The excess risk of cardiovascular disease in people with type 2 diabetes of South Asian ethnicity

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Article points

1. A literature search was performed to determine factors that increase the excess risk of cardiovascular disease (CVD) in people with diabetes from ethnic minorities.
2. It was found that people with type 2 diabetes of South Asian ethnicity present with unique characteristics that put them at higher cardiovascular risk.
3. It is therefore crucial to address these risk factors individually and specifically to the needs of each ethnic group.
4. A clinical CVD risk calculator should be used to assess individual risk, and should include variables such as diabetes, ethnicity and social deprivation.

Key words

- Cardiovascular disease
- Diabetes risk factors
- Risk management
- South Asian ethnicity

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People with type 2 diabetes have an increased risk of cardiovascular disease (CVD) compared with people without diabetes. The prevalence of diabetes in men from the Heart of Birmingham Teaching PCT is twice as high as the UK average, and over 300 people in this area die prematurely each year from diabetes or CVD; seven out of 10 people in this area are Black or Asian (Heart of Birmingham Teaching PCT, 2008). This article explores reasons for these excess circulatory deaths, such as whether excess mortality can be explained by the high proportion of people from ethnic minorities living in the area. A literature search was performed to identify up-to-date clinical evidence on cardiovascular risk management in people with diabetes from ethnic minorities. Evidence confirms that people with type 2 diabetes of South Asian ethnicity present with unique characteristics that put them at higher cardiovascular risk. It is therefore important to use a clinical CVD risk calculator such as QRISK®2 (2012), which incorporates ethnicity and diabetes as variables.

There are 2.9 million people diagnosed with diabetes in the UK (Diabetes UK, 2012), and figures based on the APHO Diabetes Prevalence Model indicate that by 2025 this will rise to approximately 5 million people (Yorkshire and Humber Public Health Observatory, 2012). This diabetes epidemic has negative health, social and economic consequences; for example, people with type 2 diabetes have a two- to four-fold increased risk of cardiovascular disease (CVD) compared with people without diabetes (Coutinho et al, 1999). Additionally, rates of CVD in people with diabetes vary markedly by country, race and ethnicity (Fuller et al, 1996).

The author worked as a clinician in the Heart of Birmingham Teaching Primary Care Trust (PCT), which covers some of the city's poorest neighbourhoods and includes around 300 000 people; seven out of 10 people in this area are black or Asian (Heart of Birmingham Teaching PCT, 2008). The rate of diabetes in men from Birmingham is twice as high as the UK average, and statistics show that 14.7% of men over the age of 40 years have diabetes in Birmingham, compared with the national average of 5.8% (Diabetes UK, 2008a). Over 300 people in this area die prematurely (aged <75 years) each year from diabetes or CVD, and between 50 and 100 of these "premature" deaths could be avoided through better clinical care.

In this study the author explores reasons for the excess circulatory deaths in the Heart of Birmingham Teaching PCT, such as whether this excess mortality can be explained by the high proportion of people from ethnic minorities living in the area. A literature search was performed to identify up-to-date clinical evidence on cardiovascular risk management in people with diabetes from ethnic minorities; this information was used to explore the causes of excess CVD risk in ethnic minority populations.

The author examines ways to combat this excess mortality and considers if more strict targets are needed for people from ethnic minorities in the management of diabetes and reduction in cardiovascular risk.

Epidemiology of diabetes in people from ethnic minorities

More than one in 10 (11.6%) deaths among 20–79-year-olds in England can be attributed to diabetes (Yorkshire and Humber Public Health Observatory, 2008). These figures confirm that diabetes is one of the biggest health challenges facing the UK today (Diabetes UK, 2008b); CVD is the most common cause (about 75%) of deaths in people with type 2 diabetes (Williams and Pickup, 2004). In the UK, circulatory disease was the largest single cause of death in 2005 (Office for National Statistics, 2008).

The UK population is increasingly multi-ethnic; figures show that 7.9% of the UK population in 2001 belonged to an ethnic minority (UK Government, 2004; *Table 1*). The non-Caucasian UK population comprised the following ethnic minority groups: Asian or Asian British (50%); Black or Black British (25%); mixed (15%); Chinese (5%); and other ethnic groups (5%). The largest ethnic minority group was Indian ethnicity (22.7% of the non-Caucasian population), followed by Pakistani (16.1%), mixed (14.6%), Black Caribbean (12.2%), Black African (10.5%) and Bangladeshi (6.1%) ethnicity; the remaining ethnic minority groups each accounted for less than 0.5% of the UK population, and together totalled 1.4% (UK Government, 2004).

