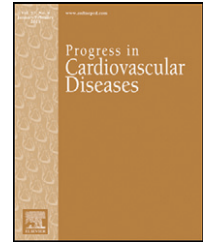


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Lifestyle Choices Fuel Epidemics of Diabetes and Cardiovascular Disease Among Asian Indians

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ABSTRACT

Within the next 15 years, India is projected to overtake China as the world's most populous nation. Due to the rapid pace of urbanization and modernization fueling population growth, in conjunction with a genetic predisposition to insulin resistance, India is suffering a rising epidemic of non-communicable diseases (NCDs), including coronary artery disease (CAD), type 2 diabetes mellitus (T2DM), and stroke. In addition to the genetic predisposition, major negative lifestyle factors are contributing to the alarming outbreak of cardiovascular disease (CVD) among the Asian Indian population; these factors include: 1) a diet high in added sugar, refined grains and other processed foods, 2) physical inactivity, 3) vitamin D deficiency (VDD), and 4) smoking/pollution. These risk factors are all highly modifiable, and steps to improve these issues should be taken urgently to avoid a worsening NCD crisis among the inhabitants of the South Asian subcontinent as well as for people with Asian Indian ethnicity worldwide.

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Exponential progress in science and technology has drastically altered daily human existence around the globe. In a few generations the world has moved from physically active lifestyles and agrarian diets to sedentary habits and processed fast food. Increased use of tobacco in certain parts of the world and heightened psychosocial stress along with low physical activity (PA) have added to this risk factor burden, which has fueled the emerging epidemics of type 2 diabetes mellitus (T2DM), high blood pressure, stroke, and coronary artery disease (CAD).¹

Within the next 15 years, India is projected to overtake China as the world's most populous nation.^{2,3} Accordingly, India's influence over the global community continues to grow, especially in the United States (US). Over the past 50 years, the number of Indian-born immigrants in the US has risen 150-fold.³ With approximately 3 million Asian Indian immigrants residing in the US, India is tied with China as the second largest immigrant group in the US by nation of origin, behind only Mexico.³

Statement of Conflict of Interest: see page 511.

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Abbreviations and Acronyms

CAD = coronary artery disease
CI = confidence interval
CV = cardiovascular
CVD = cardiovascular disease
HFCS = high fructose corn syrup
MetS = metabolic syndrome
NAFLD = non-alcoholic fatty liver disease
NCD = non-communicable disease
PA = physical activity
RR = risk ratio
T2DM = type 2 diabetes mellitus
US = United States
VDD = vitamin D deficiency
WHO = World Health Organization

Due to the rapid pace of urbanization and modernization among the Asian Indian populace, perhaps exacerbated by their genetic predisposition to T2DM,^{4,5} India is in the throes of an especially pernicious outbreak of non-communicable diseases (NCDs), with the prevalence of CAD, T2DM, and stroke rising by upwards of 100% over the past 2 decades.^{6–8} Cardiovascular (CV) disease (CVD) now accounts for 25% of deaths on the South Asian subcontinent (defined as the peninsula south of the Himalaya Mountains, which is currently comprised of the fol-

lowing countries: India, Nepal, Bhutan, Pakistan, and Bangladesh). Today about 50% of the total Indian population (1.22 billion people) is 24 years of age or younger.⁹ In the next decade, India is projected to account for more than 20% of the CAD deaths worldwide.^{7,10,11} In an age-adjusted analysis of CAD mortality in Canada during a 15-year span, Asian Indians had the highest death rate due to CAD compared to other ethnicities including Chinese and European.¹² Furthermore, the recent atherosclerotic CVD risk assessment guidelines recognize that the standard risk factors under-measure risk in the Asian Indian population.^{13–15}

Our hypothesis is that the South Asian susceptibility to T2DM and CVD is due to: 1) a diet that is very high in various processed foods, particularly refined carbohydrates; 2) an inherent susceptibility to metabolic syndrome (MetS) even with a modest excess of intra-abdominal adiposity, especially combined with a diet high in added sugars and other refined carbohydrates; 3) a very high prevalence of vitamin D deficiency (VDD); 4) a growing cohort of smokers (up to 120 million); and 5) a progressively more sedentary lifestyle.

NCD epidemic's adverse economic impact

NCDs adversely affect not only health, but also productivity and economic well-being.⁸ Because CVD manifests at younger ages among Asian Indians compared to other ethnicities, a larger proportion of deaths occur during working-age years^{7,16} (Fig 1). In Western nations mortality from CVD occurs mainly in the elderly, with only 23% of CV fatalities occurring in

people under age 70.^{7,8,17} In contrast, among the Asian Indian population, 52% of CV deaths occur in individuals under age 70.¹⁸ This high rate of premature death from CVD results in enormous losses of productivity.¹⁷ By 2020 India is projected to have a higher incidence of CVD and stroke than those of established market economies. Recent data indicate that developing countries already have 7 times as many disabled citizens from stroke as do established market economies.¹⁰ Unless preventive measures are undertaken, India is likely to lose \$2.2 trillion economically by the year 2030 from death and disability caused by CVD alone.⁸

Contributing conditions

Predisposition to T2DM

Currently India has 67 million people with T2DM; a number that is projected to double by the year 2030^{8,19} (Fig 2). This is in part related to the large scale migration of people from the rural outskirts into the urban centers of India. Waist circumference, a key risk factor for T2DM as well as many other NCDs, is rapidly expanding among the urban South Asians. As a consequence, the prevalence of T2DM increased 10-fold over the past 40 years in urban India.²⁰ Individuals with T2DM die on average of about 10 years earlier than those who are non-diabetic, and approximately 2 out of every 3 persons with T2DM die from CVD.^{6,8,10,20,21} As recently suggested by a one author of this review (JDD), added sugars (sucrose—also known as table sugar and high fructose corn syrup [HFCS]), may be involved in the development of T2DM, which may be especially applicable among individuals genetically predisposed to MetS and T2DM.²² In fact, in some studies these dietary substances are the only factors independently and significantly associated with the prevalence of T2DM after fully adjusting for other covariates (although many studies do not adequately assess PA).²³ These data suggest that the overconsumption of added sugars and other refined carbohydrates, especially among sedentary individuals, is likely one of the principle causative dietary factors driving the high prevalence of T2DM-related morbidity and premature mortality seen among Asian Indians.

India is already the world leader in residents diagnosed with impaired glucose tolerance and impaired fasting glucose, and approximately one-third of adults in India have MetS.²⁴ All 3 of these conditions are precursors to T2DM. The native people of the South Asian subcontinent are especially susceptible to the adverse metabolic effects of excess body fat, especially when it is inside the abdominal cavity, which may be increased from consumption of excess caloric loads, including added fructose.^{5,6,25,26} Among adults in India obesity (defined as a body mass index [BMI] >30 kg/m²) is rare; whereas about 1 in 3 US adults qualifies as being obese by this definition.⁸ Indeed, among the major nations, India has the lowest rate of obesity in the world²⁷ (Fig 3). Even so, the rates of T2DM and CAD are rising rapidly among Asian Indians.^{23,25} Compared to individuals with European ancestry, people with South Asian ethnicity often develop pre-diabetes

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