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I am pleased to present this special issue of the *WHO South-East Asia Journal of Public Health* on diabetes in the World Health Organization (WHO) South-East Asia Region, to coincide with the 2016 diabetes-themed World Health Day on 7 April 2016. This special issue is published at an important epidemiological juncture, when diabetes is posing a significant public health challenge, both globally and in the WHO South-East Asia Region.

In 2014, out of the 422 million adults living with diabetes worldwide, 96 million persons were from the WHO South-East Asia region. It is a matter of great concern that half of the people affected by diabetes in the region remained undiagnosed and untreated, resulting in serious complications such as retinopathy, kidney disease, stroke, heart attack and premature death.

Type 2 diabetes, which accounts for 90% of all cases, is both preventable and treatable. Promoting healthy lifestyles and early detection must, therefore, be the

cornerstone of our strategy to control the epidemic. Messages highlighting the need to maintain a normal body weight, engage in regular physical activity, and eat a healthy diet should be widely disseminated to improve the health literacy of the public. Concurrently, sound public policies that enable healthier lifestyle choices on physical activity and healthy eating should be supported by communities, policy-makers and governments. Priority must be given to strengthening health systems so that these are better equipped to facilitate early detection and provide quality treatment and long-term follow-up for those with the disease. As part of these efforts, community-based research and evaluation of diabetes programmes will be critical to gauge efficacy and further guide policy-makers.

This special issue contains a rich collection of articles, demonstrating the encouraging scientific momentum to address the growing burden of diabetes in the region. I invite policy-makers, health advocates, health professionals and others to read this special issue, and hope all readers find it informative and will be inspired to do their part to prevent and control diabetes in our societies.



Dr Poonam Khetrpal Singh
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Diabetes in South-East Asia: burden, gaps, challenges and ways forward

Quick Response Code:



Diabetes is not new to South-East Asia, since this condition was first described by Indian and Egyptian physicians three and a half thousand years ago.¹ Diabetes is a serious, chronic disease characterized by chronic elevation of blood glucose and disturbance of carbohydrate, fat and protein metabolism that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces.² Raised blood glucose, a common effect of uncontrolled diabetes, may, over time, lead to serious damage to the heart, blood vessels, eyes, kidneys and nerves. Diabetes is therefore not only a disease in itself but also an intermediate stage for many other serious conditions.

Diabetes appears to have been relatively rare until the second half of the 20th century, when it started to emerge as an important public health problem in high-income countries, with a subsequent accelerated rise in low- and middle-income countries in the past few decades.³ It is now one of the leading causes of blindness, heart attacks, strokes, renal failure and lower limb amputations worldwide.

Ten years ago, the United Nations General Assembly recognized diabetes as a health issue affecting socioeconomic development.⁴ As a lifelong illness that often requires long-term medication and treatment, diabetes can also incur catastrophic health expenditure at the individual and family level, particularly among people without financial health protection.

Diabetes was one of the four priority noncommunicable diseases (NCDs) targeted by world leaders in the 2011 *Political Declaration on the Prevention and Control of Non-communicable Diseases*⁵ and the Sustainable Development Goals (SDGs) 2016–2030.⁶ On 7 April each year, World Health Day highlights a significant public health problem, together with actions that individuals, governments and civil society can take to reduce its deleterious impact on health. World Health Day 2016 is an opportunity to advocate for scaling up prevention, strengthening treatment and care, and enhancing surveillance of diabetes. On World Health Day this year, the World Health Organization (WHO) is launching the *Global report on diabetes*,⁷ which provides some new data on the burden of diabetes, the current state of knowledge on prevention

and management, and recommendations for reducing the risk of diabetes at population and personal level, for improving the outcomes of diabetes and for tracking the results.

THE BURDEN

The number of adults in the world with diabetes has increased almost four times in less than four decades, from 108 million in 1980 to 422 million in 2014.⁷ In the WHO South-East Asia Region, this number has increased from 17 million in 1980 to 96 million in 2014. Apart from demographic change, most of the rise has been fuelled by a parallel rise in the prevalence of overweight and obesity, the major risk factor for diabetes.⁸ Lack of physical activity is also a major contributor to the rise of diabetes in the region.

Almost 9% of the adult population of the WHO South-East Asia Region has diabetes, which is the second highest prevalence after the Eastern Mediterranean Region.⁷ The prevalence has more than doubled since 1980. In 2012, close to 1 million adults in the South-East Asia Region died of the consequences of high blood glucose – this includes deaths directly due to diabetes (e.g. diabetic coma), as well as deaths from diabetes-attributable renal failure, tuberculosis and cardiovascular disease.⁷ About one in 10 premature adult deaths in the region are a result of the consequences of high blood glucose;⁷ the equivalent number in the European Region is one in 20. Population-based surveys of diabetes are becoming more frequent in countries of the South-East Asia Region, but have not yet become an integral part of routine surveillance of NCDs. Only 60% of countries have recently assessed the prevalence of diabetes. Nevertheless, data available from studies conducted in some countries have documented a rapid increase in the prevalence of diabetes in some areas.⁹ The drivers of the diabetes epidemic in the South-East Asia Region are similar to those in other parts of the world – economic development, industrialization, urbanization and consequent changes in diet and physical activity. However, the populations of South-East Asia have the misfortune to be more genetically susceptible to these diabetogenic environmental factors, which results in lower diabetes thresholds for risk factors such as age, overweight and body fat distribution.¹⁰ In South-East Asian individuals, the average age of diabetes

onset seems to be a decade earlier than for people of European origin, at an age when people are at their most economically productive and have more time ahead of them to develop costly and debilitating complications.¹⁰

CURRENT RESPONSE: GAPS AND CHALLENGES

This special World Health Day issue of the *WHO South-East Asia Journal of Public Health* is dedicated to highlighting and exploring the gaps, challenges and ways forward in diabetes prevention and control in the region. For this collection of Perspectives in this issue, experts were invited to analyse a range of aspects of the diabetes epidemic in the WHO Region of South-East Asia from different viewpoints and geographical locations. Where applicable, authors were encouraged to share lessons learnt and their potential for application to other countries of the region. As noted by Mohan et al. in the first Perspective of this issue,¹¹ benefits can accrue when lessons and good practices in diabetes prevention learnt in one country are applied to another. The results of the Country Capacity Survey of 2015 give an insight into the region's immediate priorities in addressing diabetes.⁷ Currently, only about seven out of 11 countries in the South-East Asia Region have operational policies for diabetes, either stand-alone or integrated with other NCD policies. Diabetes has to be included in the national plan for the control of NCDs. Activities in Nepal, Bhutan and Myanmar provide useful insights. As described in the Perspective by Upreti et al. for Nepal, the challenges to, and gaps to date in the delivery of, diagnostic and care services for diabetes have been substantial.¹² For example, early diagnosis and referral services are not available at all service levels, owing to lack of resources such as trained health professionals, NCD-related drugs and diagnostics. In turn, this leads to late diagnoses requiring tertiary-level care. In response, Nepal has recently given heightened prominence through a national multisectoral action plan for prevention and control of NCDs. With high-level political commitment, this plan aims to strengthen and orient health systems to address the prevention and control of NCDs and underlying social determinants, through people-centred primary health care and universal health coverage (UHC). The *WHO Package of Essential Noncommunicable (PEN) disease interventions for primary health care in low-resource settings*¹³ will be introduced, providing an opportunity to strengthen health-care services via primary health-care facilities.

Bhutan was one of the first countries to pilot the WHO PEN and is expanding the intervention to all health-care facilities – one of several national activities to prevent and control NCDs. The Diabetes Prevention and Care Programme has been operational within the Ministry of Health since 2005, with the aim of preventing diabetes in the population, minimizing complications and improving the quality of life among those living with diabetes. However, as described in the Perspective by Dorji et al.,¹⁴ despite a government-administered free health-care system and a comprehensive screening and management programme, challenges encountered have included: inadequate record-keeping resulting in losses to follow-up;

suboptimal levels of glycaemic control; lack of monitoring of standards of clinical care; and limited data on outcomes. In Myanmar, the WHO PEN has been piloted in Yangon Region and national expansion awaits ministerial approval.¹⁵ The Myanmar Diabetes Association has proposed a care model to bridge the gaps between rural and urban areas and strengthen secondary and tertiary care. Implementation will require policy development for essential drugs and equipment, capacity-strengthening of health-care workers, and appropriate referral and health-information systems.

Member States have committed to “halt the rise in diabetes and obesity” by 2025 as a part of the *Global action plan for the prevention and control of noncommunicable diseases 2013–2020* that has an overall target to reduce premature mortality by NCDs by 25%.¹⁶ This is a daunting task.¹⁷ Fewer than 10% of countries in the region have an operational policy to reduce the major risk factor for diabetes – obesity. In their Perspective, Praveen and Tandon draw attention to the high and increasing burden of generalized obesity among Indian children and adolescents and warn of the likely consequences in terms of type 2 diabetes in children and adults.¹⁸ Evidence on societal interventions to reduce the population risk of diabetes is still evolving and countries are still undergoing a learning process about what works. While stand-alone interventions are unlikely to dent the thick armour of obesogenic and diabetogenic forces, the effects of combinations of several interventions provide some basis for optimism.

There is no doubt that appropriate treatment of people with diabetes reduces the risk of complications and early death. Interventions to improve treatment will be the first to show benefit. But treatment is not simply the regulation of blood glucose levels. It includes control of concomitant risk factors for cardiovascular disease, education and support for self-care, and screening and treatment of microvascular complications. As a lifelong and progressive illness, diabetes requires continued care by a multifaceted health-care team, starting in primary health care, with defined referral pathways to secondary and tertiary care for complications. In their Perspective, Wijeyaratne et al. report on the National Initiative to Reinforce and Organize General Diabetes Care in Sri Lanka (NIROGI Lanka) project.¹⁹ A decade ago, there was a gap in the health workforce of providers trained to accommodate the needs of the rising numbers of patients with diabetes. The NIROGI Lanka project has targeted patients in lower socioeconomic groups through capacity-building activities for allied health professionals covering a range of diabetes-related needs. Central to the project was upskilling a cohort of nurses to become “diabetes educator nursing officers” (DENOs). The DENOs were trained to take a lead role in outpatient clinics, in patient registration, anthropometric measurements and education on healthy lifestyle, smoking cessation, adherence to treatment, complying with follow-up appointments, insulin self-injection, and self-monitoring of blood glucose for those with access to glucometers. They have become an important human resource in providing quality care to individuals with diabetes, under the supervision of consultants, predominantly in the outpatient department, and together with community education and empowerment.

The main priority is strengthening capacity in primary care to diagnose and manage diabetes. Although diabetes-management guidelines are available in most countries in South-East Asia, essential medicines and tests are generally not available in primary care facilities. Furthermore, the availability of tests and therapeutic interventions for chronic complications at the secondary care level is poor in the public health-care sector. In this region, as in others, there is often much enthusiasm for large-scale early-detection programmes for diabetes, but these are not encouraged until there is capacity in primary care to accommodate the subsequent increased number of diagnosed patients.

WAYS FORWARD

With a focus on prevention, as detailed in the Perspective by Somasundaram and Kalupahana,²⁰ countries of South-East Asia are encouraged to employ comprehensive strategies that include awareness-raising programmes, incentives for producing and buying healthier food, building and organizing cities to encourage physical activity, and fiscal interventions for discouraging the production and use of unhealthy commodities. While long-term structural changes and building collective capacity are essential to mainstreaming prevention, Somasundaram and Kalupahana note that some initiatives have been considered too complex in requiring levels of intersectoral governance between multiple departments and ministries that are difficult to achieve. Taking the example of Sri Lanka, their Perspective suggests “best buys” that can be implemented with the fewest structural changes, thereby reducing barriers to implementation.

As a lifelong and progressive illness, diabetes requires continued care by a multifaceted health-care team, starting in primary health care with defined referral pathways to secondary and tertiary care for complications. The main priority is strengthening capacity in primary care to diagnose and manage diabetes. Strengthening vital registration and cause-of-death certification, along with periodic population-based surveys of risk factors, including blood glucose levels, can help to monitor the trends.

Finally, the need to combat the negative impact of diabetes on the economic growth of individuals and nations, with sound financing approaches, is critical. Member States of the South-East Asia Region are at various stages of improving the equity and efficiency of their health systems and reviewing health financing as the region moves forward on UHC. In their Perspective on diabetes prevention and care in the context of UHC, Patcharanarumol et al. synthesize key points from the Thai experience that may be applicable to other countries of the region.²¹ Although the UHC strategies of the countries in the region are diverse, Patcharanarumol et al. underscore that inclusion of services for NCDs, including diabetes, is essential. They urge greater political commitment for investing more in health services and emphasize that national action plans for prevention and control of diabetes and other NCDs should be in line with strategies for health-system strengthening.

Tackling diabetes is not easy. It may be true that diabetes is an incurable disease. However, it is largely preventable and can be detected early and controlled. We need a comprehensive framework to make our societies less diabetogenic, make our screening systems more patient-friendly, make our behaviour-change interventions more powerful and sustainable, and make our health-care systems more effective to control diabetes and its complications. Efforts to prevent and treat diabetes will be pivotal to achieving the global Sustainable Development Goal target of reducing premature mortality from NCDs by one third by 2030.²² The whole of society has a role to play, including governments, employers, educators, the private sector, civil society – and individuals themselves. By working together in South-East Asia, we can halt the rise of diabetes.