In the UK the number of people who came from an ethnic group other than Caucasian increased from 3.0 million in 1991 to 4.6 million in 2001, thus showing a significant 53% rise in the ethnic minority population between 1991 and 2001 (UK Government, 2004).

The prevalence of type 2 diabetes is rising rapidly worldwide, particularly in South Asian people living in urban areas (DECODA Study Group, 2003). In the UK, the prevalence of type 2 diabetes is raised in migrant South Asian populations compared with in people of European origin (Simmons et al, 1991); Mather et al (1998) found this prevalence to be four- to six-fold higher in South Asian people than in White Europeans.

Compared with Caucasian people, the onset of type 2 diabetes can be a decade earlier in South Asian people, and they also present with much higher cardiovascular complications with higher morbidity and a 50% higher mortality (Chaturvedi and Fuller, 1996).

In the "*Health Survey For England 2004. The Health of Minority Ethnic Groups*" (The Information Centre, 2006), results indicated that the age-adjusted prevalence of doctor-diagnosed diabetes was increased almost three-fold in men of Bangladeshi and Pakistani ethnicity, compared with the UK male population; similarly, the chances of having diabetes were increased five times in Pakistani women and at least three times in Bangladeshi women. The survey also found that among men aged ≥55 years, Pakistani men had the highest

Table 1. Population of the UK by ethnic group, April 2001.

Ethnic group	Total population	(%)	Non-Caucasian population (%)
● Caucasian	54 153 898	(92.1)	–
● Mixed	677 117	(1.2)	14.6
● All Asian or Asian British	2 331 423	(4.0)	50.3
– Indian	1 053 411	(1.8)	22.7
– Pakistani	747 285	(1.3)	16.1
– Bangladeshi	283 063	(0.5)	6.1
– Other Asian	247 664	(0.4)	5.3
● All Black or Black British	1 148 738	(2.0)	24.8
– Black Caribbean	565 876	(1.0)	12.2
– Black African	485 277	(0.8)	10.5
– Black other	97 585	(0.2)	2.1
● Chinese	247 403	(0.4)	5.3
● Other ethnic groups	230 615	(0.4)	5.0
All ethnic minority populations	*4 635 296*	*(7.9)*	*100.0*
Total UK population	***58 789 194***	***(100.0)***	

From UK Government (2004).

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prevalence of ischaemic heart disease (IHD; 35.1%) while Black African men had the lowest prevalence (5.2%); among women ≥55 years, Indian women had the highest prevalence of IHD (14.7%) while Black Caribbean women had the lowest prevalence (6.3%). The prevalence of myocardial infarction (MI) in men aged ≥55 years was highest in Pakistani men (19%) and lowest in Black Caribbean men (9.3%).

Mortality from coronary heart disease (CHD) is significantly raised in both men and women born on the Indian subcontinent (Balarajan, 1996). This excess risk of CHD is seen in all South Asian populations living in the UK (McKeigue et al, 1989); interestingly, this finding holds true even for second-generation South Asian immigrants (Shaukat et al, 1995).

A comparative study conducted in East London showed that despite the fact that a higher proportion of South Asian people (Indian, Pakistani and Bangladeshi ethnicity) received anti-thrombolytic therapy than Caucasian people (81.2% versus 73.8%, respectively), South Asian individuals had a higher risk of mortality during the 6 months' follow-up (Wilkinson et al, 1996). The authors concluded that this was largely attributable to the higher prevalence of diabetes in the South Asian population, which may have contributed to the increased risk of death from CHD.

Similarly, South Asian people undergoing coronary artery bypass grafting have almost twice the mortality of Caucasian people undergoing the same procedure (Zindrou et al, 2001); this could be because South Asian people frequently have premature atherosclerosis with more diffuse and aggressive disease than Caucasian people (Anand et al, 2000).

Diabetes is also widespread among Britain's Afro-Caribbean population, as data suggest that among Black Caribbean men and women the overprevalence of diabetes is 10% and 8%, respectively. However, as stated above, the prevalence of CHD in this population is low (The Information Centre, 2006). Thus the higher prevalence of IHD in people with diabetes of South Asian ethnicity remains unexplained by having diabetes alone, and mandates search for further evidence to find the causes of this excess mortality. Overall, the associations reported between certain ethnic groups and CVD risk vary considerably, and it remains unclear what proportion of the risk varies with other known risk factors and what proportion is explained by ethnicity.

