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Guidance title:	BMI and waist circumference - black and minority ethnic groups
Committee:	Public Health Interventions Advisory Committee (PHIAC)
Subject of expert testimony:	Body mass index and waist circumference thresholds for intervening to prevent ill health among black, Asian and other minority ethnic groups
Evidence gaps or uncertainties:	[Please list the research questions or evidence uncertainties that the testimony should address] There is a paucity of prospective analyses which compare the association of objectively measured BMI as well as waist circumference (WC) with health outcomes among different ethnic groups within the same study. There are no such studies from the UK.
'What are the cut-off points for body mass index (BMI) among adults from black, Asian and other minority ethnic groups living in the UK that are 'risk equivalent' to the current thresholds set for white European populations?'	
Section B: Expert to complete	
Summary testimony:	

Title and Authors:

Ethnicity-specific obesity cut-points in the development of incident type 2 diabetes – a prospective study (SABRE) including three ethnic groups in the United Kingdom.

Authors: Therese Tillin , Naveed Sattar, Ian Godsland, Alun Hughes, Nish Chaturvedi, Nita Forouhi

Executive Summary:

Based on objectively measured baseline markers of obesity in middle age and prospectively ascertained outcomes, analyses in three ethnic groups in the SABRE study demonstrate that both British South Asian and African Caribbean populations have greater risk for developing type 2 diabetes at substantially lower cut-points of BMI or waist circumference than a European white population. A BMI cut point of 26 to 27 kg/m^2 in these ethnic groups broadly equates to the same diabetes risk in whites with a BMI of 30 kg/m^2. For waist circumference, cut offs of 91cm in men and 82 to 84cm in women of these ethnic groups equate to a similar risk of type diabetes as at currently recommended cut-offs of 102cm and 88cm in men and women in the European white population.

Methods:

Study Details:

Southall and Brent Re-Visited (SABRE) Study [1]: Population based cohort of 4,857 white European, South Asian and African Caribbean populations from north and west London, among whom 4,202 were non-diabetic at baseline (1988-91).

Analysis Population.

Baseline: Participants were aged 40-69 years at baseline, when they underwent anthropometry by trained research staff to measure weight (kg), height (cm) and waist circumference (cm) using standardised methods. Blood tests included fasting and post-load glucose measurements.
Follow-up: During 2008-2011, survivors from the baseline were invited to participate in a morbidity follow-up at a median follow-up of 19 years. Of the 4,202 participants without diabetes at baseline (in 1988-91), 3,908 (93%) were traced to a UK address (94% of European, 96% of South Asian and 84% of African Caribbean participants). We obtained data on follow-up diabetes status for a total of 2,533 participants (64% of those traced, or 60% of baseline eligible population), including data on 1,356 European, 842 South Asian and 335 African Caribbean participants. These represent 66% of traced Europeans, 65% of traced South Asians and 61% of traced African Caribbeans. Of the eligible baseline sample (4,202), 62% of European, 62% of South Asian and 52% of African Caribbean participants had direct follow-up data for incident diabetes.

Diabetes case ascertainment at follow-up

Incident type 2 diabetes status was identified from (a) primary care record review, (b) participant recall by questionnaire of physician-diagnosed diabetes plus either year of diagnosis or receipt of named anti-diabetic medication, or (c) follow-up biochemistry (fasting or 2h glucose) at clinical follow up. These sources contributed 75% (n=436), 10% (n=56) and 15% (n=86) respectively to total diabetes ascertainment (578 cases).

Selected Variables:

Age, sex, BMI, WC, incident diabetes, smoking (coded non-smoker, ex-smoker, current smoker) and years of education (continuous variable).

Statistical Analysis:

Body mass index (BMI) was calculated as weight (kg) divided by the square of the height (m). Unadjusted diabetes incidence rates were calculated by baseline BMI category for men and women of each ethnic group, using suggested WHO cut-points of <23, 25, 27.5 and 30 kg/m^2. There were very few people with BMIs below 18.5 and we combined all with baseline BMI of <23 as the reference category. We categorised waist circumference into broad categories (<80, 80-<90, 90-<100, 100+ cm) to calculate unadjusted incidence rates.

We used Poisson models to examine age adjusted ethnicity-specific associations between baseline BMI and waist circumference and diabetes incidence rates among men and women. Body mass index and waist circumference were modelled using restricted cubic splines with three knots. We estimated the adjusted predicted incidence rates for white European participants with BMI of 30 kg/m^2 and the corresponding BMI values for South Asian and African Caribbean participants. For waist circumference we selected the WHO 102 cm and 88 cm high-risk cut-points for men and women respectively [2] in order to estimate equivalent sex-specific cut-points in each ethnic minority group. We estimated 95% confidence rates in South Asians and African Caribbean’s which were equivalent to the incidence rates experienced by Europeans at a BMI of 30 kg/m^2.

Analyses were conducted separately in men and women for waist circumference, but for BMI, since the widely accepted BMI obesity cut-point of 30 kg/m^2 is applied to both men and women, we focused on examining findings for men and women combined. Statistical analyses were performed using STATA v12. Two-sided p values of <0.05 were considered statistically significant.