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Slowing the diabetes epidemic in the World Health Organization South-East Asia Region: the role of diet and physical activity

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ABSTRACT

The nutrition transition occurring in the World Health Organization South-East Asia Region, as a result of rapid urbanization and economic development, has perhaps made this region one of the epicentres of the diabetes epidemic. This review attempts to evaluate the role of diet and physical inactivity in the South-East Asia Region in promoting this epidemic and points to strategies to slow it down by lifestyle modification. The emerging new food-production technologies and supermarkets have made energy-dense foods more easily available. This includes refined carbohydrate foods like those with added sugars, and refined grains and unhealthy fats. In addition, increased availability of modern technology and motorized transport has led to decreased physical activity. South Asian diets tend to be based on high-carbohydrate foods, with a predominance of refined grains. All of these accentuate the risk of diabetes in people of this region, who already have a unique “south Asian phenotype”. However, there is increasing evidence that altering diet by replacing refined cereals like white rice with whole grains (e.g. brown rice) and increasing physical activity can help to prevent diabetes in high-risk individuals. An urgent, concerted effort is now needed to improve diet quality and encourage physical activity, by introducing changes in policies related to food and built environments, and improving health systems to tackle noncommunicable diseases like diabetes.

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Key words: diabetes, diet, epidemic, physical activity, south Asians

BACKGROUND

One of the visions of the World Health Organization (WHO) is to reduce the avoidable burden due to noncommunicable diseases (NCDs),¹ with a specific target to halt the rise in the rates of obesity and diabetes globally. Almost two thirds of the world’s population with diabetes currently resides in low- and middle-income regions. South Asia is one of the epicentres of the diabetes epidemic and diabetes rates vary from 3.3% in Nepal to 10% in India.²

The so-called “south Asian” or “Asian-Indian” phenotype makes this ethnic group more susceptible to both type 2 diabetes and premature coronary artery disease, compared to white Caucasians.^{3,4} This phenotype is characterized by increased insulin resistance; high diabetes rates, despite lower generalized obesity; central adiposity; and dyslipidaemia, with raised serum triglycerides and low levels of high-density lipoprotein (HDL) cholesterol. While genetic factors might

contribute a little to the south Asian phenotype, the current diabetes epidemic is fuelled predominantly by lifestyle, which is related to environmental factors. The two most important of these are unhealthy diet and physical inactivity. This article will therefore focus primarily on these two factors and examine how they are linked to the diabetes epidemic. It will also look at evidence and suggest how modifying these factors may help to prevent type 2 diabetes, or at least slow the rise in prevalence in this population.

Rapid globalization and urbanization have led to a rapid nutrition transition. This has affected food cultures and brought about drastic changes in the diets and physical activity of populations. This is very much pronounced in countries of the WHO South-East Asia Region, which are experiencing high increases in the prevalence of diabetes. Some of the changes in diet include increased consumption of packaged and processed foods – mainly as refined carbohydrates like white rice, added sugars, edible refined oils and fats, and decreased consumption

of whole grains, nuts, fruits and vegetables.⁵⁻⁹ Today, people in low- and middle-income countries opt for energy-dense foods, as they are cheaper and more easily available than the alternatives.¹⁰

Physical inactivity is an independent risk factor for type 2 diabetes and current evidence suggests that adequate levels of physical activity may reduce the risk of type 2 diabetes by 27%.¹¹ Modern technical gadgets and use of motorized transport have reduced physical activity among children and young adults.¹² In 2013, Ranasinghe et al. reported that the overall prevalence of physical inactivity among the population of India was 19–88%, followed by Pakistan (60%) and Sri Lanka (11–32%).¹³ The recent Indian Council of Medical Research–India Diabetes (ICMR–INDIAB) study also reported that levels of physical inactivity were high ($\approx 55\%$) among Asian-Indians.⁸ This article will first deal with diet and then discuss the role of physical inactivity in the context of NCDs like type 2 diabetes in south Asians, with a focus on India, where a lot of recent data have emerged.

DIETARY PROFILE OF SOUTH ASIANS IN RELATION TO THE DIABETES EPIDEMIC

South Asian diets are high in carbohydrates.¹⁴ These carbohydrates are mainly derived from refined cereals like white rice and refined flour. There is also a high intake of fat, especially saturated fatty acid (SFA) and polyunsaturated fatty acid (PUFA), mainly in the forms of *n*-6 (omega-6) PUFA, and trans fatty acid (TFA), and a low intake of monounsaturated fatty acid (MUFA) and *n*-3 PUFA (resulting in a higher ratio of *n*-6/*n*-3). The diet is also low in dietary fibre and several micronutrients (e.g. magnesium, calcium, and vitamin D),^{8,15-18} all of which may contribute to the increased risk for NCDs like type 2 diabetes. This shift from ancestors' diets (high in animal protein, adequate in fibre, relatively low in carbohydrates and limited animal fat¹⁹) has resulted primarily from the changes in demography and socioeconomic status and "modernization". Urbanization and rising income levels have also led to an increase in consumption of milled and polished grains like rice and wheat, rather than unpolished brown rice, corn and millet.²⁰ Further, urbanization has led to increased employment for women. This has promoted a shift from home-cooked traditional foods to precooked convenience foods, as the mother has less time to cook.²¹

DIETARY CARBOHYDRATES (QUANTITY AND QUALITY) AND DIABETES RISK

Carbohydrate-rich cereals account for 60% of daily caloric intake among Asian nations, which is one of the highest levels in the world.²⁰ Owing to rapid industrialization and to the green revolution, there has been a large increase in the consumption of refined grains (polished rice, white flour, semolina) in last few decades.^{22,23} Of the various refined grains, white rice in particular has a high glycaemic index (GI) and accounts for almost 50% of the total calories in the diet of the south Indian urban population,⁵ and 73% of the daily calorie intake of the

rural Indian population.²⁴ Data from Sri Lanka showed that white rice accounted for about 73% of caloric intake,²⁵ while in Bangladesh, rice and other cereals contributed to 80% of the total calories.²⁶

In 2009, Mohan et al. showed that dietary carbohydrates, and specifically the dietary glycaemic load, were associated with risk for type 2 diabetes among urban south Indians.²⁷ Refining of grains results in loss of fibre, vitamins, minerals and phytonutrients, which predispose to diabetes and cardiovascular disease. Another epidemiological study carried out in southern India showed that consumption of highly refined grain was significantly associated with insulin resistance, higher serum triglycerides and increased waist circumference.⁵

As south Asians traditionally consume a high-carbohydrate diet, it is difficult to alter the total carbohydrate content of their diets.^{27,28} Thus, it is important to encourage the consumption of low-GI and high-fibre foods in this population, in order to reduce the dietary glycaemic load. Making a simple change in diet, such as substituting brown rice as an alternative to polished white rice, may help to reduce the burden of type 2 diabetes in India and south Asia.²⁷ However, there are several challenges faced in promoting brown rice as a staple, as shown by a focus group study and a consumer perception study, where brown rice was associated with a poorer appeal and texture and increased cooking time.^{29,30} This underscored the need to find a healthier white-rice opportunity.

SUGAR AND SUGAR-SWEETENED BEVERAGES

In south Asia, the energy obtained from sugar and sweeteners has considerably increased in recent times. In Nepal, it increased from 4 g/capita/day in 1970 to 57 g/capita/day in 2010.³¹ A report in 2009 found that sugar intake among urban south Indians was mainly in the form of added sugar in hot beverages (tea and coffee), and contributed about 3.6% of the total glycaemic load compared to refined cereal (white rice), which provided 66% of the glycaemic load.⁷ However, recent data suggest an increase in intake of sugar from sugar-sweetened beverages among Indians. Further, the intake of "total" sugar (traditional sugar + sugars from sugar-sweetened beverages) among Indians (25.0 kg/capita in 2011) exceeds the average global annual per capita consumption of 23.7 kg.³²⁻³⁴

DIETARY FATS (QUANTITY AND QUALITY) AND DIABETES RISK: EVIDENCE

Next to refined grains, visible fats and oils are the main contributor to daily calorie intake in Indians. However, the total intake of dietary fat among Indian urban adults (24% total calories) and rural Indians (13% total calories) appears to be within the recommended intake of 30% of total calories.^{16,24,35} Visible fats and oils contribute almost half of the total calories derived from fat in Indian diets.³⁶ There has been a sharp increase in the intake of dietary fat in the last three decades, from 29 g/capita/day in 1970 to 45 g/capita/day in 1999 in the south Asian population.³⁷

More worrying is the fact that the quality of dietary fat in the south Asian population comprises a low intake of MUFA and *n*-3 PUFA and high intake of fats such as SFA, and TFA (mostly related to the widespread use of vanaspati, a hydrogenated vegetable oil), showing an imbalance and association with increased risk for NCDs especially type 2 diabetes.^{38,39} Several studies have reported that consumption of SFA or TFA contributes to an increase risk of NCDs like type 2 diabetes.^{40,41} The global mean intake of SFA ranged from 2.9% to 20.9% of total calories, with the lowest percentage reported in Bangladesh followed by India (7–8% of total calories).⁴²

Fat-rich animal foods are the primary source of SFA in diets. The total meat consumption has increased significantly in all south Asian countries in the past two decades. Countries like India have doubled their intake of meat and poultry since 2000, but the actual quantity is still low (50 g/capita/day),¹⁶ compared with diets in, for example, the United States of America (USA; 128 g/capita/day).⁴³ Meat consumption in Pakistan has increased by 130%. Sri Lanka has also gradually increased the trend in meat consumption from 1992 to 2007.²⁵

It is good news that there has been a reduction in the prevalence of coronary heart disease with the replacement of energy from SFA or TFA with PUFA but this is restricted to high-income countries.⁴³ Studies have shown that south Asians consume an excess of *n*-6 PUFA. This has primarily occurred because traditional oils such as groundnut (a good source of MUFA) and sesame were replaced with oils that are high in *n*-6 PUFA, like sunflower and safflower oils, leading to an imbalance in the *n*-6/*n*-3 ratio. Studies have shown that this imbalance in *n*-6/*n*-3 ratio, owing to consumption of these high-*n*-6 PUFA oils, is associated with an increased risk for metabolic syndrome.³⁶ Similar findings were reported by Misra et al. in 2009.¹⁷

TFAs are even more deleterious to health than SFAs, owing to the hydrogenation process, which converts liquid oils to solid fats like vanaspati and margarine. The consumption of vanaspati accounts for 50% of TFA use and it is predominantly consumed in south Asian countries like India and Pakistan.^{44,45}

LOW CONSUMPTION OF FRUIT AND VEGETABLES

There is evidence to suggest that consumption of fruit and vegetables (≥ 5 servings or 400 g/day) is associated with a reduction in the risk of chronic disease like type 2 diabetes and coronary heart disease.^{17,46,47} However, the intake of fruit and vegetables is far below the recommended levels in almost all south Asian countries. The average per capita consumption of fruit and vegetables in India is around 3 servings/day,¹⁵ while it is 2.2 servings/day in Sri Lanka,⁴⁷ 1.8 servings/day in Nepal,⁴⁸ and 1 serving/day in Maldives.⁴⁹ A study in south Indians showed an inverse association between intake of fruit and vegetables and blood pressure, waist circumference, total cholesterol and low-density lipoprotein (LDL) cholesterol concentrations.⁶ Another study showed that total dietary fibre intake was inversely associated with total cholesterol and LDL cholesterol levels in people with diabetes.⁵⁰

DIETARY STEPS FOR PREVENTING OR SLOWING THE DIABETES EPIDEMIC IN SOUTH ASIA

A “healthy” diet, in terms of diabetes and prevention of cardiovascular disease, should include more whole grains, legumes, nuts, fish, fruit and vegetables and less refined carbohydrate, simple sugar and processed meat, and food that is high in sodium and TFA should be avoided as much as possible.⁵¹ Tables 1 and 2 summarize the nutrient recommendations for the prevention of NCDs such as diabetes and suggest healthier alternative dietary strategies. The two most important recommendations for south Asians would be to use whole-grain cereals and fats that are higher in *n*-3 fatty acid content. These two recommendations are discussed in greater detail in the subsequent sections.