Diabetes risk factors and ethnicity

Differences between Asian, Afro-Caribbean and Caucasian people at diagnosis of type 2 diabetes have been studied (UK Prospective Diabetes Study [UKPDS] Group, 1994). The authors found that Asian individuals were younger at diabetes diagnosis ($P<0.001$), with a mean age of 46.8 years for men and 47.6 years for women; this compares with 51.8 years and 52.9 years for Caucasian men and women, respectively, and 51.6 years and 50.2 years for Afro-Caribbean men and women, respectively. Asian people were less obese than Caucasian and Afro-Caribbean people, but had a higher waist-to-hip ratio.

Blood pressure levels were also lower in Asian individuals, with a mean systolic blood pressure of at least 10 mmHg lower than Caucasian and Afro-Caribbean individuals in the study. Additionally, Asian people in the study more often abstained from smoking and drinking alcohol than people from other ethnicities. Despite these differences in the baseline characteristics, this study showed a similar prevalence of complications between Asian, Caucasian and Afro-Caribbean individuals at diagnosis of type 2 diabetes.

The UKPDS Group (1998) found that after adjusting for conventional cardiovascular risk factors, Afro-Caribbean people with diabetes had a lower risk of MI than Caucasian people. South Asian people were significantly younger at the time of MI (mean age, 56.5 years) than Caucasian (62.0 years) and Afro-Caribbean (60.2 years) people. However, the study showed significant differences in cardiovascular risk factors by ethnicity; Afro-Caribbean individuals had a higher HbA_{1c} but lower fasting plasma insulin, triglycerides and total cholesterol compared with Caucasian people. South Asian people also had lower levels of total cholesterol and of LDL-cholesterol compared with Caucasian people. South Asian and Afro-Caribbean women were far less likely to smoke than Caucasian women.

Contrary to this evidence, a further study based on the Southall Diabetes Survey in the UK

Page points

1. Disparity in findings from studies mandates the identification of more robust evidence to assess the association of ethnicity and cardiovascular risk in people with diabetes.
2. A systematic search of the literature identified various factors that contribute to the excess CVD risk in South Asian people with type 2 diabetes.
3. Obesity is present in most South Asian people with type 2 diabetes.
4. Studies have provided concrete and similar evidence that show raised triglyceride levels and low HDL-cholesterol concentrations in Asian immigrants compared with the Caucasian population.

showed that South Asian people with diabetes aged 30–64 years were significantly more likely than age-matched Caucasian people with diabetes to die as a result of IHD (Mather et al, 1998). In this study, adjustments were made for differences in age, sex and diabetes duration; however, one limitation was the lack of adjustment for differences in other cardiovascular risk factors, which may have accounted for this increased risk.

Similar limitations can also be seen in data from the UKPDS 32 (UKPDS Group, 1998), where certain unmeasured factors may have accounted for the finding of no increased risk of MI in South Asian people with diabetes when compared with Caucasian participants. One major limitation of the UKPDS 32 is the lack of further subdivision of South Asian ethnicity; for example, a lack of comparison of MI prevalence between Pakistani, Bangladesh and Indian participants. If the South Asian group comprised mostly Indian people, this may have confounded the results as the evidence suggests that Pakistani and Bangladeshi people appear to have a higher prevalence of heart disease than Indian people (Modood et al, 1997).

Interestingly, UKPDS 32 excluded the subjects who could not speak English sufficiently well to consent to and comprehend the protocol. A survey undertaken in the mid-1990s of >1000 adults, mainly migrants, aged 16–64 years from selected ethnic groups in England and Wales found that only 16% of Bengali, 44% of Gujarati and 29% of Punjabi people reached a level of survival competence in written and spoken English, which is a level that can minimally provide independent functioning (Carr-Hill et al, 1996). If "poor English" is associated with deprivation, which is shown to be associated with an increased burden of vascular disease among people with diabetes (Wild et al, 2008), in the UKPDS 32 the reported MI rates for the South Asian cohort may have been confounded as a result of selection bias.

Disparity in findings from all these studies mandates the identification of more robust evidence to assess the association of ethnicity and cardiovascular risk in people with diabetes.

Identification of excess CVD risk factors in South Asian people with diabetes

A systematic search of the literature identified the following factors that contribute to the excess CVD risk in South Asian people with type 2 diabetes.

Central obesity and insulin resistance

Obesity is present in most South Asian people with type 2 diabetes (Hanif et al, 2002). The prevalence and associations of obesity in a South Asian population with type 2 diabetes was assessed from six inner-city GP practices in Birmingham; in total, 200 individuals (108 women) randomly selected from two GP practices were assessed. Using World Health Organization (WHO) criteria for the classification of obesity (defined as a BMI >30 kg/m^2), obesity was present in 45.2% of the South Asian cohort.