Results:

Key baseline characteristics are shown in Table 1 **confidential information removed**. At baseline, mean age (±SD) was 51.8±7.0, range 40-72 years. During the median follow-up period of 19 (IQR: 15, 20) years, diabetes developed in 578 participants (23% total sample; 14% in European, 33% in South Asian and 30% in African Caribbean participants).

Incidence rates of diabetes in men were greater in South Asian and African Caribbean participants (respectively 20.8 (95%CI:18.4, 23.6) and 16.5 (12.7, 21.4)/1000 person years) compared with 7.4 (6.3, 8.7)/1000 person years in white European participants. Likewise, incidence rates in women were highest in South Asian participants (12.0 (8.3, 17.2) and African Caribbean participants 17.5 (13.0, 23.7) compared with 7.2 (5.3, 9.8)/1000 person years in white European participants.

BMI

The age and sex adjusted incidence rate for white European men and women with baseline BMI of 30 kg/m^2 was 19.7 (95% CI 13.0, 26.4)/1000 person years. For the equivalent incidence of diabetes at a BMI of 30 kg/m^2 in white European participants, age and sex adjusted BMI cut-points were:

> BMI of 26.0 (24.6, 26.5) kg/m^2 in South Asian participants and BMI of 27.0 (26.7, 29.3kg/m^2) in African Caribbean participants (men and women combined). – See Figure 1 **confidential information removed**.

When we repeated the analyses separately in men and women (adjusted for age), the equivalent 'risk' for diabetes occurred at lower BMI in the ethnic groups as follows ("risk equivalency" at a BMI of 30 kg/m^2 in white Europeans):

> South Asian men: **confidential information removed** kg/m^2; African Caribbean men: **confidential information removed** kg/m^2; South Asian women: **confidential information removed** kg/m^2; African Caribbean women: **confidential information removed** kg/m^2

Waist circumference

For men of both ethnic minorities, waist cut-points of 91.0 (87.4, 92.4) cm were equivalent in risk to 102cm in white European men (with an age-adjusted incidence rate of 19.5 (12.1, 26.9)/1000 person years). Among women, cut-points of 84.3 (76.5, 89.8) cm in South Asian and 81.6 (73.4, 85.5) cm in African Caribbean participants were equivalent to 88cm in white European participants (with an age-adjusted incidence rate of 11.5 (5.5, 17.5)/1000 person years). See Figure 2a and 2b **confidential information removed**.

Notably, additional analyses that further adjusted for smoking status and education level did not change the findings for either BMI or WC.

Discussion:

Our findings suggest that in terms of incidence rates of development of diabetes, mid-life BMIs of 26 kg/m^2 in South Asians and of 27 kg/m^2 in African Caribbeans were equivalent to the conventional cut-point of 30 kg/m^2 in white Europeans. For central obesity, South Asian and African Caribbean men had almost identical associations between increasing waist circumference and diabetes incidence, such that in both ethnic minorities men with waist circumferences of 91 cm had equivalent risk to white European men with waist circumferences of 102 cm. Waist circumferences of 84.3 cm and 81.6 cm respectively in South Asian and African Caribbean women were associated with equivalent incidence rates of diabetes to white European women with waist circumferences of 88 cm.

Together with previous evidence, our findings raise the issue that lower obesity cut-off points than the conventional cut-off points may be warranted in immigrant South Asians and African Caribbeans compared with the European white population in the UK, to predict equivalent risk for type 2 diabetes. Inasmuch as the purpose of an anthropometric (e.g. BMI) cut-off point is to identify the proportion of people with a high risk for important health conditions (e.g. diabetes) in a population, it has the potential to inform public health action points, like health promotion, and prevention programmes including lifestyle advice. However, lowering the cut-off values in ethnic groups will have the obvious effect of increasing the prevalence of obesity among that population. At the individual level, the label of being obese would be assigned at lower BMI thresholds, with unknown consequences. Currently there is lack of evidence on whether minority ethnic groups would respond to health behaviour interventions in a similar way to white Europeans even at conventional obesity cut-offs, and nothing is known about the effectiveness of interventions if BMI thresholds to define obesity were lowered. Nonetheless, it is tempting to speculate that if health awareness of greater diabetes risk at lower obesity levels was raised among South Asians and African Caribbeans as well as among healthcare providers, it could lead to better information about appropriate behaviour change for the prevention of diabetes. For instance, one target could be to promote greater physical activity among ethnic minority groups who have well documented evidence for being less physically active than Europeans [3, 4]. Encouragingly, there is evidence that targeted lifestyle intervention among people with impaired glucose tolerance is effective in preventing or delaying the onset of diabetes among South Asians in India [5]. We need to fill the research gap to identify if such lifestyle interventions could also work among minority ethnic group populations with obesity defined using lower cut-points. Given the rapidly escalating prevalence of diabetes in these ethnic groups these issues are of major public health importance. Taken collectively these issues argue for public health action points for metabolic risk at lower BMI (and waist circumference) cut points among the South Asian and African Caribbean ethnic groups. However, due consideration is needed of the potential benefits and harms of a public health action point. The use of lower cut-points to label people as obese could incur unintended consequences of the label itself, of increased prevalence (of obesity) as well as the potential for refusal of some interventions to individuals where there are BMI criteria for exclusion, while benefits could accrue from early lifestyle advice, health promotion and preventive measures.