Improving the quality of dietary carbohydrate foods

Whole grains consist of bran and germ constituents that are rich in dietary fibre, iron, magnesium, selenium, β -oryzanol and B vitamins. The bran protects the starchy endosperm from rapid digestion, thereby reducing the GI of the food. Prospective cohort studies in populations from high-income countries have shown that a high intake of whole grains lowers the risk of developing obesity, cardiovascular disease and type 2 diabetes.^{52–54} An intervention trial carried out on overweight Asian-Indians, using continuous glucose monitoring, showed a 20% reduction in their 24-h glycaemic responses and a 50% reduction in their fasting insulin levels when white rice was substituted with brown rice.⁵⁴ Unfortunately, the availability of brown rice and millets is still a challenge in most of south Asia, as most grains available in the market have undergone various degrees of polishing to improve their shelf-life and cooking quality.⁵⁵

However, as mentioned earlier, brown rice showed poor sensory attributes and acceptability among the south Asian population, which has become accustomed to white rice or other refined flour like wheat.^{29,30} Hence, the authors feel that the way forward would be to introduce health foods with lower glycaemic response, which would also have better consumer acceptability. In an effort to improve the quality of white rice, research work was carried out with agricultural scientists to develop a new hybrid rice variety. This helped to retain good amounts of non-digestible carbohydrate content even after polishing the rice and showed five times higher dietary fibre content compared to regular white rice, so it was introduced in the Indian market. This high-fibre white rice was shown to have a significantly lower GI (GI = 61.3 which is in the category of medium GI) compared to regular white rice (GI = 79.2, high-GI category).⁵⁶ However, although this work is promising, it is still only preliminary and randomized controlled trials need to be done to establish the usefulness of this rice.

Table 1. Recommended dietary guidelines for healthy living and prevention of noncommunicable diseases

Food components	Dietary guidelines for Asian-Indians 2011 ³⁵	WHO 2003 ^{a,46}
Energy		
Sedentary activity level	Normal weight: 30 kcal/kg of ideal body weight/day Overweight: 20–25 kcal/kg of ideal body weight/day	
Moderate activity level	Normal weight: 35 kcal/kg of ideal body weight/day Overweight: 30 kcal/kg of ideal body weight/day	
Heavy activity level	Normal weight: 40 kcal/kg of ideal body weight/day Overweight: 35 kcal/kg of ideal body weight/day	
Carbohydrates ^b	50–60% of total energy	55–75% of total energy
Dietary fibre	25–40 g/day	20 g/day
Protein	1 g/kg body weight/day	10–15% of total energy
Fats		
Total	30% of total energy	15–30% of total energy
SFA	<10% of total energy <7% of total energy (if LDL >100 mg/dL)	<10% of total energy <7% of total energy (for high-risk groups)
<i>n</i> -6 PUFA	5–8% of total energy	5–8% of total energy
<i>n</i> -3 PUFA	1–2% of total energy	1–2% of total energy
<i>n</i> -6/ <i>n</i> -3 ratio	5–10	—
MUFA	10–15% of total energy	By difference
TFA	<1% of total energy	<1% of total energy
Dietary cholesterol	200–300 mg/day	<300 mg/day
Fruit and vegetables	>400 g per day	>400 g per day
Salt	<5 g of added salt per day; prefer iodized salt in the diet	<5 g of added salt per day
Free sugars ^c	<10% of total energy	<10% of total energy

GI: glycaemic index; LDL: low-density lipoprotein; MUFA: monounsaturated fatty acid; PUFA: polyunsaturated fatty acid; SFA: saturated fatty acid; TFA: trans fatty acid; WHO: World Health Organization.

^aWHO 2003 recommendations are followed by Bangladesh, Sri Lanka and Pakistan.

^bInclude complex carbohydrates mainly whole grains, millets, legumes and pulses, fruit and vegetables and low-GI foods.

^cMost of the free sugars are sugars added in food preparation and sweetened beverages and natural free sugars are present in honey, syrups, fruit juices and fruit juice concentrates.

Improving the quality of dietary fat sources

The use of MUFAs in the diet has been shown to reduce the risk associated with type 2 diabetes.³⁸ However, MUFA intake is low in India, even compared to other south Asian countries.³⁷ Studies have shown that just one ounce of nuts a day, adjusted with the carbohydrate intake, can provide cardiometabolic benefits and also improve satiety.⁵⁸ It is also possible that use of oils that are rich in MUFA and higher in *n*-3 fatty acid may help to prevent diabetes by reducing insulin resistance.⁵⁹

THE ROLE OF PHYSICAL INACTIVITY IN THE DIABETES EPIDEMIC

Physical inactivity has been shown to be an important risk factor for most chronic diseases, including type 2 diabetes, and seems to increase the risk of type 2 diabetes independently of diet. A sedentary lifestyle over several years has been shown to be associated with increased risk for type 2 diabetes, cardiovascular disease and premature mortality.^{60,61}

Table 2. Dietary strategies for a healthy dietary pattern to slow the epidemic of diabetes

South Asian food habits leading to increased risk	Beneficial replacements
↑ Refined grains, starches, sugars	↑ Whole grains, millets
↑ High-GI foods (simple and easily digestible carbohydrates)	↑ Low-GI foods (complex carbohydrates rich in dietary fibre)
↑ Red meats	↑ Legumes and pulses, fatty fish (<i>n</i> -3 PUFA)
↑ Industrial trans fats/ready-to-eat processed foods	↑ Fruit and vegetables
↑ Saturated fats, ghee	↑ Low-fat dairy products; combination of vegetable oils (with appropriate <i>n</i> -6/ <i>n</i> -3 ratio and rich in MUFA)
↓ MUFA-rich foods	↑ Nuts and oilseeds and vegetable oils like mustard and canola
↑ Added-salt and added-sodium foods	↓ Added salt and salty products like pickles, chips etc.
↑ Sugar-sweetened beverages (e.g. fruit juices)	↑ Whole fruits

GI: glycaemic index; MUFA: monounsaturated fatty acid; PUFA: polyunsaturated fatty acid; ↑: increase; ↓: decrease.

According to the American Diabetes Association (ADA), “physical activity” is defined as bodily movement produced by the contraction of skeletal muscle that requires energy expenditure in excess of resting energy expenditure, while “exercise” is defined as a subset of physical activity that is planned and structured, and consists of repetitive bodily movement performed to improve or maintain one or more components of physical fitness.⁶² There is mounting epidemiological evidence that, in addition to reduced physical activity, “sedentary behaviour”, defined as engaging in activities at the resting level of energy expenditure, which includes sleeping, sitting, lying down, computer time and viewing television, also plays an important role in the etiology of type 2 diabetes.^{63–65}

According to the American College of Sports Medicine (ACSM), individuals with type 2 diabetes generally have a lower level of fitness (VO_{2max}) than those without diabetes. Therefore, exercise intensity should be at a comfortable level in the initial periods of training and should progress cautiously as tolerance for activity improves. Resistance training has the potential to improve muscle strength and endurance, enhance flexibility and body composition, decrease risk factors for cardiovascular disease, and result in improved glucose tolerance and insulin sensitivity.⁶⁶ In order to prevent type 2 diabetes in high-risk individuals (e.g. those with impaired glucose tolerance), the ADA and ACSM recommend at least 150 min/week (2.5 h/week) of moderate to vigorous physical activity (see Table 3).^{62,66–68}

Table 3. Recommended physical activity for individuals with type 2 diabetes

Organization	Type of physical activity	Frequency
American College of Sports Medicine (ACSM), 2000 ⁶⁶	Moderate to vigorous aerobic training	At least 3 nonconsecutive days/week
	Moderate to vigorous resistance training	At least 2 days/week
Canadian Diabetes Association (CDA), 2003 ⁶⁷	Moderate to vigorous aerobic training	At least 3 nonconsecutive days/week
	Moderate to vigorous resistance training	3 days/week
American Diabetes Association (ADA), 2004 ⁶²	Moderate to vigorous aerobic activity	150 min/week spread out over at least 3 days/week
	Moderate to vigorous resistance training	2–3 days/week
ADA and ACSM, 2010 ⁶⁸	Moderate to vigorous aerobic activity	150 min/week spread out over at least 3 days/week with no more than 2 consecutive days between bouts of aerobic activity
	Moderate to vigorous resistance training	2–3 days /week
	For additional health benefits:	
	<ul style="list-style-type: none"> • Combined aerobic and resistance training • Encouraged to increase total daily unstructured physical activity • Flexibility training may be included but should not be undertaken in place of other recommended types of physical activity 	

PATTERNS OF PHYSICAL ACTIVITY IN SOUTH ASIANS

Wide variations in the prevalence of physical activity have been reported in countries of south Asia, namely Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.¹³ In 2004, Fischbacher et al. reported that the rates of physical activity were 50–75% less among South Asians compared to the general population living in the United Kingdom of Great Britain and Northern Ireland.⁶⁹

Table 4 shows the patterns of physical activity in countries of south Asia.^{8,70–86} The World Health Survey, a large cross-sectional study, was conducted by WHO in 51 countries in 2002 and 2003.⁷⁴ This included countries that had a large proportion of the world's population, with a wide geographical distribution across WHO regions, including several countries in the South-East Asia Region. Physical activity was assessed using the International Physical Activity Questionnaire (IPAQ). The prevalence of physical inactivity for men in south Asian countries, including Bangladesh, India, Nepal, Pakistan and Sri Lanka, ranged from 6.5% to 12.8%, while for women it ranged from 9.7% to 27.3%.⁷⁴

Three studies on physical activity have been reported from Sri Lanka: the WHO STEPS (STEPwise approach to Surveillance) survey,⁷² one in the western province of Sri Lanka,⁷⁵ and finally a nationally representative study.⁸³ The prevalence of inactivity was reported to be 25% in the WHO STEPS survey, 31.8% in the western province and 11% in the national sample. Men were more inactive than women and inactivity was reported to be 35.2% in urban adults and 27.6% in rural adults in the study from the western province of Sri Lanka.⁷⁵ A study on physical activity conducted in Pakistan by Khuwaja and Kadir in 2010 reported a high prevalence of inactivity (60.1%).⁷⁸ The WHO STEPS survey conducted in Bhutan in 2007, Maldives in 2011 and Nepal in 2013 reported inactivity levels of 58.6%, 45.9% and 3.5% in these populations, respectively.^{73,82,84}

Several studies have been done in India, and the prevalence of inactivity ranged widely, from 9.7% to 54.4%, probably reflecting the methodology used or the sample surveyed.^{8,74} The WHO STEPS survey done on 1359 males and 1469 females in a rural area in Faridabad district of Haryana reported a very high rate of physical inactivity.⁷⁶ Another study conducted by Sullivan et al. in 2011, which assessed the physical activity levels in migrant groups in India ($n = 6447$), showed that physical activity was highest in rural men, followed by migrants and then urban men.⁸⁰ Levels of sedentary behaviour and television viewing were lower in rural residents, whereas these were similar among migrant and urban residents.⁸¹ In 2014, Anjana et al. assessed the pattern of physical activity in a community-based national survey, the ICMR–INDIAB study, in four areas of India (Tamil Nadu, Maharashtra, Jharkhand and Chandigarh, representing the south, west, east and north of India respectively), using the Global Physical Activity Questionnaire (GPAQ).⁸ Of the 14 227 individuals studied, 54.4% were inactive. Subjects were more inactive in urban compared to rural areas (65.0% versus 50.0%).

Thus, epidemiological studies from south Asian countries show that a large percentage of people in this region are inactive, with very few engaging in recreational physical activity; the explosive increase in the prevalence of type 2 diabetes in these countries may be attributed to this high percentage of inactivity. A systematic review done by Horne and Tierney in 2012, on barriers to exercise and physical activity among older adults in south Asia, concluded that lack of understanding about benefits, a communication gap with health-care professionals, cultural beliefs, and lack of culturally sensitive facilities are some of the barriers for physical activity.⁸⁷ In a recent study conducted by Anjana and colleagues in 2015,⁸⁸ for the Diabetes Community Lifestyle Improvement Program (D-CLIP), the most frequent barriers to exercise perceived by men were “few places to exercise” and “tires me”, followed by “takes too much of my time” and “places to exercise are far away”. The reasons most frequently cited by women were “takes too much of my time”, followed by “few places to exercise” and “takes time away from my family”. Thus, it is clear that these barriers to physical activity must be overcome if levels of physical activity in the society are to be improved.

EVIDENCE FOR THE ROLE OF PHYSICAL ACTIVITY IN REDUCING THE RISK OF TYPE 2 DIABETES

There is a large body of evidence supporting the hypothesis that physical activity may be useful in preventing or delaying the onset of type 2 diabetes. Studies have shown that physically active individuals have a 30–50% lower risk of developing type 2 diabetes compared to sedentary individuals.⁸⁹ Bassuk and Manson concluded that physical activity may prevent or delay the onset of type 2 diabetes and its cardiovascular sequelae, through beneficial effects on body weight, insulin sensitivity, glycaemic control, blood pressure, lipid profile, fibrinolysis, endothelial function and inflammatory defence systems.⁹⁰

Randomized controlled trials from populations in high-income countries and in Asia have demonstrated that supervised exercise programmes, with or without dietary modifications, significantly reduced the incidence of diabetes in high-risk groups, by up to 67%.^{91–97} In the non-randomized Malmö trial, 260 men with impaired glucose tolerance underwent a 6–12-month supervised exercise programme and diet counselling.⁹⁶ After 6 years of follow-up, the cumulative incidence of diabetes in the intervention group was found to be 11%, as compared to 21% in the control group.

