

# Waist circumference cut-offs for metabolic syndrome and insulin resistance in women and men of African ancestry living with HIV

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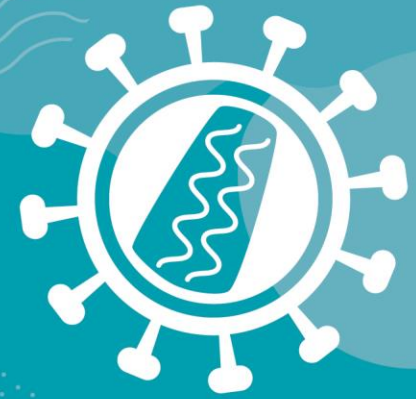
King's College Hospital NHS Foundation Trust, UK



**Waist circumference cut-offs for metabolic syndrome and  
insulin resistance in women and men of African ancestry  
living with HIV**

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In relation to this presentation, I declare that I have no conflict of interest

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# Background

- People with HIV are at increased risk of cardiovascular disease
  - Metabolic Syndrome (MetS) is a cluster of cardiovascular risk factors, and defined by three or more of the following:
    - Fasting triglycerides  $>1.7$  mmol/L
    - Fasting HDL-cholesterol  $<1.0$  mmol/L (men) or  $<1.3$  mmol/L (women)
    - Blood pressure  $\geq 130/85$  mmHg, or use of antihypertensive medication
    - Fasting glucose  $\geq 5.6$  mmol/L, or use of hypoglycaemic medications
    - Waist Circumference  $\geq 80$  cm (women) or  $\geq 94$  cm (men)
- There are no validated waist circumference cut-offs for use in Black populations

# Aims

## **In a cohort of women and men of African ancestry with HIV:**

- To explore the relationship between waist circumference (WC) and
  - Other components of the metabolic syndrome
  - HbA1c and insulin resistance
- To identify optimal WC cut-offs to define metabolic syndrome in this population

# Methods

- We used data from the CKD-Africa study
  - Individuals of African ancestry who previously participated in the GEN-AFRICA study were invited for a cardiometabolic assessment
    - Waist circumference (WC) and standardized blood pressure (BP) measurements
    - Fasting triglycerides, HDL-cholesterol and glucose measurements
    - Glycated haemoglobin (HbA1c)
    - Homeostatic model assessment for insulin resistance (HOMA-IR)

# Methods - statistics

- Data were analysed separately for women and men
- Linear regression models were fitted to explore the relationships between WC (exposure) and other components of the MetS, HbA1c and HOMA-IR (outcomes)
- Receiver operating characteristic (ROC) curves with Youden indices were fitted to identify optimal WC cut-offs for the various outcomes



**Receiver Operating Characteristic (ROC)** curves show how a predictive model can distinguish between the true positives and true negatives

