GENEVA HEALTH FORUM CONFERENCE 2026 · SCIENTIFIC POSTER

Breast Cancer Vulnerability and Population Exposure in Nigeria

Using GIS-Based Multi-Criteria Decision Analysis

Yetunde Mariam Badmos[1]* and Olalekan John Taiwo[1]

[1]Department of Geography, University of Ibadan, Ibadan, Nigeria · *badmosyetunde@gmail.com · olalekantaiwo@gmail.com

32,278
new breast cancer cases, 2022
The highest total in Africa (GLOBOCAN 2022).

16,332
breast cancer deaths, 2022
Screening is limited and cancer care is concentrated in a few tertiary centres.

26.83
deaths per 100,000 women
Age-standardised mortality, among the highest in the world.

Introduction

- **Burden:** Nigeria recorded about 32,278 new breast cancer cases and 16,332 deaths in 2022, the highest national totals in Africa. Sub-Saharan Africa has the highest mortality-to-incidence ratio of any world region (about 0.51 in 2022).
- **Gap:** Evidence on the spatial distribution of breast cancer risk factors across Nigerian states is limited. No composite index has yet integrated behavioural, environmental and socioeconomic determinants at the sub-national level to guide the targeting of screening and prevention.

Objectives

Aim: To construct a Breast Cancer Vulnerability Index (BCVI) for Nigeria and assess population exposure across its vulnerability classes.

1. Construct the BCVI across the 36 states and the Federal Capital Territory (FCT) using GIS-based multi-criteria decision analysis (MCDA).
2. Compare Analytic Hierarchy Process (AHP) and Best-Worst Method (BWM) vulnerability classifications.
3. Test the association between vulnerability-class population and reported 2025 incidence.

Hypotheses: (1) vulnerability class is unrelated to reported incidence; (2) AHP and BWM classifications agree significantly.

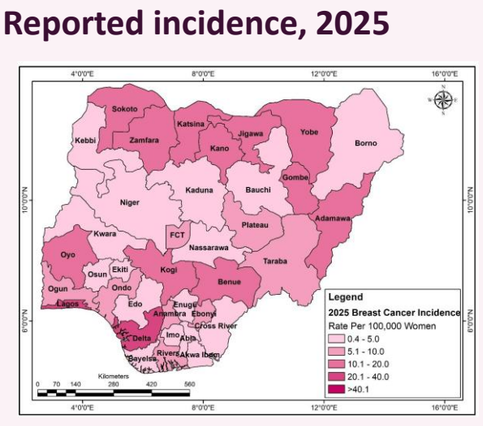
Methodology

- **Data:** 2025 spatial ecological study of 37 units. Behavioural data from NDHS 2024, socioeconomic data from NBS 2022 and Global Data Lab, satellite environmental indicators, incidence from DHIS2 (public facilities), population from WorldPop.
- **Preparation:** eleven criteria were retained after redundancy screening. State-level variables were interpolated by ordinary kriging (ArcGIS Pro) and scaled to a 0 to 1 range.
- **Weighting:** AHP (11 × 11 Saaty matrix, consistency ratio CR = 0.049) and BWM (Excel Solver; alcohol best, NDVI worst), combined by weighted overlay and classed as low, medium or high (equal interval).
- **Analysis:** zonal statistics gave population exposure. Spearman (primary) and Pearson (secondary) correlations tested vulnerability against incidence. Cohen's κ and Spearman's ρ compared AHP with BWM.

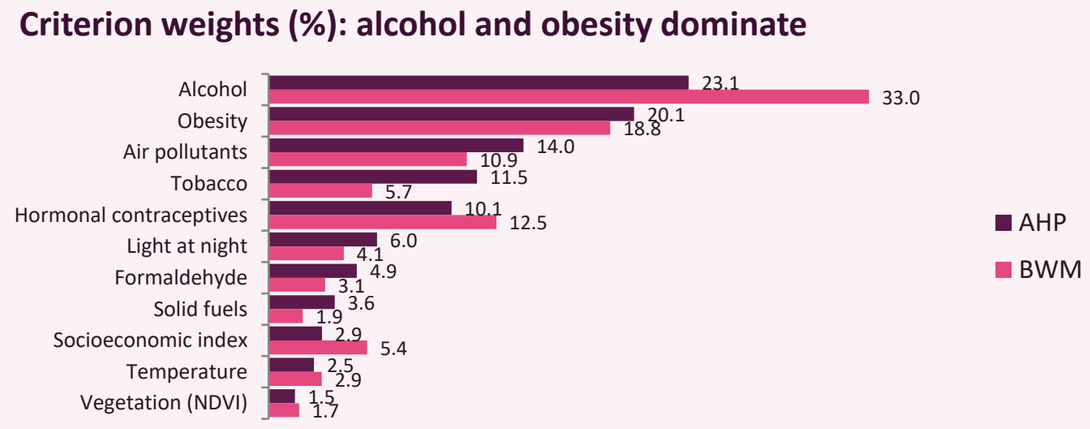
Results

- **Weights:** alcohol consumption and obesity carried the largest weights under both methods, together 43.18% (AHP) and 51.79% (BWM). AHP consistency was acceptable (CR = 0.049) as well as that of BWM (CR = 0.7).
- **Pattern:** vulnerability rises from north to south under both methods: high in the South-South and South-West (including Lagos), low in the North-West and North-East. BWM classed more land as high (24.01% versus 8.77% under AHP).
- **Agreement:** 73.0% of states fell in the same dominant class under AHP and BWM (Cohen's κ = 0.61; Spearman ρ = 0.86, p < 0.001).
- **Incidence:** vulnerability-class population was not significantly correlated with reported incidence under either method (all p > 0.05). Only total population was (Pearson r = 0.343).