The first of the randomized trials of lifestyle intervention for prevention of diabetes was the Da Qing trial conducted in China (1986–1992). In this study, after 6 years of active intervention, the risk for diabetes was reduced by 46% in an exercise-only group compared with a control group.⁹¹ In both the Finnish Diabetes Prevention Study (DPS)⁹² and the United States (US) Diabetes Prevention Program (DPP),⁹³ lifestyle intervention, which included both diet and exercise, significantly reduced the incidence of diabetes by 58%. The DPP, though not specifically

Table 4. Levels of physical activity in south Asian countries

Author, year	Country	Sample size	Assessment tool	Prevalence
Vazet et al., 2004, 2006 ^{70,71}	India	782	Physical Activity Level (PAL)	Men: PAL 1.22–1.64; women: PAL 1.30–1.56
World Health Organization, 2006 ⁷²	Sri Lanka	11 680	WHO STEPS Global Physical Activity Questionnaire (GPAQ)	Prevalence of inactivity 25.0% (men 17.9%, women 31.9%)
World Health Organization, 2007 ⁷³	Bhutan	2484	WHO STEPS Global Physical Activity Questionnaire (GPAQ)	Prevalence of inactivity 58.6% (men 49.8%, women 69.6%)
Guthold et al., 2008 ⁷⁴	Bangladesh	5166	International Physical Activity Questionnaire (IPAQ)	Prevalence of inactivity: men 6.5%, women 25.2%
	India	7945		Prevalence of inactivity: men 9.3%, women 15.2%
	Nepal	7945		Prevalence of inactivity: men 6.7%, women 9.7%
	Pakistan	5610		Prevalence of inactivity: men 12.8%, women 27.3%
	Sri Lanka	5464		Prevalence of inactivity: men 7.3%, women 13.8%
Arambepola et al., 2008 ⁷⁵	Sri Lanka	1400	International Physical Activity Questionnaire (IPAQ)	Prevalence of inactivity 31.8% (men 38.5%, women 24.7%)
Krishnan et al., 2008 ⁷⁶	India	2828	WHO STEPS Global Physical Activity Questionnaire (GPAQ)	Prevalence of inactivity 34.2% (men 22.2%, women 45.5%)
Haldiya et al., 2010 ⁷⁷	India	1825	Interviewer-administered questionnaire	Prevalence of inactivity 40.0% (men 40.8%, women 39.7%)
Khuwaja and Kadir, 2010 ⁷⁸	Pakistan	534	International Physical Activity Questionnaire (IPAQ)	Prevalence of inactivity 60.1%; women were significantly more inactive than men (OR: 2.1, $P < 0.001$)
World Health Organization, 2010 ⁷⁹	Bangladesh	9275	WHO STEPS Global Physical Activity Questionnaire (GPAQ)	Prevalence of inactivity 27.0% (men 10.5%, women 41.3%)
Sullivan et al., 2011 ⁸⁰	India	6447	Physical activity level (PAL)	Prevalence of extreme inactivity 9.7% (men 7.4%, women 12.9%)
Mittal et al., 2011 ⁸¹	India	520	Interviewer-administered questionnaire	Prevalence of inactivity 29.4% (men 12.7%, women 46.1%)
World Health Organization, 2011 ⁸²	Maldives	1780	WHO STEPS Global Physical Activity Questionnaire (GPAQ)	Prevalence of inactivity 45.9% (men 39.1%, women 52.4%)
Katulanda et al., 2013 ⁸³	Sri Lanka	4485	International Physical Activity Questionnaire (IPAQ) – short version	Prevalence of inactivity 11.0% (men 14.6%, women 8.7%)
World Health Organization, 2013 ⁸⁴	Nepal	4143	WHO STEPS Global Physical Activity Questionnaire (GPAQ)	Prevalence of inactivity 3.5% (men 4.5%, women 2.4%)
Vaidya and Krettek, 2014 ⁸⁵	Nepal	640	WHO STEPS Global Physical Activity Questionnaire (GPAQ)	Prevalence of low physical activity 43.3% (men 38.3%, women 45.1%)
Anjana et al., 2014 ⁸	India	14 227	WHO STEPS Global Physical Activity Questionnaire (GPAQ)	Prevalence of inactivity 54.4% (men 41.7%, women 58.3%)
Zaman et al., 2015 ⁸⁶	Bangladesh	4073	WHO STEPS Global Physical Activity Questionnaire (GPAQ)	Prevalence of inactivity 38.6% (men 34.2%, women 42.5%)

OR: odds ratio; STEPS: World Health Organization STEPwise approach to Surveillance; WHO: World Health Organization.

aimed at Asians, had a small Asian subpopulation, and reported that Asians had a greater risk reduction for diabetes (70%) with lifestyle intervention (diet and physical activity) as compared to the white population (51%).⁹³ In a Japanese trial conducted in 2005 involving 458 men with impaired glucose tolerance, intensive lifestyle modification reduced the risk of diabetes by 67%.⁹⁴ A follow-up of the Finnish DPS in 2006 showed a 43% reduction in diabetes risk over a median of 7 years after discontinuation of active counselling.⁹⁷

In India, few trials have been conducted to assess the benefit of physical activity in type 2 diabetes. The Indian Diabetes Prevention Programme (IDPP) reported that, after 3 years of follow-up, the relative risk reduction for diabetes was 28.5% with lifestyle management, 26.4% with metformin, and 28.2% with the combined interventions, compared with the control group.⁹⁵ The same group conducted the IDPP-3, which was a randomized clinical trial that studied 10 sites to assess whether mobile phone messaging that encouraged lifestyle changes could reduce incident type 2 diabetes in Indian men with impaired glucose tolerance.⁹⁸ A total of 537 participants were randomly assigned to a mobile phone messaging intervention ($n = 271$) with frequent SMS text messages, or standard care ($n = 266$, control group receiving standard lifestyle advice at baseline). The cumulative incidence of diabetes was significantly lower in those who received mobile phone messages (18%) than in controls (27%).

D-CLIP, a randomized controlled trial of diabetes prevention in adults with prediabetes (impaired glucose tolerance or impaired fasting glucose or both) compared standard care to a culturally tailored lifestyle education curriculum based on the US DPP, plus stepwise addition of metformin when needed.⁹⁹ During 3 years of follow-up, 34.9% in the control group and 25.7% in the intervention group developed diabetes; the relative reduction in diabetes incidence was 32%.¹⁰⁰

Together, these trials demonstrate that modification of diet and physical activity is highly effective in preventing type 2 diabetes in different ethnic and racial groups. However, there is now emerging data on the long-term benefits of such interventions. The median 7-year follow-up of the DPS showed that not only was the marked reduction in the risk of type 2 diabetes in the intervention group sustained, but the absolute risk difference between the groups in fact increased during the post-intervention period.¹⁰¹ Similarly, the 20-year follow-up of the Da Qing cohort showed that the lifestyle-modification group continued to have a lower incidence of type 2 diabetes compared to control participants.¹⁰² These data suggest that intensive lifestyle modification, even for a limited time, can have long-term benefits as far as the risk of type 2 diabetes is concerned.

A number of studies have shown that individuals who are active have a lower risk of developing type 2 diabetes compared to those who are sedentary. Among more than 70 000 initially healthy women from the USA participating in the Nurses' Health Study, walking briskly for at least 30 min/day for 5 days/week was associated with a 25% reduction in diabetes over 8 years of follow-up among those reporting no vigorous exercise, after adjustment for age, body mass index, and other risk factors for diabetes.¹⁰³

In a community-based study conducted in Chennai, south India (Chennai Urban Population Study), standard lifestyle advice (e.g. increasing physical activity and improving diet) was provided to the participants at baseline. After a 10-year follow-up, a 277% increase in the exercise levels of residents of a middle-income colony (the Asiad Colony) was reported, following the construction of a park by the residents of the colony themselves.¹⁰⁴ During the follow-up period, in a colony of individuals from a lower income group, where no built intervention was given, the prevalence of diabetes increased from 6.5% to 15.3% (a 135% increase). However, in the Asiad Colony, a middle-income group where the park was available, the prevalence only increased modestly from 12.4% to 15.4% (i.e. a 24% increase).¹⁰⁵ This indicates that a moderate investment of time and effort might slow the rise in the prevalence of diabetes. This phenomenon is referred to as "prevention of excess gain".¹⁰⁶ This study has been cited as a potential model for prevention of diabetes through community action.¹⁰⁷

THE SYNERGISTIC EFFECT OF DIET AND PHYSICAL ACTIVITY IN SLOWING THE EPIDEMIC OF DIABETES

Nutrition transition and increasingly sedentary lifestyles, which could have a synergistic effect on diabetes risk, are observed in south Asian populations. This underscores the need for policy changes and effective education programmes related to lifestyle modifications in low- and middle-income countries. Thus, prioritizing prevention strategies to curtail the epidemic of diabetes requires an understanding of the relative importance of various modifiable risk factors. Recently, in an urban south Indian population, the contribution of various modifiable risk factors to the partial population-attributable risk for diabetes was evaluated in a cohort of 1376 individuals who were free of diabetes at baseline and followed up for 10 years.³⁸ Abdominal obesity was found to contribute the most to incident diabetes (relative risk [RR]: 1.63). The risk for diabetes increased with increasing quartiles of the diet risk score (computed incorporating intake of refined cereals, fruits and vegetables, dairy products and MUFA; highest quartile RR: 2.14) and time spent viewing television (RR: 1.84) and sitting (RR: 2.09). The combination of five risk factors (obesity, physical inactivity, unfavourable diet risk score, hypertriglyceridaemia and low HDL cholesterol) could explain 80.7% of all incident diabetes. However, improvement in diet and levels of physical activity alone could reduce the prevalence of diabetes by 50%.³⁸ This suggests that modifying these easily identifiable risk factors could prevent the majority of cases of incident diabetes in the Asian-Indian population. Translation of these findings into public health practice will go a long way in arresting the progress of the diabetes epidemic in this region.

NATIONAL-LEVEL POLICY RECOMMENDATIONS

Prevention and management of NCDs like type 2 diabetes across the globe is crucial and will be an uphill task in south Asia, owing to a multitude of barriers. WHO has taken initiatives to combat the risk associated with morbidity, mortality and

disability due to NCDs, through multisectoral collaboration and cooperation at national, regional and global levels. As a result, the population can benefit by achieving the highest attainable standards of health and productivity throughout their lifespan. The goals set by WHO in 2013 include (i) a 25% reduction in overall mortality; (ii) a 10% reduction in the prevalence of physical inactivity; (iii) a 10% reduction in excess alcohol consumption; (iv) a 30% reduction in tobacco usage; (v) a 30% reduction in salt/sodium intake; and (vi) a 25% reduction in high blood pressure.¹

Hence, when planning prevention programmes at national level, a multifaceted approach is essential for success. Some of the policies listed next may help to slow down the epidemic of NCDs such as type 2 diabetes among the countries of south Asia.

- National food policies must target and improve the availability and accessibility of healthy and nutritious foods. Coordination between the public and private sectors needs to be improved to make the policies function properly.
- The government should make efforts to ensure that the food industry strictly complies with norms of food safety and standards.
- Nutrition and agricultural policies that support production and distribution of healthy foods are critical, such as introducing agricultural subsidies that increase the accessibility and affordability of whole grains, fruit, vegetables, legumes and nuts.
- Collaboration between health, education, information and agriculture ministries is essential to create awareness and to facilitate a healthy lifestyle among the population.
- Nutrition and physical activity programmes targeting schoolchildren should be developed to reduce childhood obesity. The sale of unhealthy processed foods like junk foods should be prohibited in schools and in nearby shops. Promoting sales of such products through advertisement must also be controlled.
- Creating awareness of the impact of unhealthy diets, and educating people that prevention is the best cure for NCDs like type 2 diabetes, through newspapers, national TV channels and radio channels, may help to promote healthy eating behaviours and thus promote good health.
- Encouraging physical activity by the creation of amenities such as public spaces (e.g. parks) for walking or cycling is needed to facilitate healthy living.
- It is important for health policy-makers to take the actions necessary to reduce harmful behaviours such as smoking, alcohol misuse, use of trans fat in restaurants and consumption of junk foods.
- As the burden of NCDs is now shifting towards the poor, reducing the cost of drugs and ensuring reasonable access to care remains a high priority. It is important to develop strategies to educate and motivate the public regarding the prevention of diabetes and other NCDs.
- Public and private-sector organizations across all countries of south Asia should work together, in order to measure the magnitude of the problem and design a holistic approach for preventing NCDs like type 2 diabetes, as lessons and good practices learnt from one country can easily be applied to another.

CONCLUSION

Healthy diet and regular physical activity have numerous beneficial effects on the prevention of type 2 diabetes. Economic policies related to agriculture, investment, trade and marketing could have an impact on what the population consumes. Policy-makers should consider these factors while formulating strategies to reduce the burden due to type 2 diabetes and other NCDs in this region. A multi-stakeholder approach is needed to slow down the epidemic of diabetes in South Asians. The time to act is now.

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Childhood obesity and type 2 diabetes in India

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Quick Response Code:



ABSTRACT

India is witnessing an increase in the burden of childhood obesity, especially among the upper socioeconomic strata and in urban areas. Emerging literature suggests a link between childhood obesity and the diabetes epidemic in India. Asian-Indian children and adolescents are increasingly susceptible to a high percentage of body fat and abdominal adiposity. Further, they are exposed to an obesogenic environment, created by rapid urbanization and nutrition transition in India. Obese children have a higher risk of developing abnormalities that are recognized as precursors to diabetes, such as subclinical inflammation, insulin resistance and metabolic syndrome, which often track to adulthood. A review of the literature suggests the need for more longitudinal studies to improve understanding of the long-term consequences of childhood obesity in India. A life-course approach with a combination of population- and risk-based strategies is warranted, to prevent childhood obesity and curtail its consequences in adulthood.