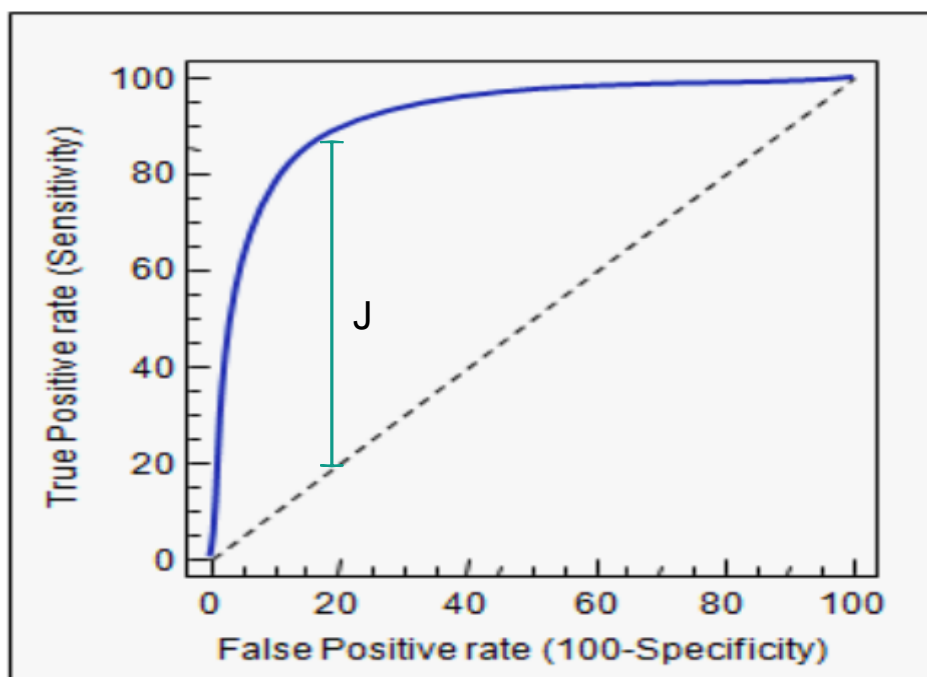


Image from <https://www.medcalc.org/manual/roc-curves.php>

The **Area Under the Curve (AUC)** shows how well the model distinguishes between positives and negatives

*(the further the curve is from the diagonal line, the better the model is at distinguishing between positives and negatives)*

The **Youden Index (J)** defines the optimal cut-off  
*(greatest difference between true positive and false positive)*

AUC:

- <0.7                      Poor discrimination
- $0.7 \leq \text{ROC} < 0.8$     Acceptable discrimination
- $0.8 \leq \text{ROC} < 0.9$     Excellent discrimination
- $\text{ROC} \geq 0.9$             Outstanding discrimination