Ehtisham et al (2005) provided evidence that suggests the presence of higher insulin resistance in healthy adolescents of South Asian ethnicity compared with Caucasian adolescents; however, the authors noted that a healthy adolescent of South Asian ethnicity, even within normal BMI limits for that given age, is more likely to have higher levels of body fat that is more centrally distributed. This study was performed in Birmingham, and participants within the South Asian cohort were mostly Pakistani adolescents. Results confirmed that South Asian adolescents were less insulin sensitive than White European adolescents (homeostatic model assessment of insulin sensitivity, 52.4% versus 58.9%, respectively; $P<0.05$), they had significantly more body fat (girls, 30.6% versus 26.0%, $P<0.005$; boys, 20.8% versus 14.8%, $P<0.001$) and more central fat (waist–thigh ratio in girls, 1.36 versus 1.25, $P<0.001$; boys, 1.52 versus 1.42, $P<0.001$).

Lipid abnormalities

The UKPDS (UKPDS Group, 2001) has provided concrete and similar evidence suggesting there are raised triglyceride levels and low HDL-cholesterol concentrations in Asian immigrants compared with the Caucasian population; this pattern of lipid abnormality is typical of the dyslipidaemia associated with diabetes, and is an important characteristic of the metabolic syndrome.

Sedentary lifestyle

The risk of developing type 2 diabetes is greater in individuals who are overweight or less active physically (Diabetes Prevention Program Research Group, 2002); this has previously been proven for

people of Asian ethnicity (Dowse et al, 1991).

There is evidence that South Asian people who are newly diagnosed with type 2 diabetes are likely to be more often sedentary and less physically active than matched Caucasian and Afro-Caribbean people; the UKPDS Group (1994) demonstrated that 40% of South Asian people were sedentary and less physically active, compared with 17% of Caucasian people and 16% of Afro-Caribbean people at the time of diagnosis of type 2 diabetes. Further evidence comes from The Information Centre (2006), which demonstrated that the prevalence of low activity levels (defined as participation in <30 minutes a week of at least moderate-intensity activity) was markedly high among South Asian men (at least 68%) and women (at least 74%).

Smoking

The Information Centre (2006) showed that the prevalence of self-reported cigarette smoking was 24% among men within the general population. Equivalent estimates among ethnic groups showed the highest prevalence of smoking was in Bangladeshi men (40%), followed by Pakistani men (29%); the prevalence of self-reported smoking in Black Caribbean and Indian men was 25% and 20%, respectively.

The UKPDS Group (1994) showed a lower prevalence of smoking in Asian people who were newly diagnosed with type 2 diabetes. This study demonstrated that 42% of the Asian cohort never smoked, compared with 21% of Caucasian and 36% of Afro-Caribbean participants.

The results from the discussed studies show that there are some differences within populations; for example, within the South Asian population, Bangladeshi men are twice as likely to smoke than Pakistani or Indian men, which could at least explain one of the causes of the excess CVD risk in Bangladeshi men. However, the prevalence of smoking is more or less the same among men of various other ethnic groups, and it is significantly low among Asian women. Therefore, smoking in itself does not explain the increased CVD risk in Pakistani and Indian people within the South Asian ethnic group.

Genetic factors

The development of obesity and type 2 diabetes is triggered by environmental factors in genetically susceptible individuals; not all obese individuals develop diabetes, and genetic susceptibility appears to be a prerequisite. The change in the environment towards a more affluent Western lifestyle plays a key role in the epidemic increase in the prevalence of type 2 diabetes worldwide (Ridderstrale and Groop, 2009).

There is robust evidence from metabolic and genetic studies that supports a role for ENPP1/PC1 in the pathophysiology of type 2 diabetes and other insulin-resistance-related conditions (Bacci et al, 2005); ENPP1/PC1 is a widely expressed class II transmembrane glycoprotein, which can interact with insulin receptors and decrease the insulin-induced tyrosine phosphorylation of its intracytoplasmic domain (Maddux and Goldfine, 2000). It has been shown that if a variation K121Q occurs in the gene that codes for ENPP1/PC1, the chances of developing insulin resistance and type 2 diabetes increase massively (Bacci et al, 2005).

The prevalence of this K121Q variation appears to be different in various populations, and has been reported to be higher in Asian Indian people than in Caucasian people (Abate et al, 2003); similarly, a higher prevalence of this variation has been reported in African American people (Chandalia et al, 2007). Thus this may explain the higher prevalence of diabetes in these ethnic groups.