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Key words: childhood obesity, diabetes, insulin resistance, metabolic syndrome, tracking

BACKGROUND

The global tsunami of noncommunicable diseases (NCDs) has swept across all age groups, including children and adolescents. However, the young age group affected by NCDs is often underrecognized. NCDs are responsible for approximately 1.2 million deaths worldwide each year in the age group below 20 years.¹ Children and adolescents are affected by a wide range of NCDs, such as cancer, diabetes (both type 1 and type 2), chronic respiratory diseases, congenital heart diseases, etc. Most of the behavioural risk factors for NCDs (tobacco use, unhealthy diet, lack of physical activity, etc.) start during childhood and often lead to intermediate risk factors such as obesity, hypertension and dyslipidaemia early in life, even in childhood and adolescence.

The growing body of literature on the developmental origin of chronic disease suggest a life-course approach for tackling risk factors.² Childhood obesity is one of the prominent risk factors with serious health implications across the lifespan. Obese children and adolescents are more likely to be obese as adults. Further, they are at a higher risk for developing chronic diseases, such as cardiovascular diseases, diabetes, musculoskeletal disorders and cancers, at a younger age.³ Studies from high-income countries have demonstrated that childhood obesity is also associated with premature mortality and disability in adulthood.⁴ However, such data from low- and middle-income countries are scarce.

Many studies have shown a strong relationship between fetal undernutrition, early-life exposure to obesity and type 2 diabetes.² This is particularly relevant for countries in the World Health Organization (WHO) South-East Asia Region, including India, where there is a double burden of childhood under- and overnutrition.⁵ The coexistence of severe malnutrition and childhood obesity could have a pivotal role in the exponential increase in prevalence of diabetes among Indians. Further, body composition and fat distribution, which are influenced by both genetic and environmental factors, may contribute to the pathophysiology of diabetes in the Indian context. This review aims to summarize the available literature from India on the burden and consequences of childhood obesity and its link with type 2 diabetes in children and adults.

THE GLOBAL BURDEN OF CHILDHOOD OBESITY

Globally, the prevalence of overweight and obesity among children and adolescents increased by 47.1% between 1980 and 2013.⁶ Such a rapid increase led to a high burden of overweight and obesity (23.8% of boys and 22.6% of girls) in high-income countries in 2013. Low- and middle-income countries also experienced a substantial increase, with a rise from 8% in 1980 to 13% in 2013, with no difference between the sexes.⁶ Low- and middle-income countries, including those in South-East Asia, had the highest increase in prevalence of childhood obesity in the past two decades.

THE BURDEN OF CHILDHOOD OBESITY IN INDIA

With a rapid demographic and socioeconomic transition, India is becoming the epicentre of epidemics of both adult and childhood obesity, especially in urban populations. Although the age-standardized rates are low, in absolute terms India is the country with the third-highest level of obesity in the world. Over the years, epidemiological studies have reported a consistent increase in the prevalence of childhood overweight and obesity in the subcontinent. A systematic analysis conducted as part of the Global Burden of Disease study 2013 reported that 5.3% of males and 5.2% of females aged under 20 years in India were overweight. The overall prevalence of obesity among males and females in the above age category was 2.3% and 2.5% respectively.⁶

The rates of childhood obesity vary significantly across India. Studies suggest a definite socioeconomic gradient in the burden of childhood obesity in the country, with higher prevalence in urban areas and in the upper economic strata. A cross-sectional study of schoolchildren from north India aged 5–18 years estimated a significant difference in the prevalence of childhood obesity between lower and upper socioeconomic strata.⁷ However, recent studies from the rural population predict a higher prevalence in lower socioeconomic strata in the near future.

BODY FAT COMPOSITION IN INDIAN CHILDREN AND ADOLESCENTS

For any given body mass index (BMI), adults in South-East Asia tend to have high body fat, particularly abdominal fat, compared to other ethnic groups.⁸ This typical body fat composition increases the risk of insulin resistance at a lower BMI compared to other ethnic groups. A similar difference in body composition has been seen in Asian-Indian children living in Europe and the United States of America (USA). Despite small abdominal viscera and low muscle mass, Indian neonates preserve body fat during their intrauterine development and are relatively obese at birth compared to Caucasians.⁹ Studies showed that this “thin-fat phenotype” persists in postnatal life and results in a significant difference in the body fat content of Indian children compared to other ethnic groups.^{10,11}

Very few studies from India have reported the body fat composition of children and adolescents. A study from north India, which compared the percentage body fat of Indian children aged 7–17 years with data from NHANES (National Health and Nutrition Examination Survey – USA) and the New York Pediatric Rosetta Study, found that Indian children accumulate more body fat during the peripubertal years in comparison with US children.¹² Those in the highest percentile of BMI have a higher percentage body fat than their American counterparts. However, thinner children are likely to have a lower percentage body fat than their age- and sex-matched counterparts. Comparison of two cross-sectional studies from India and Germany also reported similar findings.¹³ Despite the emerging evidence of high body fat among Indian children and adolescents, its prenatal and postnatal determinants are not well studied.

BODY FAT DISTRIBUTION IN INDIAN CHILDREN AND ADOLESCENTS

The pathogenesis of diabetes is influenced not only by the quantity of fat stored but also by its location. Excessive visceral fat, as indicated by abdominal obesity, is one of the strong predictors of insulin resistance, subclinical inflammation and diabetes in Asian-Indian adults.¹⁴ It is now evident that children and adolescents of Indian origin are also susceptible to abdominal obesity. A study of migrant populations in the United Kingdom of Great Britain and Northern Ireland (UK) concluded that Indian children tend to deposit more fat on the trunk and less on the upper limbs compared with their Caucasian counterparts.¹⁵ Epidemiological studies showed a substantial burden of abdominal obesity among children in India. In 2011, a large multi-city study reported that 4.5% of urban children in India aged 8–18 years were centrally obese.¹⁶ The prevalence ranged from 2.1% in Agra to 9.1% in metropolitan Delhi. Based on these data, the authors projected that 3.16 million urban boys and 5.39 million urban girls in India would have abdominal obesity.

CHILDHOOD OBESITY AND THE PATHOGENESIS OF DIABETES: EVIDENCE FROM INDIA

Subclinical inflammation

Inflammation is a key component of the link between obesity and diabetes. Longitudinal studies have established that obesity-associated chronic low-grade inflammation precedes and predicts diabetes.¹⁷ In obese children and adolescents, C-reactive protein (CRP) was the most consistent and the strongest association observed with inflammatory markers.¹⁷ Low levels of adiponectin, which are associated with insulin resistance and inflammation, have also been observed in children and adolescents with obesity. A multi-ethnic study conducted in the UK showed 104% higher CRP levels in south Asian children as compared with their Caucasian counterparts.¹⁸ A study of healthy adolescents and young adults aged 14–25 years from north India observed elevated levels of CRP among 21.8% of overweight subjects and 24.5% of subjects with a high percentage of body fat. Similar results were reported from studies in other parts of the country.¹⁹ It is clear from the review that more longitudinal studies are required to improve understanding of the long-term health risk of chronic low-grade inflammation among obese Indian children.

Insulin resistance

Childhood obesity is strongly associated with insulin resistance, which is considered as a forerunner of type 2 diabetes. Asian-Indian individuals are susceptible to insulin resistance from their early infancy.²⁰ Further, insulin resistance syndrome has been reported in children as young as 8 years in India.²¹ A study on post-pubertal children in India reported a high prevalence of insulin resistance among children with adverse truncal body fat patterning, abdominal adiposity and excess body fat.²² A study conducted among adolescents aged

14–19 years reported that 64% of the obese adolescents in India had fasting hyperinsulinaemia, a surrogate marker of insulin resistance.²³ Another study conducted by the current authors' group on Indian adolescents aged 10–17 years found that insulin resistance, measured in terms of values from the homeostatic model assessment of beta-cell function and insulin resistance (HOMA-IR), increased progressively from normal-weight to obese adolescents in both sexes.²⁴ Early detection of insulin resistance among children is vital in the prevention of metabolic syndrome and diabetes.

Metabolic syndrome

Metabolic syndrome is defined as a cluster of glucose intolerance, hypertension, dyslipidaemia and central obesity, with insulin resistance as the source of pathogenesis.²⁵ Obese children and adolescents with insulin resistance are at increased risk of metabolic syndrome.²⁶ There is a paucity of information from India on metabolic syndrome among children and adolescents. Comparison between studies is difficult, as they have used different criteria for diagnosis. Using the ATP III (Adult Treatment Panel III) criteria, a study from north India estimated an overall prevalence of metabolic syndrome of 4.2% among adolescents aged 12–17 years. The prevalence was almost nine times higher among obese individuals (36.6%).²⁷ Recently, the authors estimated the prevalence of metabolic syndrome among Indian adolescents aged 10–18 years, using ATP III and International Diabetes Federation (IDF) criteria. The overall prevalence was 4.3% and 3.0% respectively. The prevalence was much higher among obese adolescents, at 49% (ATP III) and 46.4% (IDF).²⁸ Despite the high prevalence of metabolic syndrome among obese adolescents, its role in the incidence of diabetes has not been confirmed through longitudinal studies.

TRACKING OF CHILDHOOD OBESITY

In life-course epidemiology, the concept of persistence or relative stability of risk factors over time is often referred to as tracking. Current evidence from high-income countries supports the tracking of childhood obesity, as well as obesity-related behaviours, to adulthood.²⁹ Overweight children have at least two times higher risk of becoming overweight adults compared to normal-weight children.²⁹ Persistence of overweight is greater in those with a high level of obesity.²⁹ However, such data from low- and middle-income countries are limited. Data from the New Delhi Birth Cohort Study suggest that higher BMI and greater BMI gain in late childhood and adolescence are associated with increased adult adiposity and central adiposity.³⁰ A recent longitudinal study from Pune, India, found a significant positive correlation between the BMI of children at 8 and 21 years. Those in the highest quartile of BMI at 8 years had a relative risk of 2.87 of remaining in the same quartile at 21 years of age.³¹ Apart from BMI, waist circumference and skinfold thickness also showed a similar pattern of tracking.³¹

Data are emerging from India on the long-term consequences of childhood obesity tracking. An analysis from the New Delhi

Birth Cohort Study showed that rapid weight gain in childhood and adolescence is associated with a higher prevalence of glucose intolerance and metabolic syndrome in adulthood.³² More longitudinal studies are needed to improve understanding of the pattern and determinants of childhood obesity tracking in India.

PREDIABETES AND TYPE 2 DIABETES AMONG CHILDREN AND ADOLESCENTS IN INDIA

Globally, there has been an increase in the burden of prediabetes among children and adolescents.³³ In a recent population-based study conducted in south India, the overall prevalence of dysglycaemia was 3.7%, which increased to 12.7% in girls with abdominal obesity.³⁴ In the authors' recent study, the prevalence of impaired fasting glucose and impaired glucose tolerance among obese adolescents was 6.5% and 5.5% respectively.²⁸

Population-based data on type 2 diabetes among children and adolescents are unavailable from India. However migrant studies from high-income countries have demonstrated a high prevalence of type 2 diabetes among south Asian adolescents.³⁵ Isolated clinic-based studies from India report a consistent increase in the proportion of individuals with type 2 diabetes among adolescents. A clinic-based study from Chennai reported that 30.4% of individuals diagnosed with diabetes at a young age (<25 years) who were registered at their centre during 1992–1995 had type 2 diabetes.³⁶ This increased to 49.1% during 2006–2009.³⁶ Out of the total 5546 patients recruited (between 2000 and 2011) by the large clinical registry of youth-onset diabetes funded by the Indian Council of Medical Research, 25.3% were diagnosed as having type 2 diabetes (unpublished data). However, results from these clinic-based studies should be interpreted with caution, as they could be influenced by referral bias.

Obesity is an important determinant of type 2 diabetes among south Asian adolescents in the UK.³⁵ A case-control study by the present authors' research group in Delhi found significantly higher measures of generalized and regional obesity, hypertriglyceridaemia and hypercholesterolaemia in children and young adults with diabetes as compared to young people who did not have diabetes.³⁷ Longitudinal studies are needed to establish the causal relationship between childhood obesity and young-onset type 2 diabetes.

CONCLUSION

Current literature suggests a high burden of generalized obesity among Indian children and adolescents, with a definite socioeconomic gradient. Asian-Indian children are increasingly susceptible to unfavourable body composition, as well as regional adiposity. The conventional BMI criteria for obesity are inadequate to identify these differences in body fat composition or distribution. Hence, ethnicity-specific, metabolically relevant cut-off values should be considered while diagnosing obesity and adiposity. Emerging literature suggests tracking of childhood obesity and body fat patterning

to adulthood. Obese Indian children have a high burden of subclinical inflammation, insulin resistance and metabolic syndrome at a younger age than their non-obese counterparts. Clinic-based studies from India, and migrant studies from high-income countries, report an increase in the proportion of type 2 diabetes among adolescents. The age at presentation of type 2 diabetes is also declining in India. All these point towards a direct link between childhood obesity and the diabetes epidemic in India.