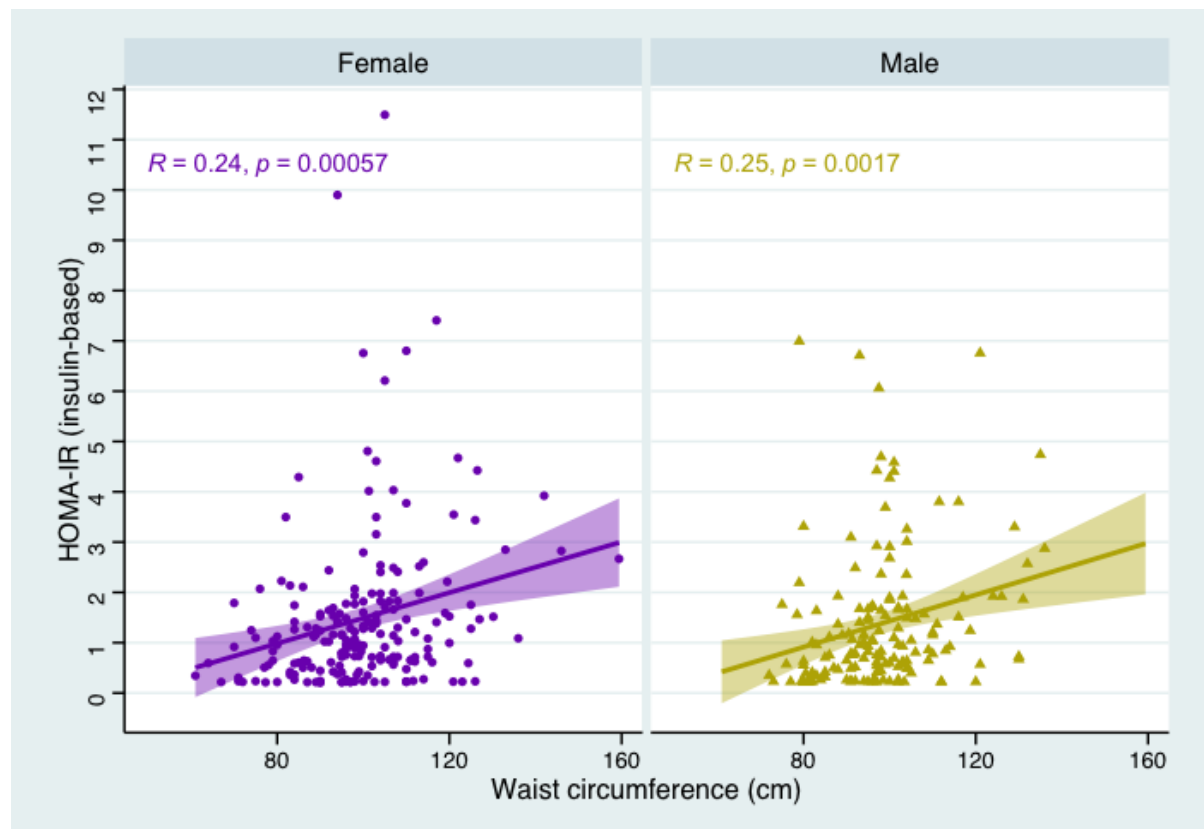


# Participant characteristics

|  | Overall (N=383)          | Female (N=210)           | Male (N=173)             | p value <sup>1</sup> |
|--|--------------------------|--------------------------|--------------------------|----------------------|
| Age  | 52 [45, 57]              | 51 [45, 56]              | 54 [45, 58]              | 0.040                |
| Region of birth: Sub-Saharan Africa        | 275 (71.8)               | 167 (79.5)               | 108 (62.4)               | <0.001               |
| Time since HIV infection diagnosis (years) | 14 [9, 18]               | 14 [9, 18]               | 14 [9, 18]               | 0.74                 |
| On antiretroviral therapy                  | 380 (99.2)               | 207 (98.6)               | 173 (100.0)              | 0.32                 |
| Time since starting ART (years)            | 10 [7, 15]               | 10 [7, 15]               | 10 [6, 15]               | 0.79                 |
| HIV RNA <200 copies/mL                     | 360 (94.0)               | 199 (94.8)               | 165 (93.1)               | 0.63                 |
| Recent CD4 cell count                      | 538 [372, 747]           | 544 [364, 750]           | 534 [383, 742]           | 0.87                 |
| Current smoker                             | 36 (9.8)                 | 17 (8.4)                 | 19 (11.4)                | 0.43                 |
| <b>BMI (kg/m<sup>2</sup>)</b>              | <b>30.0 [26.6, 34.2]</b> | <b>32.3 [27.8, 36.8]</b> | <b>28.2 [25.7, 31.2]</b> | <b>&lt;0.001</b>     |
| Systemic hypertension                      | 248 (65.1)               | 131 (62.7)               | 117 (68.0)               | 0.33                 |
| Diabetes mellitus                          | 69 (18.0)                | 32 (15.2)                | 37 (21.4)                | 0.15                 |
| Kidney disease                             | 97 (25.3)                | 53 (25.2)                | 44 (25.4)                | 1.00                 |
| Cardiovascular disease                     | 27 (7.0)                 | 15 (7.1)                 | 12 (6.9)                 | 1.00                 |
| <b>Waist circumference (cm)</b>            | <b>98 [90, 105]</b>      | <b>98 [90, 107]</b>      | <b>97 [90, 104]</b>      | <b>0.162</b>         |

- 91% of women had WC ≥ 80cm; 64% of men had WC ≥ 94cm

# Linear Regression models



Participants on insulin excluded

| R <sup>2</sup> values | Female | Male  |
|-----------------------|--------|-------|
| HDL-cholesterol       | -0.05  | -0.11 |
| Triglycerides         | 0.12   | 0.12  |
| Systolic BP           | 0.13   | 0.13  |
| Diastolic BP          | 0.16   | 0.14  |
| Glucose               | 0.14   | 0.19  |
| HbA1C                 | 0.11   | 0.21  |
| HOMA-IR               | 0.24   | 0.25  |

# Receiver Operating Characteristic Curves

To identify Waist Circumference cut-offs for female participants

|  | Area under ROC curve | Waist circumference cut-off (cm) | Sensitivity       | Specificity       |
|--|----------------------|----------------------------------|-------------------|-------------------|
| HDL-cholesterol <1.3 mmol/L                      | 0.51 (0.42, 0.61)    | 100 (71, 126)                    | 0.52 (0.37, 0.65) | 0.55 (0.46, 0.62) |
| Triglycerides >1.7 mmol/L                        | 0.66 (0.56, 0.76)    | 96 (93, 105)                     | 0.95 (0.68, 1.00) | 0.43 (0.28, 0.73) |
| Systolic BP ≥130mmHg (or on anti-HPT meds)       | 0.58 (0.50, 0.66)    | 92 (84, 118)                     | 0.82 (0.18, 0.93) | 0.38 (0.22, 0.96) |
| Diastolic BP ≥85mmHg (or on anti-HPT meds)       | 0.59 (0.51, 0.67)    | 101 (87, 121)                    | 0.58 (0.15, 0.90) | 0.63 (0.27, 0.99) |
| Fasting glucose ≥5.6 mmol/L (or DM)              | 0.66 (0.59, 0.74)    | 92 (89, 103)                     | 0.96 (0.90, 1.00) | 0.33 (0.26, 0.40) |
|  |                      |                                  |                   |                   |
| HbA1c ≥6.5% (≥48 mmol/mol, or DM)                | 0.70 (0.62, 0.78)    | 100 (93, 102)                    | 0.87 (0.74, 1.00) | 0.58 (0.32, 0.69) |
| HOMA-IR ≥1.5 (excluding participants on insulin) | 0.65 (0.57, 0.74)    | 100 (98, 104)                    | 0.69 (0.52, 0.83) | 0.64 (0.50, 0.77) |