Socioeconomic and cultural factors

There are a number of cultural and socioeconomic factors that may explain the excess CVD risk in people with diabetes across ethnic groups.

A report by the Office for National Statistics (2002) showed that in 2000–2001 almost 68% of the Pakistani and Bangladeshi UK population were living in low-income households, and both of these groups were more reliant than other groups on social security benefits, which made up nearly a fifth (19%) of their gross income; benefits were also a considerable source of income for the Black population (15%). In terms of education, this report showed that Pakistani and Bangladeshi people were the most likely to be unqualified.

Deprivation has been shown to be associated with a higher prevalence of type 2 diabetes (Connolly et al, 2000). Additionally, less educated and lower earning individuals with diabetes bear a larger

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Page points

1. The language barrier is an important factor in poor outcomes; there is a significant proportion of Asian people who barely reach a level of survival competence in written and spoken English.
2. The lack of knowledge of diabetes and health beliefs among ethnic groups in the UK is an important consideration; for example, a lack of diabetes and coronary heart disease-related knowledge has been seen in South Asian people.
3. A higher prevalence of microalbuminuria and end-stage renal disease in people with diabetes of South Asian ethnicity may be contributing to their increased risk of cardiovascular disease.
4. In order to reduce cardiovascular risk in South Asian people with diabetes, there needs to be a specific focus on preventing and managing renal complications.

burden of morbidity but use hospital care less (Bachmann et al, 2003). Deprivation is shown to be associated with a higher prevalence of obesity and failure in achieving targets for reducing CVD risk in diabetes (Wild et al, 2008).

The language barrier is another important factor in poor outcomes; as discussed previously, there is a significant proportion of Asian people who barely reach a level of survival competence in written and spoken English. Poor proficiency in the English language is significantly associated with undetected elevated blood glucose in Bangladeshi people and undetected elevated blood pressure in Pakistani people (Mainous et al, 2006). Thus the language barrier appears to be a source of disengagement of these ethnic groups with healthcare providers.

The lack of knowledge of diabetes and health beliefs among ethnic groups in the UK is an important consideration. For example, a lack of diabetes and CHD-related knowledge has been seen in South Asian people (Rankin and Bhopal, 2001); this study showed that a considerable proportion of Asian people did not even have basic information about diabetes or CHD.

Renal factors

There is evidence suggesting that the prevalence of microalbuminuria and macroalbuminuria is increased in people of Asian ethnicity compared with Caucasian people (Retnakaran et al, 2006). This finding has also been shown in studies from UK populations with relatively large numbers of South Asian people (Burden et al, 1992). A systematic review of the literature by Gerstein and Dinneen concluded that microalbuminuria phase in people with type 2 diabetes appears not only to be a predictor of renal disease but also a powerful marker of cardiovascular mortality (Gerstein and Dinneen, 1999).

Diabetic nephropathy is associated with high mortality; the mortality from all causes in people with diabetic nephropathy is 20–40 times higher than that of matched individuals without nephropathy (Trevisan and Viberti, 2002).

Therefore, in the light of evidence from all these studies it could be argued that a higher prevalence of microalbuminuria and end-stage renal disease in people with diabetes of South Asian ethnicity may be contributing to their increased risk of CVD. Thus in order to reduce cardiovascular risk in this group, there needs to be a specific focus on preventing and managing renal complications.

Blood pressure

The *Health Survey for England 2004* (The Information Centre, 2006) showed that the observed prevalence of hypertension was higher in Black Caribbean people (38% in men; 32% in women) than in other ethnic minority groups; in the general population, 32% of men and 29% of women were found to be hypertensive. Interestingly, the lowest prevalence of hypertension was observed in Bangladeshi men (16%) and Pakistani women (15%).

The UKPDS Group (1994) also observed that blood pressure levels were lower in Asian people newly diagnosed with type 2 diabetes, with a mean systolic blood pressure of at least 10 mmHg lower in Asian people than in Caucasian and Afro-Caribbean people.

Overall the prevalence of hypertension in South Asian people in the UK may be similar to the indigenous population. However, the prevalence of hypertension in this group remains a significant risk factor for CVD, and South Asian people in the UK may be at higher risk of diabetic and cardiovascular complications as a result of raised blood pressure because of their overall adverse risk factor profile (Barnett et al, 2006).

