | No formal education | 9 (2.0) |
|            | Primary | 51 (11.2) |
|            | Secondary | 182 (39.9) |
|            | Tertiary | 117 (25.7) |
|            | Not indicated | 97 (21.3) |
| Occupational groups* | High professional | 20 (4.4) |
|                   | Lower professional | 72 (15.8) |
|                   | Skilled | 7 (1.5) |
|                   | Semi-skilled | 125 (27.4) |
|                   | Unskilled | 122 (26.8) |
|                   | Unemployed | 27 (5.9) |
|                   | Not indicated | 83 (18.2) |

*These consists divorced (0.4%), separated (1.3%), widowed (2.4%), *UK registrar classification of 1911

**Table 2: Differences in the mean values of tested cardiovascular risk factors by age group**

| Variables | <40 years | Mean±SD | 95% CI | >40 years | Mean±SD | 95% CI | P |
|-----------|-----------|---------|-------|-----------|---------|-------|---|
| SBP (mmHg) | 121.1±15.67 | 139.9±26.87 | ~22.870 | 14.737 | <0.001 |
| DBP (mmHg) | 76.7±11.71 | 86.9±16.04 | ~12.739 | 7.555 | <0.001 |
| BG (mg/dl) | 92.3±38.56 | 103.8±32.59 | ~18.355 | 4.682 | 0.001 |
| BMI (kg/m²) | 26.7±6.15 | 28.9±6.65 | ~3.348 | 1.001 | <0.001 |
| BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, BG: Blood glucose, CI: Confidence interval, SD: Standard deviation
Table 3: Sociodemographic characteristics and the 10-year cardiovascular risk for stroke or myocardial infarction

| Variables                  | Category          | Low (n=400) | Moderate (n=33) | High (n=23) | $\chi^2$ | $P$  |
|----------------------------|-------------------|-------------|----------------|-------------|---------|------|
| Age group (years)          | ≤19               | 8 (100.0)   | 0 (0.0)        | 0 (0.0)     | 105.148 | <0.001 |
|                            | 20-29             | 72 (100.0)  | 0 (0.0)        | 0 (0.0)     |         |      |
|                            | 30-39             | 140 (97.2)  | 4 (2.8)        | 0 (0.0)     |         |      |
|                            | 40-49             | 116 (87.9)  | 13 (9.8)       | 2 (1.7)     |         |      |
|                            | 50-59             | 41 (71.9)   | 9 (15.8)       | 7 (12.3)    |         |      |
|                            | ≥60               | 23 (53.5)   | 7 (16.3)       | 13 (30.2)   |         |      |
| Marital status             | Married           | 278 (85.8)  | 28 (8.6)       | 18 (5.6)    | 6.106   | 0.047 |
|                            | Never married     | 43 (95.6)   | 2 (4.4)        | 0 (0.0)     |         |      |
| Level of education         | NFE               | 7 (77.8)    | 0 (0.0)        | 2 (22.2)    | 32.263  | <0.001|
|                            | Primary           | 35 (68.6)   | 6 (11.8)       | 10 (19.6)   |         |      |
|                            | Secondary         | 160 (87.9)  | 18 (9.9)       | 4 (2.2)     |         |      |
|                            | Tertiary          | 111 (94.9)  | 4 (3.4)        | 2 (1.7)     |         |      |
| Occupational group         | High professional | 18 (90.0)   | 1 (5.0)        | 1 (5.0)     | 16.165  | 0.095 |
|                            | Lower professional| 64 (88.9)   | 8 (11.1)       | 0 (0.0)     |         |      |
|                            | Skilled nonmanual | 6 (85.7)    | 1 (14.3)       | 0 (0.0)     |         |      |
|                            | Semi-skilled      | 115 (92.0)  | 4 (3.2)        | 6 (4.8)     |         |      |
|                            | Unskilled         | 101 (82.8)  | 13 (10.7)      | 8 (6.6)     |         |      |
|                            | Unemployed        | 23 (87.7)   | 2 (7.4)        | 2 (7.4)     |         |      |

Not indicated excluded from analysis. LR: Likelihood ratio Chi-squared, NFE: No formal education, CVR: Cardiovascular risk