Review of the literature has emphasized the importance of future research to understand the relationship between childhood obesity and diabetes. More epidemiological studies are required to estimate the burden and consequences of childhood obesity in India. Secular trends in the incidence of obesity among children and adolescents also need to be studied. The effect of early-life factors, as well as environmental determinants of both generalized and abdominal obesity among Indian children, is largely unknown. Longitudinal studies are essential to understand the long-term health impact of childhood obesity tracking. Further, there is an urgent need to address the lack in the evidence base for management of established obesity and coexisting metabolic abnormalities such as insulin resistance and metabolic syndrome among children and adolescents.

Available evidence on the natural history of type 2 diabetes in India suggests the need for a life-course approach in the prevention and control of childhood obesity. A comprehensive multilevel, multicomponent obesity-prevention strategy addressing a wide range of issues, starting from maternal and childhood undernutrition, and including sociodemographic and environmental factors, is a necessity in India. Conventional childhood obesity programmes are school based and do not address most of the upstream determinants of obesity. Since the seeds of childhood obesity are sown in the domestic environment, culturally specific family- and community-level intervention would have more impact. These community-level interventions should be complemented with an environment that supports physical activity and healthy diet. Population-wide policies, such as restriction of marketing unhealthy foods and beverages to children, nutrition labelling, taxes and subsidies, are required to create such an enabling environment. The Ensemble, Prévenons l'Obésité des Enfants (EPODE) [Together Let's Prevent Childhood Obesity] programme in Europe,³⁸ The Pacific Obesity Prevention in Communities (OPIC) project³⁹ and the Romp & Chomp programme in Australia⁴⁰ are examples of such community-level interventions that can be adapted to Indian settings.

Opportunistic screening of obese children for metabolic syndrome and insulin resistance would help to prevent the long-term health consequences of these disorders. Parents and health professionals should be empowered with cost-effective tools to identify high-risk children. Moreover, children and adolescents should be given due importance when designing national NCD-prevention and management programmes. It is high time to build the sea walls of prevention, as the tides of childhood obesity are approaching the shore.

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Population-based dietary approaches for the prevention of noncommunicable diseases

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ABSTRACT

As the incidence of noncommunicable diseases such as diabetes continues to rise at an alarming rate in South-East Asia, it is imperative that urgent and population-wide strategies are adopted. The most important contributors to the rise in noncommunicable disease are a rise in mean caloric intake and a decrease in physical activity. The evidence for population-based dietary approaches to counter these factors is reviewed. Several structural and cohesive interdepartmental coordination efforts are required for effective implementation of prevention strategies. Since low- and middle-income countries may lack the frameworks for effective and integrated multi-stakeholder intervention, implementation of population-based dietary and physical-activity approaches may be delayed and may be too late for effective prevention in current at-risk cohorts. Evidence-based strategies to decrease energy intake and increase physical activity are now well established and their urgent adoption by Member States of the World Health Organization South-East Asia Region is essential. In the context of Sri Lanka, for example, it is recommended that the most effective and easy-to-implement interventions would be media campaigns, restrictions on advertisement of unhealthy foods, taxation of unhealthy foods, subsidies for production of healthy foods, and laws on nutrition labelling that introduce colour coding of packaged foods.

Key words: best buys, food taxation, NCD, noncommunicable diseases, obesity

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BACKGROUND

Noncommunicable diseases (NCDs) such as cardiovascular disease, diabetes and cancers are on the rise worldwide. This rise in NCDs will have a huge social impact, as well as causing exponential increases in the economic costs incurred as a result of secondary prevention and treatment of complications. The highest quantum of rise in NCDs is seen in low- and middle-income countries (LMICs) that already struggle with health allocations and parity of access to the poor. Poverty and barriers in access to health care, together with delays in responding to the rising and changing health-care requirements, can overwhelm the health budgets of most countries. Member States of the World Health Organization (WHO) South-East Asia Region, such as those in India, Maldives and Sri Lanka, show particular vulnerability, with NCDs causing a high proportion of deaths.¹

There are two major problems in implementation of effective NCD-prevention interventions. Firstly, NCD intervention strategies can be complex and costly. Most LMICs do not have the framework for the effective and integrated multi-stakeholder intervention that is required. Therefore, despite having NCD policies, their implementation is often inadequate.

Secondly, there is a time delay in implementation of programmes, and this delay will allow the incidence of NCDs to rise. An example is that of prediabetes. In many countries, 40–50% of the population has dysglycaemia and more than half of these people have prediabetes.^{2,3} By the time system interventions take effect, the individuals with prediabetes will have progressed to diabetes; the number of cases of diabetes can double in one to two decades.

CAUSAL FACTORS FOR THE CURRENT PANDEMIC OF NONCOMMUNICABLE DISEASES

The risk factors for most NCDs can be broadly classified into metabolic and behavioural. The former include risk factors such as hypertension, overweight/obesity, hyperglycaemia and hyperlipidaemia, while the latter include tobacco use, physical inactivity, unhealthy diet and misuse of alcohol. It is likely that behavioural factors such as physical inactivity and unhealthy diet increase the risk of NCDs, via an increase in risk for the metabolic risk factors, mainly obesity. Indeed, the increasing prevalence of NCDs such as cardiovascular disease and type 2

diabetes is associated with an increasing prevalence of obesity. In individuals of South Asian descent in particular, the risk for NCDs such as type 2 diabetes starts at a lower body mass index when compared to Caucasians.⁴ Moreover, owing to nutrition transition, the annual increase in the prevalence of obesity in LMICs is greater than that in high-income countries.⁵ Therefore, urgent action is needed to prevent the escalation of obesity and NCD rates in LMICs. An understanding of the causes of obesity is essential for the development of strategies to treat and prevent obesity, which would help to alleviate the risk for NCDs.

CAUSES OF OBESITY

Body weight is determined by the balance between energy intake and expenditure. Energy intake is from the ingestion of carbohydrates, proteins, fat and alcohol, while energy expenditure is through resting metabolic rate, the thermic effect of food and physical activity. When the energy intake exceeds energy expenditure, a state of positive energy balance occurs, leading to an increase in body weight, of which 60% to 80% is usually body fat.⁵ Homeostatic mechanisms for energy balance prevent wide fluctuations in body weight. Despite the evidence for these homeostatic mechanisms, most people gain weight over their adult years. This suggests that there may be limits to the body's ability to match energy intake and expenditure, especially under changing environmental conditions. For example, data from the National Health and Nutrition Examination Survey suggest that the average daily energy intake in the United States of America (USA) increased by 168 kcal/day for men and 335 kcal/day for women between the years 1971 to 2000.⁶ Without mechanisms for energy balance, this increase would theoretically give rise to a yearly weight gain of 8 kg for men and 16 kg for women. Similarly, there is evidence that energy expenditure has also decreased over time. For example, Church et al. have reported that occupational physical activity in the USA has declined by 142 kcal/day since 1960, which in theory would increase body weight by about 7 kg per year.⁷ Taken together, the changes in energy intake and energy expenditure over the past decades would predict more weight gain in adults than has actually occurred, if there were no physiological homeostatic processes attempting to maintain energy balance. Therefore, the recent escalation of obesity rates is likely to be due to a combination of increased energy intake and reduced energy expenditure, which have exceeded the body's limits of homeostatic mechanisms for energy balance. This is an important consideration when developing interventions targeted at both preventing and reversing obesity.

From the perspective of energy balance, it would be easier to prevent obesity than to reverse it, since physiological regulatory mechanisms defending body weight appear to respond much more strongly to weight loss than to prevention of weight gain. Thus, it would be easier to prevent weight gain than to produce sustained reductions in body weight in those who are already obese. Compensatory reductions in resting metabolic rate and increases in hunger occur during energy restriction and weight loss. However, simply preventing positive energy balance should not produce significant compensation through

increased energy intake or a reduction in resting metabolic rate. Therefore, a reasonable starting point in addressing obesity is to develop behaviour goals for primary prevention of weight gain. According to different predictive methods, weight gain in adult and child populations could be prevented by an energy deficit of 100 kcal/day⁸ and 150 kcal/day⁹ respectively. Therefore, population-based strategies for prevention of weight gain need only advocate small changes in physical activity and energy intake to be successful. Such programmes could concentrate on helping people to reduce the energy density and portion size of some foods consumed and increasing lifestyle physical activity.

EVIDENCE-BASED STRATEGIES TO DECREASE ENERGY INTAKE AND INCREASE PHYSICAL ACTIVITY

Shifts in dietary patterns in Member States of the WHO South-East Asia Region, particularly with respect to greater intake of fat, sugar and foods from animal sources, appear to have contributed to the increase in energy intake in recent years.^{4,10} According to Duffey and Popkin, the number of eating/drinking occasions per day, portion size per eating occasion, and energy density per eating/drinking occasion are the largest contributors to annualized changes in daily total energy among US children between 1977 and 2010.¹¹ The energy density of meals is highly dependent on the fat and sugar content in the food. Therefore, effective strategies to reduce the energy density of meals include increasing the consumption of fruit and vegetables and cutting down the consumption of high-fat food and sugary drinks. Reducing portion sizes is also an important strategy in this regard. All these aforementioned changes are behavioural ones, which require population-based interventions to succeed.

A recent review by the American Heart Association of population-based approaches to improving diet and physical activity has identified key evidence-based areas, which are summarized in Tables 1 and 2.¹² These are broadly classified into media and education, labelling and information, economic incentives, schools, workplaces, local environment, and restrictions and mandates. Since the resources for these interventions are limited, it is important to identify the "best buys" from among them. These are discussed next.

Feasible population-based dietary options for the prevention of noncommunicable diseases in Member States of the South-East Asia Region: "best buys"

The WHO South-East Asia Region has been an emerging frontier for the food industry, which is aggressively marketing to increase the sale of their unhealthy products. Low cost and easy availability of convenience foods have also influenced many South-East Asian populations, particularly in urban areas, to increasingly consume high-saturated-fat snacks, refined carbohydrates and sweetened carbonated beverages.¹³

Table 1. Summary of evidence-based population approaches to promoting healthy diets

Area	Population approach
Media and education	<ul style="list-style-type: none"> Media and educational campaigns to increase consumption of healthy foods or to reduce consumption of unhealthy foods or beverages
Labelling and information	<ul style="list-style-type: none"> Mandated nutrition facts panels or front-of-pack labels/icons, as a means to influence industry behaviour and product formulations
Economic incentives	<ul style="list-style-type: none"> Subsidy strategies to lower the prices of healthy foods and beverages Tax strategies to increase the prices of unhealthy foods and beverages Changes in agricultural subsidies to facilitate production, transportation and marketing of healthier foods
Schools	<ul style="list-style-type: none"> Specialized educational curricula, trained teachers, supportive school policies, healthy food and beverage options School garden programmes Fresh fruit and vegetable programmes that provide free/affordable fruit and vegetables to students
Workplaces	<ul style="list-style-type: none"> Comprehensive worksite wellness programmes Increased availability of healthier food/beverage options
Restrictions and mandates	<ul style="list-style-type: none"> Restrictions on television advertisements for unhealthy foods or beverages advertised to children Restrictions on advertising and marketing of unhealthy foods or beverages near schools and public places frequented by youths General nutrition standards for foods and beverages marketed and advertised to children Regulatory policies to reduce specific nutrients in foods (e.g. trans fats, salt, sugar)

Table 2. Summary of evidence-based population approaches to improving physical activity

Area	Population approach
Labelling and information	<ul style="list-style-type: none"> Point-of-decision prompts to encourage use of stairs
Schools	<ul style="list-style-type: none"> Increased availability and types of school playground spaces and equipment Increased number of physical education (PE) classes and trained PE teachers at schools Regular classroom physical activity breaks during academic lessons
Workplaces	<ul style="list-style-type: none"> Worksite wellness programmes Structured worksite programmes that encourage activity and also provide a set time for physical activity during work hours Adding new or updating worksite fitness centres
Local environment	<ul style="list-style-type: none"> Improved accessibility of recreation and exercise spaces and facilities (e.g. building of parks and playgrounds, increasing operating hours, use of school facilities during non-school hours) Improved land-use design Improved pavement and street design to increase active commuting (walking or cycling) to school by children Improved traffic safety Improved neighbourhood aesthetics (to increase activity in adults) Improved walkability

Further, evidence from studies indicates that knowledge about food and healthy food behaviours is inadequate among populations in this region.^{14,15} Media and education campaigns are successful evidence-based strategies in delivering health messages on increasing the consumption of healthful foods such as fruit and vegetables, or reducing consumption of less healthful foods such as high-fat foods and sugary drinks. This strategy can also be used to educate the public to reduce portion sizes. One method to combine both of the above is to introduce a “plate method”, which focuses on both reducing the energy density of food (half the plate should be vegetables) and decreasing portion sizes (only one quarter of the plate should be grains/starches). Media and education campaigns are particularly relevant in South-East Asian countries, considering that much of the food eaten in this region is from the informal sector, such as from street vendors, and therefore beyond the control of labelling strategies or marketing restrictions.