Dietary factors

Asian meals have been shown to cause prolonged periods of glycaemia (Burden et al, 2005), and South Asian dietary patterns have also been shown to result in a higher degree of insulinaemia directly related to high carbohydrate intake (Sevak and Marmot, 1994). However, the question of which aspects of the South Asian lifestyle in the UK predispose these people to glucose intolerance and dyslipidaemia remains largely unanswered (Hanif, 2005).

Implications for primary care

All the evidence discussed above confirms that people with type 2 diabetes of South Asian ethnicity present with unique characteristics that put them at higher cardiovascular risk. All these identified, distinctive factors when present together

constitute a state of heightened cardiovascular risk, thus making it crucial to address all these factors individually and specifically to the needs of each ethnic group. Thus it is important to use a clinical CVD risk calculator that incorporates ethnicity and diabetes as variables; QRISK®2 (2012) is the most up-to-date CVD risk calculator that includes self-assigned ethnicity and diabetes as well as other additional factors, including deprivation measured using the Townsend Deprivation Score. By including this additional information it is more likely that healthcare professionals can accurately estimate CVD risk for an individual.

In 2004 the UK government introduced "pay-for-performance rewards" for primary care in the form of Quality and Outcomes Framework (QOF) points (The Information Centre, 2012). Millett et al (2007) carried out research in an ethnically diverse area of Southwest London; they found that although more individuals overall met their treatment targets after the introduction of QOF points than before, this system had not addressed the disparities and gaps in the management and control of diabetes between ethnic groups and the Caucasian population in the UK. Thus the current pay-for-performance strategy alone is not sufficient to address ethnic disparities in the quality of care.

The introduction of ethnicity-specific targets and incentives may result in primary care staff engaging better with people with diabetes from ethnic minorities; for example, it is proposed that QOF points should be designated for providing group sessions for people from ethnic minorities. Thus ethnicity-driven QOF targets may be an answer to this problem of healthcare disparities.

Additionally, while the current QOF points reward primary care for keeping an obesity register, there is no incentive in place for taking any measure to help manage obese individuals on this register. Thus perhaps rewarding extra QOF points for recording waist circumference in all Asian individuals presenting to primary care would enable the earlier identification of people at risk.

There are also significant implications for commissioners and policy makers in primary care, particularly in relation to the implementation of screening programmes such as vascular checks (NHS Health Check, 2012). It will be important to ensure higher-risk groups, such as people of South Asian ethnicity or people from deprived areas, respond to invitations for screening; otherwise, this approach may inadvertently widen health inequalities. Policy makers and individual practices would need to work closely together in order to guard against this by monitoring uptake; where uptake is low but risk is high they will need to use other approaches to improve uptake in these groups. These may include more innovative approaches, such as the use of social services and religious and community facilities.

There is a need to develop local policies in order to raise local awareness to reduce CVD risk across all ethnic groups through population-wide initiatives, such as promoting physical activity, healthy eating and smoking cessation measures. Similarly, clinical commissioning must also focus on individual risk assessments; although there is no agreement as to which risk assessment tool is the preferred CVD calculator tool for the UK population, QRISK2 (2012) may become the calculator of choice because it includes social deprivation and ethnicity variables. ■

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Abate N, Carulli A, Grundy S (2003) Genetic polymorphism PC-1 K121Q and ethnic susceptibility to insulin resistance. *J Clin Endocrinol Metab* **88**: 5927–34

Anand S, Yusuf S, Vuksan V (2000) Differences in risk factors, atherosclerosis and cardiovascular disease between ethnic groups in Canada: The Study of Health Assessment and Risk in Ethnic groups (SHARE). *Lancet* **356**: 279–84

Bacci S, Ludovico O, Prudente S (2005) The K121Q polymorphism of the ENPP1/PC-1 gene is associated with insulin resistance/atherogenic phenotypes, including earlier onset of type 2 diabetes and myocardial infarction. *Diabetes* **54**: 3021–5

Bachmann M et al (2003) Socioeconomic inequalities in diabetes complications, control, attitudes and health service use. *Diabet Med* **20**: 921–9

Balarajan R (1996) Ethnicity and variations in mortality from coronary heart disease. *Health Trends* **28:** 45–51

Barnett A et al (2006) Type 2 diabetes and cardiovascular risk in the UK South Asian community. *Diabetologia* **49**: 2234–64

Burden A, McNally P, Feehally J, Wallis J (1992) Increased incidence of end-stage renal failure secondary to diabetes mellitus in Asian ethnic groups in UK. *Diabet Med* **9**: 641–5

Burden M, Samanta A, Spalding D, Burden A (2005) A comparison of the glycaemic and insulinaemic effects of an Asian and a European meal. *Pract Diabetes Int* **11**: 208–11