In the following 10-year period. Using the WHO/ISH risk prediction chart without cholesterol (AFR D), about nine out of every ten women in this study had a low (<10%) 10-year risk of an adverse cardiovascular event. Indeed, the proportion of respondents with a low 10-year CVR in this study (87.7%) falls within the previously reported values of 78.6%–97.0% from low- and middle-income countries.[8,14–18]

In this study, 12.2% of the women had a moderate-to-high 10-year risk of stroke or myocardial infarction. The findings in this study, although consistent with other reports from sub-Saharan Africa,[8,14] were particularly worrisome. For one, this study was conducted exclusively among women from a wide age range. In most of the available literature, the WHO/ISH risk prediction chart was used to assess both men and women aged 40 years and older. In this study, 9.9% of the women aged 40 years and above had a high risk (at least 20% chance) of a heart attack or a stroke event within the next 10 years. This is almost double the predicted risk for a mixed population of men and women in the same age range from a previous report from Nigeria.[10] In another population study in rural Nepal, 4.2% of the women had an estimated high CVD risk.[15] The relatively higher percentage reported in this study may be attributable to urbanization compared to the rural population in the Nepal study. Furthermore, the estimated high CVR of 1.5% reported among women aged at least 40 years in a recent Kenyan study of secondary data was a far cry from the 9.9% in this study.[18] However, Vusirikala et al. reported that the CVR was underestimated compared to actual adverse cardiovascular events recorded.[18] Of note also, is that none of the respondents in the index study had ever smoked tobacco, and their total cholesterol levels were not considered in assessing their total CVR.

Being at least 40 years old was significantly associated with a high CVR, while the contrary was true for younger women. Indeed, in this study, all the patients with high CVR were 40 years and older. The prevalence of hypertension and diabetes mellitus was high in this study. Aside from advancing age being a nonmodifiable CVR factor, older respondents (40 years and above) had a leaning toward higher blood pressure and fasting blood levels. The mean SBP among the older women was in the hypertensive range. Aside from age, educational status was also significantly associated with the total CVR profile. The tendency toward a high CVR increased with low educational levels. A significant proportion of the women in this study with a high 10-year risk of stroke and heart attack had no more than primary education. This finding is consistent with previous reports in which low educational status was associated with increased CVR.[9–21] These studies have shown that lower educational status fuels poor knowledge of CVR factors with attendant heart unhealthy behaviors, as well as inequity in health-care access. Education is an index of socioeconomic status. Thus, persons with lower educational status also tended to have reduced access to health-care delivery, particularly in climes such as Nigeria, where out-of-pocket spending is the norm.

The index study has some limitations: first, in its design. This study was cross-sectional and not prospective. A prospective study would have allowed for comparative analysis between baseline and end-of-study data. Furthermore, comparative analysis between genders was impracticable in this study as only women were assessed. The choice of the WHO/ISH risk prediction chart may also be questioned. The ideal risk prediction tools should be derived from prospective population-based studies. However, the WHO/ISH risk prediction chart used in this study was derived from the modeling approach. Furthermore, the WHO/ISH risk prediction charts do not assess crucial underlying CVR factors such as obesity, lifestyle-related risk factors including unhealthy diet...
and physical inactivity, psychosocial risk factors, and family history of premature CVD. Thus, the WHO/ISH risk prediction tools underestimate the risk of cardiovascular outcomes compared to other commonly available risk assessment tools. However, the WHO risk assessment tools provide ethnic/regional specifications that make screening easier in low-resource settings such as Nigeria. Although far from the ideal, it remains one of the most practical tools for routine CVR assessment in Nigeria. Finally, the method of recruitment of the study population was opportunistic and not probability based. This has the potential to bloat the estimated CVR reported in this study.

**CONCLUSION**

Findings from this study show that 12.2% of the women have a moderate-to-high 10-year risk of fatal/nonfatal cardiovascular event (stroke and myocardial infarction). Increasing age and lower educational levels were linked with high CVR in this study. Although most of the respondents under the age of 40 years had low CVR, this should not be misconstrued as no risk. Therefore, the need to aggressively pursue the fulfillment of the Sustainable Development Goal 3 even among young women aged <40 years cannot be overemphasized. Educating women will help to bridge the socioeconomic and other gender-related inequities with far-reaching benefits on their cardiovascular health.

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**Conflicts of interest**

There are no conflicts of interest.

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