However, media and education campaigns need to be supplemented by other strategies, such as labelling of packaged foods. Labelling is another strategy to increase public awareness, as well as to modify the behaviour of the food industry. This strategy includes mandating panels showing nutrition facts on packaged food items. An additional strategy would be to colour code foods based on the “healthfulness” of the food item. This strategy, however, would need legislative changes by the government. Education campaigns can also be used for increasing physical activity with minimal cost. An example is the display of point-of-decision prompts to encourage the use of stairs instead of elevators. At present, nutrient labelling of packaged foods is voluntary in most Member States in the South-East Asia Region and front-of-pack labelling is only practised in Thailand.¹⁶

Economic incentives are also important in changing consumer behaviour. These include providing subsidies to lower the prices of healthful foods such as fruit and vegetables, since the relatively high cost of fruit and vegetables in many countries discourages consumption of such healthy food items. Providing concessions to the agriculture sector to create an infrastructure that facilitates production, transportation and marketing of healthier foods, sustained over several decades, would be important in maintaining a constant supply of these foods.

Tax strategies to increase the prices of less healthful foods and beverages is another method to increase the price of unhealthy foods and reduce their consumption. For example, a recent economic-epidemiologic modelling study showed that sustained taxation of sugar-sweetened beverages at a high tax rate could mitigate rising obesity and type 2 diabetes in India among both urban and rural subpopulations.¹⁷

Schools and workplaces are important sites for implementation of interventions to prevent NCDs. Providing specialized educational curricula including healthful behaviours, training teachers on NCD prevention, and providing healthy food and beverage options at schools are important strategies in this regard, and have been shown to be successful.^{14,15} To increase physical activity in schoolchildren, it is important to increase the availability of school playground spaces and equipment.

Increasing physical education (PE) classes and having trained PE teachers at schools are important ways by which physical activity can be increased without much expense. Having regular classroom physical activity breaks during academic lessons could also be important in breaking long spells of sedentary behaviour. Workplace “best buy” interventions include providing access to healthy food options, providing a set time for physical activity during work hours and adding new, or updating, worksite fitness centres.

Restrictions and mandates are also important strategies that a government can enforce to promote healthy behaviours. This includes restrictions on television advertisements for less healthful foods or beverages advertised to children and restrictions on advertising and marketing of less healthful foods or beverages near schools and public places. However, WHO’s recommendations on restricting the marketing of unhealthy foods and sugar-sweetened beverages have not yet been implemented in Member States of the South-East Asia Region. Recommending general nutrition standards for foods and beverages marketed and advertised to children is another strategy to cut down consumption of high-energy foods by children. Finally, regulatory policies to reduce specific nutrients in foods (e.g. trans fats, salt, sugar) is another method to reduce consumption of these nutrients.

Making changes to the local environment is an important strategy by which physical activity can be increased. While it can be argued that this incurs a huge cost, incorporation of these strategies to new constructions can overcome this problem. Improved accessibility of recreation and exercise spaces and facilities (e.g. building of parks and playgrounds, increasing operating hours, use of school facilities during non-school hours), improved pavement and street design to increase active commuting (walking or cycling) to school by children, improved traffic safety, improved neighbourhood aesthetics (to increase activity in adults) and improved walkability are some of the areas that can be addressed to increase physical activity.

OPPORTUNITIES AND CHALLENGES TO IMPLEMENTATION: THE EXAMPLE OF SRI LANKA

NCD interventions must be urgent and simple, in order to be effective. The “best buy” model is to implement the most cost-effective approach. However, “best buys” that have been considered are themselves too complex and require multiple departments and ministries in various levels of governance to come together to implement the model as a cohesive unit. Therefore, it is important that the “best buy” is actually the simplest as well as the most cost-effective approach and can be implemented with the fewest structural changes in the particular country.

For example, in the context of Sri Lanka, we recommend that the most feasible approaches are: media campaigns, restrictions on advertisement of unhealthy foods, taxation of unhealthy foods, subsidies for production of healthy foods, and laws on nutrition labelling that introduce colour coding of

packaged foods. In Sri Lanka, the mass media, especially the electronic media, play a significant role in making the public aware of current issues, which can have an impact on public behaviour. Moreover, these media organizations are involved in mobilizing the public in issues of national significance. For example, several media organizations were at the forefront of collecting and delivering aid to the individuals affected by the 2004 tsunami. In this context, media campaigns on health promotion, as well as restriction of advertisement of unhealthy foods, would be of paramount importance. Food taxation, although not very popular, has been shown to be effective in decreasing the consumption of foods that have been targeted.¹⁸ The taxation has to be transparent and implemented with consultation of the population, and, in order to be effective and acceptable, the taxation of food should not be seen as revenue earning but as encouraging and rewarding a switch to alternative healthy foods. The tax should be applied not just for foods where caloric sweetener has been added but for all foods that are calorie dense.

In terms of implementation of these strategies, one approach would be a consensus from an expert panel on the types of foods to be subjected to these taxes or concessions.¹⁹ This expert panel should include nutrition professionals, academics and clinicians with an interest in obesity. Once a consensus is reached, their recommendations should be presented to administrators and policy-makers for implementation. Evidence-based strategies to decrease energy intake and increase physical activity are now well established. Countries in South-East Asia face an overwhelming burden of NCDs and preventive interventions must be implemented as a matter of urgency.

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Diabetes prevention and care in the universal health coverage context: the example of Thailand

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ABSTRACT

Universal health coverage (UHC) is a key policy issue in countries of the World Health Organization (WHO) South-East Asia Region. However, despite projections of significant increases in burden, there is little protection against the financial risks associated with noncommunicable diseases (NCDs), including diabetes. Thailand achieved UHC of all 67 million of the population in 2002, under three public health insurance schemes. The country therefore provides a case-study on diabetes prevention and care in the context of UHC. Although the budget for the Thai Universal Coverage (UC) scheme, which covers nearly 80% of the population, increased significantly during 2003–2013, the proportion allocated to clinical prevention and health promotion declined from 15% to 11%. The financial case for investment in diabetes prevention is made, particularly with respect to a focus on primary care and the use of community volunteers. The UC scheme can expand to nearly 100% population coverage, with a comprehensive benefit package and financial risk protection. Although the rates of complications and fatalities in patients with diabetes have improved over the last few years, achievement of well-controlled fasting blood glucose for all patients is still the main challenge for further improvement. It is recommended that, in order to improve coverage of diabetes care and prevention, it is essential for countries in the WHO South-East Asia Region to include major NCD services, in particular primary prevention, in their UHC strategies. Since a resilient health system is key to UHC delivery, strengthening of the health workforce and infrastructure should be part of any action plan to prevent and control diabetes.

Key words: diabetes, noncommunicable diseases, Thailand, universal health coverage

BACKGROUND

The aim of universal health coverage (UHC) is to ensure that all people obtain the health services they need without suffering financial hardship when paying for them. Sustainable Development Goal Target 3.8 is to achieve UHC, including financial risk protection; access to quality essential health-care services; and access to safe, effective, quality and affordable essential medicines and vaccines for all. UHC is therefore a key policy issue in countries not only in the World Health Organization (WHO) South-East Asia Region, but also in other regions. Although UHC is gaining in popularity in the region, there are many challenges to implementation. These include

expanding coverage to the poor and to non-poor workers in the informal sector, and defining a cost-effective common benefit package that is responsive to the disease burden. Ensuring readiness and adaptability of the supply-side health system presents an even greater challenge.¹

UHC can be viewed from three perspectives: population coverage, service coverage and protection from financial risk.² The definition of service coverage can be controversial, as it requires specification of the range of service packages that should be provided; the design of the UHC system; and the scale of health-system development, which vary among countries.³ The performance of a health system in relation to UHC can be

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measured by assessing multiple criteria,^{4,5} such as population coverage, access to and use of health services, protection from financial risk, patient satisfaction with the process, and the result of care.⁶ The scope of performance includes health gain, cost containment, health outcome, efficiency, quality, equity, access, choice, transparency, accountability, citizen participation and provider satisfaction.⁷ Some criteria are interrelated; for example, accessibility is related to both equity of service and utilization.

Implications of diabetes for universal health coverage

In the context of UHC, noncommunicable diseases (NCDs) have already received global attention, and are given high priority; the 66th World Health Assembly endorsed the *Global action plan for the prevention and control of noncommunicable diseases 2013–2020*.⁸ However, in many low- and middle-income countries, there is little protection against the financial risk associated with NCDs; thus, financial costs are largely borne by households themselves, rather than governments or insurance schemes. For example, when patients with diabetes require insulin, this represents an important cost burden for them and their families.⁹

Morbidity and mortality related to diabetes have increased at global, regional and country levels. As one of the major NCDs, diabetes is projected to be the seventh-leading cause of death by 2030.¹⁰ The prevalence of diabetes in 11 countries of the WHO South-East Asia Region is predicted to increase significantly, from 46.9 million patients in 2000 to 119.5 million in 2030.¹¹ For Thailand, the number of patients with diabetes is predicted to rise to 2.7 million by 2030.¹¹

It is anticipated that, in the context of UHC, the higher prevalence of diabetes and higher population coverage with health insurance will lead to increasing use of health services by patients with diabetes. Therefore, the health system needs to be ready to respond to an increased demand, by ensuring not only adequate health financing but also a competent health workforce, sufficient medicines and the availability of other support systems.

The universal health coverage schemes in Thailand

Thailand has achieved UHC of all 67 million of the Thai population covered under the three public health insurance schemes. The Universal Coverage Scheme (UC scheme) is the largest of these, with coverage of nearly 80% of the total population. Most of the members of the UC scheme are from the informal sector and might have low education and low income. The Social Security Scheme (SSS) has the second largest population coverage, at about 10% of the total population. Most members of the SSS are adults with low comorbidity. The Civil Servant Medical Benefit Scheme (CSMBS) is the third scheme in terms of coverage, covering nearly 10% of the total population. Most members of this scheme are in the working age group and have a relatively high income. To date,

the Thai UC scheme has resulted in good outcomes as a whole, and in particular for poor families. Members of the population who are worse off receive greater benefit from the UC scheme policy than those who are better off.¹² Utilization of ambulatory care for members of the UC scheme increased from 2.45 to 3.12 visits per person per year between 2003 and 2013, or from a total of 112 to 152 million outpatient visits during the same period.¹³ In addition, the national household-representative Thailand Health and Welfare Survey found that, in the context of Thai UHC, having chronic disease was a significant factor in increasing the likelihood of outpatient visits and hospital admission.^{14,15}

This article provides an overview of diabetes prevention and care in the context of UHC. Specific examples from the Thai experience are highlighted, in order to synthesize key points and lessons learnt that may be applied to other countries of the WHO South-East Asia Region.

DIABETES IN THE CONTEXT OF FINANCING FOR PREVENTION OF NONCOMMUNICABLE DISEASES

Interventions for the prevention and control of NCDs have been recommended and endorsed; however, less than 50% of countries in the world have responded to the goals of the WHO *Global action plan for the prevention and control of noncommunicable diseases 2013–2020*⁸ with an adequate budget for implementation.¹⁶ It is common for the majority of a country's health budget to be for curative services, with little available for health-promotion and preventive services.¹⁷ A WHO working group reported in 2015 that the budget for population-based health-promotion activities in upper-middle-income countries was tiny, at less than 1% of the total health budget.¹⁸

In 2016, in an analysis of National Health Account data compiled by WHO, Tangcharoensathien et al. demonstrated the following:¹⁹

- In 2013, countries in the WHO African and South-East Asia Regions had very low total health expenditure per person per year, at US\$ 109 and US\$ 71, respectively, compared with expenditures in the WHO Region of the Americas and European Region of US\$ 3694 and US\$ 2354 per person per year, respectively. The total health expenditure in the South-East Asia Region is inadequate to pursue good health outcomes for the population.
- In 2012, the proportion of health expenditure for preventive and public health services was low in all WHO regions, at around 4% of total health spending. The African and South-East Asia Regions spent only US\$ 10 and US\$ 7 per person per year, respectively, for health prevention and public health services, while the Region of the Americas and the European Region spent US\$ 100 and US\$ 67 per person per year, respectively. This level of expenditure on prevention and public health services in the African and South-East Asia Regions makes it difficult to respond to prevention and control of NCDs, particularly in the context of increasing levels of NCD in the regions.