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# Receiver Operating Characteristic Curves

To identify Waist Circumference cut-offs for male participants

|  | Area under ROC curve | Waist circumference cut-off (cm) | Sensitivity       | Specificity       |
|--|----------------------|----------------------------------|-------------------|-------------------|
| HDL-cholesterol <1.0 mmol/L                      | 0.57 (0.47-0.68)     | 89 (88, 102)                     | 1.00 (0.64, 1.00) | 0.28 (0.21, 0.35) |
| Triglycerides >1.7 mmol/L                        | 0.54 (0.43-0.65)     | 93 (85, 115)                     | 0.80 (0.20, 0.94) | 0.38 (0.20, 0.93) |
| Systolic BP ≥130mmHg (or on anti-HPT meds)       | 0.66 (0.57-0.74)     | 97 (91 103)                      | 0.62 (0.42, 0.82) | 0.71 (0.46, 0.86) |
| Diastolic BP ≥85mmHg (or on anti-HPT meds)       | 0.65 (0.57, 0.74)    | 97 (93, 103)                     | 0.60 (0.41, 0.81) | 0.72 (0.47, 0.87) |
| Fasting glucose ≥5.6 mmol/L (or DM)              | 0.57 (0.48, 0.67)    | 98 (85, 115)                     | 0.59 (0.20, 0.92) | 0.63 (0.23, 0.94) |
|  |                      |                                  |                   |                   |
| HbA1c ≥6.5% (≥48 mmol/mol, or DM)                | 0.65 (0.55, 0.75)    | 98 (90, 106)                     | 0.68 (0.38, 0.92) | 0.66 (0.30, 0.86) |
| HOMA-IR ≥1.5 (excluding participants on insulin) | 0.64 (0.54, 0.73)    | 96 (92, 115)                     | 0.77 (0.26, 0.90) | 0.53 (0.35, 0.97) |

# Receiver Operating Characteristic Curves

To identify Waist Circumference cut-offs for male participants

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| HDL-cholesterol <1.0 mmol/L                      | 0.57 (0.47-0.68)     | 89 (88, 102)                     | 1.00 (0.64, 1.00) | 0.28 (0.21, 0.35) |
| Triglycerides >1.7 mmol/L                        | 0.54 (0.43-0.65)     | 93 (85, 115)                     | 0.80 (0.20, 0.94) | 0.38 (0.20, 0.93) |
| Systolic BP ≥130mmHg (or on anti-HPT meds)       | 0.66 (0.57-0.74)     | 97 (91 103)                      | 0.62 (0.42, 0.82) | 0.71 (0.46, 0.86) |
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| Triglycerides >1.7 mmol/L                        | 0.54 (0.43-0.65)     | 93 (85, 115)                     | 0.80 (0.20, 0.94) | 0.38 (0.20, 0.93) |
| Systolic BP ≥130mmHg (or on anti-HPT meds)       | 0.66 (0.57-0.74)     | 97 (91 103)                      | 0.62 (0.42, 0.82) | 0.71 (0.46, 0.86) |
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# Summary and conclusions

- Waist circumference was poorly correlated with other components of the metabolic syndrome, and with HbA1c; slightly stronger correlations were observed with HOMA-IR.
- Waist circumference cut-offs in this population were similar for women (92-101 cm) and men (93-98 cm), however, the low areas under the ROC-curves mean these WC cut-offs have poor specificity for cardiometabolic abnormalities.
- Our analyses do not support waist circumference targets for optimal cardiometabolic health in this population but suggest that a reduction in waist circumference may have beneficial effects on cardiometabolic status.

# Acknowledgments

- Guy's and St Thomas' Charity and BHIVA (Research Award)
- GEN-AFRICA and CKD-AFRICA study participants
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