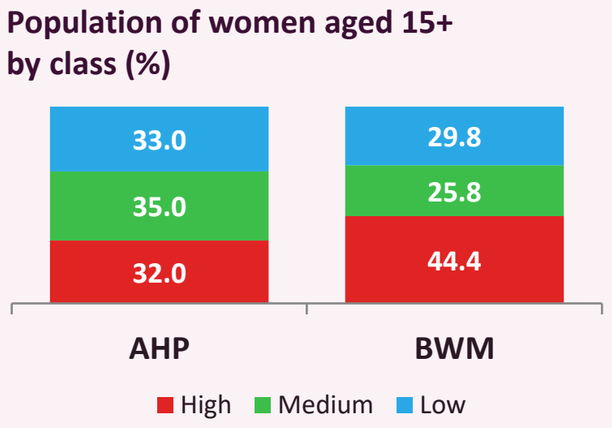
Reported incidence, 2025



Criterion weights (%): alcohol and obesity dominate

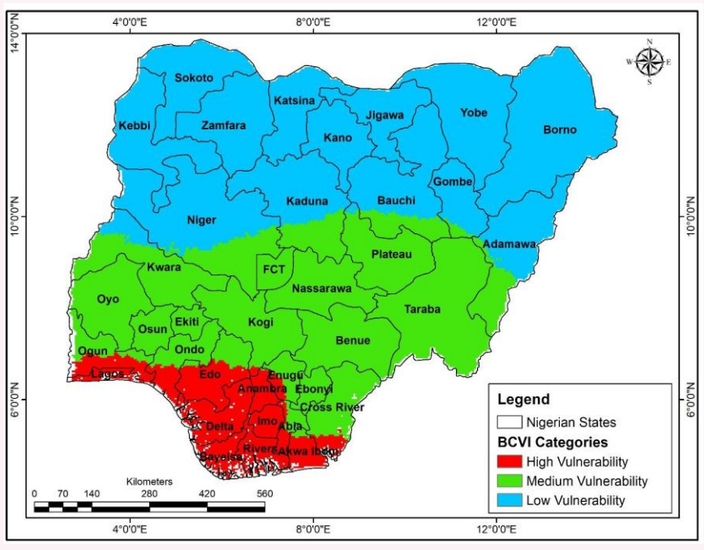


Population of women aged 15+ by class (%)

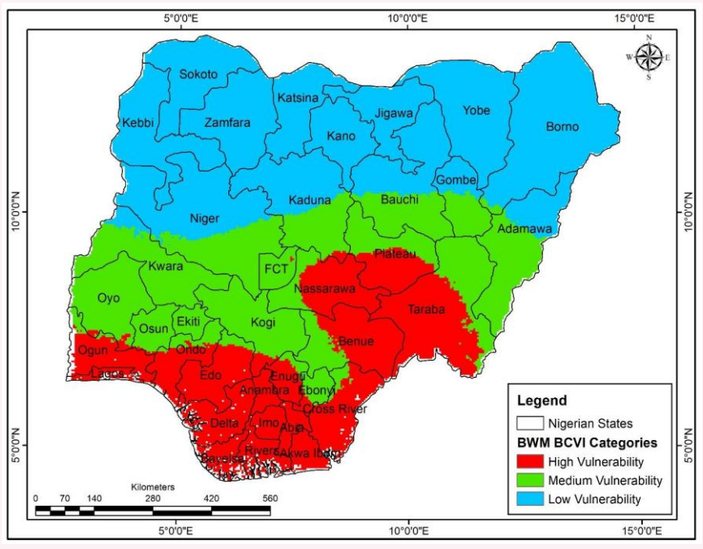


Where vulnerability concentrates

AHP classes



BWM classes



32% to 44%
of women aged 15+ in the high class, AHP to BWM

κ = 0.61
AHP and BWM agree on 73% of states (ρ = 0.86)

No link
with reported incidence (all p > 0.05)

Discussion

Both methods show higher vulnerability in the South-South, South-West and Lagos, and lower vulnerability in the north. BWM gives alcohol and obesity more weight (52% versus 43%), which enlarges the high class. Incidence peaks in Lagos and several northern states, so uneven screening and under-reporting likely mask true burden. The maps show modelled exposure, not diagnosed cases: low vulnerability does not mean low burden.

Conclusions

Southern Nigeria is the priority zone. The BCVI is a planning tool for places, not a diagnosis for women.

- **Target screening:** prioritise southern states
- **Deploy mammography:** place services equitably
- **Strengthen data:** registries, age-standardised surveillance, DHIS2

References: Bray F et al. (2024) CA Cancer J Clin 74:229–263; Saaty TL (1980) The Analytic Hierarchy Process; Rezaei J (2015) Omega 53:49–57; Landis JR, Koch GG (1977) Biometrics 33:159–174.

Data: District Health Information Software 2 (DHIS2, public facilities), NDHS 2024, NBS 2022, Global Data Lab, WorldPop, FAO GAUL, VIIRS, Sentinel-5P, CAMS, MODIS, Landsat 8. Maps and charts: authors' analysis (2026). No specific funding.
The authors thank the Geneva Health Forum organisers for the platform to share this work.