Carr-Hill R, Passingham S, Wolf A (1996) *Lost Opportunities: The Language Skills of Linguistic Minorities in England and Wales.* ERIC Clearinghouse, Washington, DC, USA

Chandalia M, Grundy M, Abate N (2007) Ethnic differences in the frequency of ENPP1/PC1 121Q genetic variant in the Dallas Heart Study cohort. *J Diabetes Complications* **21**: 143–8

Chaturvedi N, Fuller J (1996) Ethnic differences in mortality from cardiovascular disease in the UK: Do they persist in people with diabetes? *J Epidemiol Comm Health* **50**: 137–9

"There is a need to develop local policies in order to raise local awareness to reduce CVD risk across all ethnic groups through population-wide initiatives, such as promoting physical activity, healthy eating and smoking cessation measures."

Connolly V, Unwin N, Kelly W (2000) Diabetes prevalence and socioeconomic status: A population-based study showing increased prevalence of type 2 diabetes mellitus in deprived areas. *J Epidemiol Community Health* **54**: 173–7

Coutinho M, Gerstein H, Yusuf S (1999) The relationship between glucose and cardiovascular events: A meta-regression analysis of published data from 20 studies of 95 783 individuals followed for 12.4 years. *Diabetes Care* **22**: 233–40

DECODA Study Group (2003) Age- and sex-specific prevalence of diabetes and impaired glucose regulation in 11 Asian cohorts. *Diabetes Care* **26**: 1770–80

Diabetes Prevention Program Research Group (2002) Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* **346:** 393–403

Diabetes UK (2008a) *Birmingham Men Twice as Likely to Have Diabetes*. Available at: http://bit.ly/T6GeTv (accessed 18.1.13)

Diabetes UK (2008b) *Diabetes Prevalence 2008*. Available at: http://bit.ly/WwZ1Ul (accessed 18.01.13)

Diabetes UK (2012) *State of the nation*. Available at: http://www.diabetes.org.uk/Documents/Reports/State-of-the-Nation-2012.pdf (accessed 18.1.13)

Dowse G et al (1991) Abdominal obesity and physical inactivity as risk factors for NIDDM and impaired glucose tolerance in Indian, Creole, and Chinese Mauritians. *Diabetes Care* **14:** 271–82

Ehtisham S, Crabtree N, Barrett T (2005) Ethnic differences in insulin resistance and body composition in United Kingdom adolescents. *J Clin Endocrinol Metab* **90**: 3963–9

Fuller J, Stevens S, Wang S (1996) International variations in cardiovascular mortality associated with diabetes mellitus: The WHO Multinational Study of Vascular Disease in Diabetes. *Ann Med* **28**: 319–22

Gerstein H, Dinneen S (1999) The association of microalbuminuria and mortality in non insulin dependent diabetes mellitus. A systematic overview of literature. *Arch Intern Med* **157:** 1413–8

Hanif M et al (2002) Obesity is highly prevalent in Indo-Asian type 2 diabetics and increases risk of metabolic syndrome. *Diabet Med* **19**: 6

Hanif W (2005) *Type 2 Diabetes and Obesity in the South Asian Population*. Available at: http://bit.ly/UCUjWT (accessed 18.01.13)

Heart of Birmingham Teaching PCT (2008) *Heart of Birmingham Teaching PCT*. Available at: http://www.hobtpct.nhs.uk/ (accessed 18.01.13)

Maddux B, Goldfine I (2000) Membrane glycoprotein PC-1 inhibition of insulin receptor function occurs via direct interaction with the receptor alpha-subunit. *Diabetes* **49:** 13–9

McKeigue P, Miller G, Marmot M (1989) Coronary heart disease in south Asians overseas: A review. *J Clin Epidemiol* **422**: 597–609

Mainous A, Baker R, Majeed A, Tilley B (2006) English language skills and diabetes and hypertension among foreign-born South Asian adults in England. *Public Health Rep* **121**: 331–6

Mather H, Chaturvedi N, Fuller J (1998) Mortality and morbidity from diabetes in South Asians and Europeans. 11 year follow-up of the Southall Diabetes Survey. *Diabet Med* **15**: 53–9

Millett C, Gray J, Saxena S, Majeed A (2007) Ethnic disparities in diabetes management and pay-for-performance in the UK: The Wandsworth Prospective Diabetes Study. *PLoS Med* **4**: 1087–93

Modood T, Berthoud R, Lakey J et al (1997) *Ethnic Minorities in Britain: Diversity and Disadvantage*. The Fourth National Survey of Ethnic Minorities. Policy Studies Institute, London