Study strengths and limitations:

SABRE is a longitudinal study with participants from three ethnic groups drawn from the same west and north-west London population. Study follow-up is lengthy (19 years) from middle age and there are good numbers of diabetes cases in men. We also have objectively measured rather than self-assessed anthropometric data and diabetes incidence was comprehensively assessed at individual level via primary care record review, self-report, medication use and direct testing to identify undiagnosed cases. We believe this to be the first longitudinal study in the UK to report ethnicity- and sex-specific associations between mid-life BMI and waist circumference and incident diabetes. We acknowledge that number of women in this study is small, due to the initial study design and we would urge caution in considering the cut-points for women. Loss to follow-up is usual in cohort studies and follow-up data are missing for approximately 40% of participants (38% to 48% across ethnic groups), however, there were no significant differences in baseline characteristics of those with and without follow-up data and we would not anticipate (though we cannot exclude) differences in the associations between incident diabetes and baseline obesity measures in those lost to follow-up. We also acknowledge that we have anthropometric data from only a single measurement made in mid-life. However, the findings are plausible and correspond with the unadjusted rates and probabilities. Our findings are also consistent with earlier studies in Asian populations which recommended BMI cut-points ranging between 22 and 27 kg/m^2 as equivalent to 30 kg/m^2 in Europeans in association with diabetes or increased cardiometabolic risk (6-10). We note that in SABRE, South Asian and African Caribbean study participants were all first generation migrants and these findings may not necessarily be applicable to future generations, or to South Asians and African Caribbeans living in their home countries or to those who have migrated to countries other than the UK, or to those of mixed ethnicity. Moreover, our analyses do not include other ethnic groups in the UK such as the Chinese or people of Middle Eastern origin. Our findings of the lower obesity cut-points in South Asians and African Caribbeans compared with white Europeans apply only to the outcome of type 2 diabetes, and may not apply to other endpoints such as cardiovascular disease, cancer or mortality.

Why diabetes as outcome?

The rationale to choose diabetes as the most appropriate outcome for these analyses is based on its progressive and strong associations with adiposity, and given its rising prevalence and public health burden globally. Moreover, there is clear evidence that obesity and type 2 diabetes are causally linked, and that adiposity is a major risk factor in all ethnic groups, being a central component of all diabetes risk scores. By contrast, BMI commonly displays complex J-shaped or U-shaped associations with vascular and mortality outcomes (due in many cases to reverse causality whereby co-morbidity, sub-clinical illness or smoking may lead to weight loss, yet increase mortality risk) making interpretations of such relationships much more difficult.

Conclusion:

In an analysis of a tri-ethnic cohort (SABRE study), middle-aged British South Asians and African Caribbeans had equivalent risk of developing diabetes at substantially lower cut-points of BMI or waist circumference than white Europeans. Our findings suggest the potential benefit of public health measures for the prevention of metabolic risk in South Asian and African Caribbean populations long before the current conventional obesity cut-points are reached.

For public health guidance, it might be reasonable to use pragmatic lower BMI and WC thresholds for metabolic risk among South Asians and African Caribbeans as a “black, Asian and minority ethnic - BAME)” group rather than setting different thresholds for each separate ethnic group. While acknowledging the strengths and limitations of the SABRE study, our results suggest that the following thresholds could be potentially used for PH action.
For BMI – a threshold of 27 kg/m^2 in both men and women of South Asian and African Caribbean origin.
For WC – a threshold of 91 cm in men and 84 cm in women of South Asian and African Caribbean origin (or rounded to nearest values in inches, for greater ease of use).
We would caution that these cut points should not be used to classify or label people as obese, which could incur unintended consequences; their use should be to trigger public health action for metabolic risk.

Appendix:

See Table 1, Figure 1, Figure 2a, Figure 2b **confidential information removed**

References:

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Table 1. Baseline characteristics by ethnicity and sex (for those traced and followed up, and without diabetes at baseline): SABRE study, London (baseline 1988-91)

	Men			Women		
Means±SD or geometric means(95%CI)	European	South Asian	African Caribbean	European	South Asian	African Caribbean
Total number at baseline without diabetes						
Number followed up (% of baseline)						
Age: years range						
BMI, kg/m^2						
BMI categories, kg/m^2, %						
<23						
23-<25						
25-<27.5						
27.5-<30						
30-<40						
>=40						
Waist circumference, cm						
Waist categories, %						
<80 cm						
80-<90 cm						
90-<100 cm						
100+ cm						
Years of education						
Smoking: current/ex/never %						

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*p<0.05, **p<0.01, ***p<0.001