NHS Health Check (2012) *NHS Health Check*. Available at: http://www.healthcheck.nhs.uk/ (accessed 18.1.13)

Office for National Statistics (2002) *Social focus in brief*. Available at: http://www.ons.gov.uk (accessed 18.01.13)

Office for National Statistics (2008) *Marked differences between UK's four National Health Services*. Available at: http://www.ons.gov.uk/ons/rel/ukhs/united-kingdom-health-statistics/2008/2008-news-release.pdf (accessed 18.01.13)

QRISK®2 (2012) *QRISK®2-2012 Cardiovascular Disease Risk Calculator*. Available at: http://qrisk.org/ (accessed 18.1.13)

Rankin J, Bhopal R (2001) Understanding of heart disease and diabetes in a South Asian community: Cross-sectional study testing the "snowball" sample method. *Public Health* **115**: 253–60. Available at: http://www.ncbi.nlm.nih.gov/pubmed/11464296 (accessed 18.1.13)

Retnakaran R et al (2006) Risk factors for renal dysfunction in type 2 diabetes. UKPDS 74. *Diabetes* **55**: 1832–9

Ridderstrale M, Groop L (2009) Genetic dissection of type 2 diabetes. *Mol Cell Endocrinol* **297**: 10–7. Available at: http://www.ncbi.nlm.nih.gov/pubmed/19000735 (accessed 18.1.13)

Sevak LM, Marmot M (1994) Relationship of hyperinsulinemia to dietary intake in South Asian and European men. *Am J Clin Nutr* **59**: 1069–74

Shaukat N, DeBono D, Jones D (1995) A comparison of risk factors in south Asian and north European coronary artery patients with their young male offspring. *Br Heart J* **74**: 318–23

Simmons DD, Williams DR, Powell MJ (1991) The Coventry Diabetes Study: Prevalence of diabetes and impaired glucose tolerance in Europids and Asians. *Q J Med* **81**: 1021–30

The Information Centre (2006) *Health Survey for England 2004. Volume 1: The Health of Minority Ethnic Groups*. Available at: http://bit.ly/XthP5w (accessed 18.1.13)

The Information Centre (2012) *The Quality and Outcomes Framework (QOF)*. Available at: http://www.QOF.ic.nhs.uk/ (accessed 18.1.13)

Trevisan R, Viberti G (2002) Diabetic nephropathy. In: Wass AH, Shalet SM, Gale E, Amiel SA, eds. *Oxford Textbook of Endocrinology and Diabetes*. Oxford University Press, Oxford

UK Government (2004) *Focus on Ethnicity and Identity*. Available at: http://www.ons.gov.uk/ons/rel/ethnicity/focus-on-ethnicity-and-identity/focus-on-ethnicity-and-identity-summary-report/focus-on---ethnicity-and-identity-data.zip (accessed 18.1.13)

UK Prospective Diabetes Study Group (1994) UKPDS XII: Differences between Asian, Afro-Caribbean and White Caucasian type 2 diabetic patients at diagnosis of diabetes. *Diabet Med* **11**: 670–7

UK Prospective Diabetes Study Group (1998) Ethnicity and cardiovascular disease: The incidence of myocardial infarction in White, South Asian and Afro-Caribbean patients with type 2 diabetes (UKPDS 32). *Diabetes Care* **21**: 1271–7

UK Prospective Diabetes Study Group (2001) Relationship between ethnicity and glycaemic control, lipid profiles and blood pressure during the first 9 years of type 2 diabetes UKPDS 55. *Diabetes Care* **24**: 1167–74

Wild S, Mcleod F, Lindsay R (2008) Impact of deprivation on cardiovascular risk factors in people with diabetes: An observational study. *Diabet Med* **25**: 194–9

Wilkinson J, Sayer K, Laji C, Timmis A (1996) Comparison of case fatality in south Asian and white patients after acute myocardial infarction: Observational study. *BMJ* **312**: 1330–3

Williams G, Pickup CJ (2004) Macrovascular diseases in diabetes. In: Brown A, ed. *Handbook for Diabetes*. Blackwell Publishing, Oxford

Yorkshire and Humber Public Health Observatory (2012) *Diabetes Prevalence Model*. Available at: http://bit.ly/aphodiabetes (accessed 18.1.13)

Zindrou D, Taylor K, Ratnatunga C (2001) Comparison of operative mortality after coronary artery bypass grafting in Indian subcontinent Asians versus Caucasians. *Am J Cardiol* **88**: 303–16