The UC scheme in Thailand provides for its members a comprehensive range of essential health services with a primary care focus, covering outpatient, inpatient and accident and emergency services; dental and other high-cost care; and diagnostics, special investigations, essential medicines and medical supplies. The UC scheme also includes clinic-based preventive and health-promotion services provided in health facilities for all the population. The increase in use of essential health services with a package including a wide range of benefits is made possible by a specific protected budget for the UC scheme funded by general taxation. Importantly, the UC scheme applies mixed-method provider payments, with mainly close-ended capitation for ambulatory services and based on diagnosis-related groups, with a global budget for inpatient care. This contributes to cost containment and system efficiency.²⁰

The budget for the UC scheme increased significantly between 2003 and 2013, from 30 538 to 108 744 million baht. However, similar to the situation in the WHO South-East Asia Region and other regions, the majority of the budget was for curative services, which includes services for diabetes. Less than 15% of the budget for the UC scheme was for clinical prevention and health-promotion services. Notably, this proportion declined from around 15% to 11% between 2003 and 2013. There is a policy to raise the budget for clinical prevention and health promotion up to 15% again. In 2014, the budget for prevention and promotion was 14%, which was mainly for clinical prevention interventions, such as immunization. In addition, the UC scheme provides special attention for some selected diseases according to their high burden, for example cerebrovascular diseases, diabetes and hypertension. The UC scheme promoted screening for diabetes and hypertension, with an earmarked budget of 1% of the total UC budget in 2014, or about US\$ 51 million, and a budget for prosthetics for diabetes patients was earmarked in the rehabilitation category.²¹

Of note, under the UC scheme, managed by the National Health Security Office (NHSO), an innovative financing for health promotion and prevention, the “Community Health Fund”, has been created, which is funded equally by the NHSO and the local government unit of each area. This Community Health Fund is pooled at subdistrict level and managed by a multisectoral committee set up at the subdistrict level. The fund was established in 2006 and is mainly for health-promotion and disease-prevention activities, including for diabetes and other NCDs.²² However, although the system for health promotion and prevention was established nearly a decade ago, its effectiveness for prevention and control of diabetes and other NCDs is not yet proved.

THE FINANCIAL CASE FOR INVESTMENT IN DIABETES PREVENTION

Investment in prevention

Underdiagnosis of diabetes is a cost issue, as it delays the start of treatment, exposing patients to the risk of complications, which in turn leads to higher treatment costs. For example, a study in Thailand demonstrated the median cost of illness for

patients with complications is over four times higher (US\$ 480) than that for patients without complications (US\$ 115).²³

Further, a cost-effectiveness study on the World Health Organization Package of Essential Noncommunicable (PEN) disease interventions project in Bhutan indicated high value for money on opportunistic screening for diabetes and hypertension. The findings even suggested that expansion of the universal screening programme would be more cost-effective.²⁴ Such findings demonstrate that investment in prevention (screening) and promotion (awareness of risk factors) in relation to diabetes would be a cost-effective policy and strategy for countries in the South-East Asia Region to adopt.

Focusing on primary care

Focusing on primary care in low-resource settings can ensure efficient resource use, sustainable health financing, and equitable access to basic essential health services²⁴, especially where a high proportion of the population lives in rural areas. For example, a study in Thailand illustrated that a visit to the regional hospital was 3.48 times more expensive than a visit to a community hospital.²⁵ Thus, it will be strategic and cost-effective to invest in expansion of facilities for prevention and treatment of diabetes at primary care level, and to equip primary care facilities with adequate human resources and infrastructure.

In addition, increased provision of services by health-care providers at the grassroots level can also contribute to an increase in the demand for health services, as people can easily access services at this level. The doctor and nurse ratio for the population has increased rapidly in remote areas of Thailand since before UHC was rolled out.²⁶

Village health volunteers

The primary health-care system in Thailand was set up in 1977, before the *Declaration of Alma-Ata* in 1988.²⁷ The system comprises not only health personnel at health centres and community hospitals, but also village health volunteers (VHVs) and, initially, village health communicators (this role was subsequently integrated into that of VHVs). These personnel are local community members and so act as a bridge between the primary health-care system and the community. This community health-care system improved in synergy with the primary health-care system when UHC was implemented in 2002.

Prevention of diabetes conducted by trained VHVs has been found in many studies to be effective.^{28–31} Interventions for prevention and control of diabetes by VHVs can cover education on the importance of a healthy diet and regular exercise, as well as measurement of body mass index, waist circumference and systolic blood pressure.²⁹ Key factors for successful interventions for prevention and control of diabetes have been shown to be trust between the patient and VHV; a good relationship and communication between health staff and

the VHV; a good attitude of the VHV towards patients because they are from the same village; networking within patient groups and the VHV; and creative activities.²⁸

IMPROVING THE COVERAGE AND QUALITY OF DIABETES CARE AND PREVENTION

Improving coverage

Effective coverage of health services is more challenging than population coverage. The National Health Examination Survey (NHES) conducted in 1991, 1997, 2004 and 2009 provides information on NCDs, including diabetes, in Thailand. The four rounds of NHES showed a progressive increase in the prevalence of diabetes from 1991 to 2009, in both male and female adult populations (see Fig. 1).^{32–35}

In the 2009 NHES, 5.1% of male and 6.2% of female adults aged 18–59 years, almost 3.2 million people, had diabetes. When compared with 2004, the proportion of non-diagnosed diabetes reduced from 66% and 49% to 43% and 22% in men and women respectively, while the proportion of well-controlled diabetes increased from 9% and 15% to 20% and 35% in men and women respectively (see Fig. 2). However, effective coverage of patients with well-controlled diabetes was still not satisfactory. Hence, it is crucial to improve effective coverage by promoting active primary prevention, early screening and an effective treatment campaign, in order to prevent serious complications leading to high-cost care, such as end-stage renal disease and diabetic retinopathy.

Quality of diabetes services

The Thai UC scheme regularly monitors indicators related to diabetes services. For many years, these indicators have been presented in the annual report of the UC scheme as a time trend, from 2005 to 2013.¹³ The UC scheme shows positive outcomes for patients with diabetes. The accessibility of health services for patients with diabetes increased from 55.0% in 2009 to 95.7% in 2013.¹³ The rate of complications for patients with diabetes has decreased for most organs: eye complications decreased from 4.2% in 2011 to 3.5% in 2013 and cardiovascular complication decreased from 1.3% to 0.9%; however, renal complications increased from 5.4% in 2011 to 8.2% in 2013. The fatality rate for patients aged ≥ 15 years with diabetes with or without complications decreased from 3.58% in 2005 to 2.23% in 2013.¹³

The outcomes of diabetes are attributable not only to factors within the health sector but also to other factors, including good design of the UC scheme, effective health-system strengthening, and a conducive environment to combat risk factors related to diabetes.

- Effective design of the UC scheme requires a comprehensive benefit package, including promotion, prevention, curative and rehabilitation services, with an emphasis on health security of the population, and accessibility to quality of care without financial risk, while also promoting equity and efficiency of the system.
- The capacity of the health system to deliver services is crucial, otherwise the benefit package of the UC scheme will not be available in real practice. This requires a well-

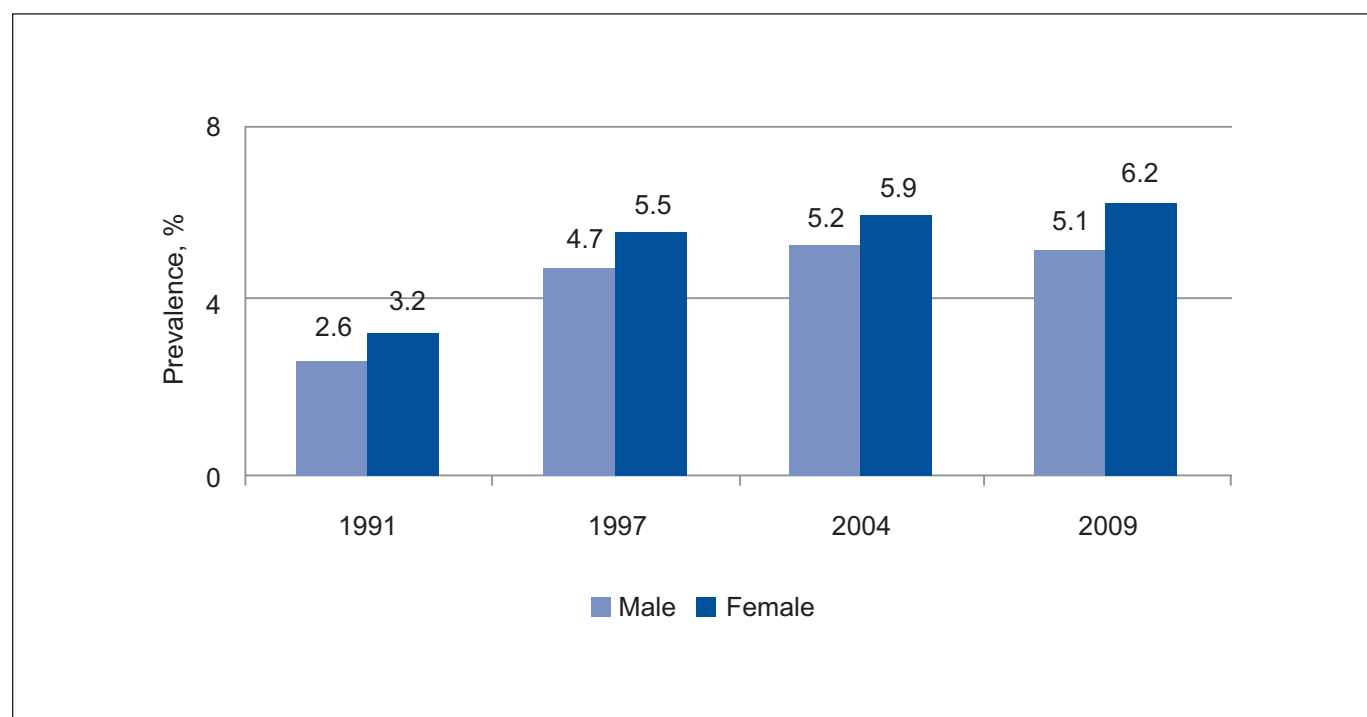


Fig. 1. Prevalence of diabetes in the male and female Thai population aged 18–59 years, 1991–2009^{32–35}

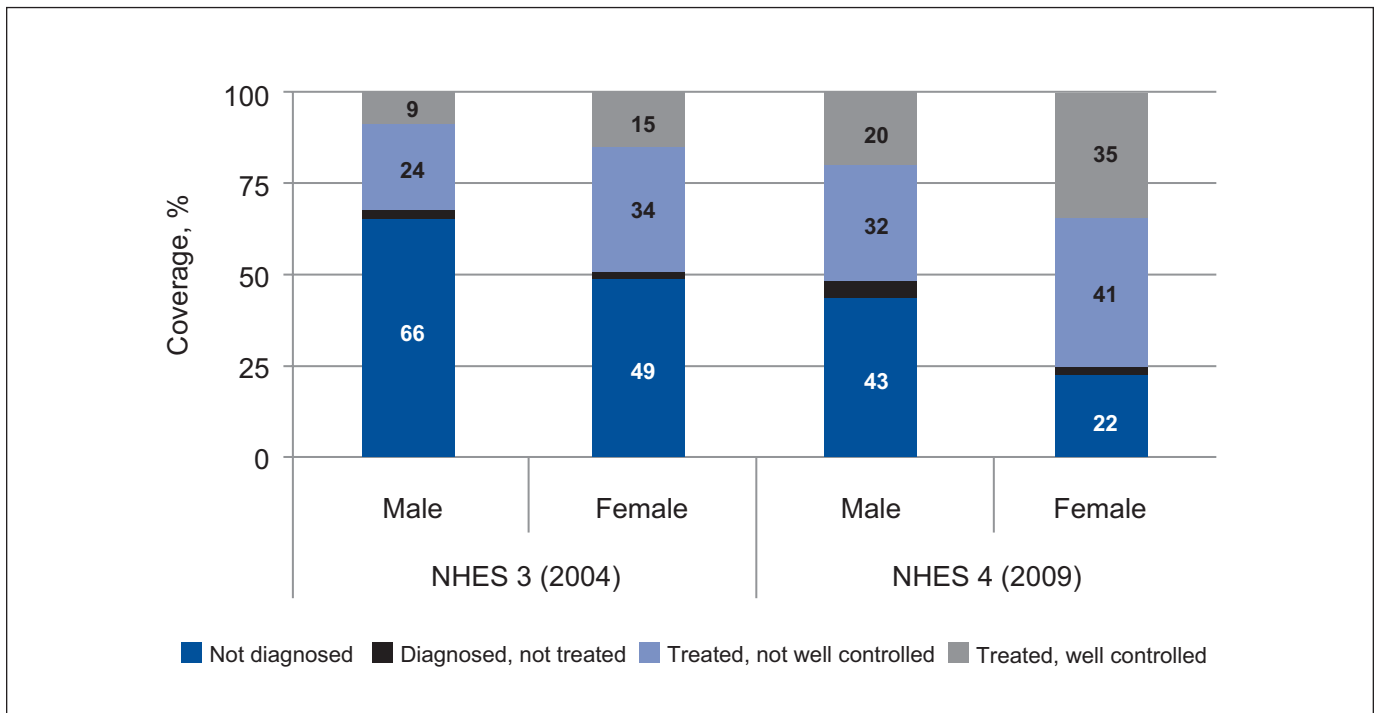


Fig. 2. Effective coverage for diabetes by sex, 2004 and 2009³²⁻³⁵

functioning primary health-care delivery system, with a proper mechanism for referral to a higher level of care when complex interventions are needed, and referral back to community level when the patient’s condition is stable.

- Innovative financing of a “sin tax” (for products that are harmful to health, such as alcohol and tobacco), managed by the Thai Health Promotion Foundation, provides additional funding for health promotion and addressing social determinants of health, and for community and civil society activities.

Last but not least, population awareness and expectation is another key factor that implicitly urges the health system to be more responsive in relation to the quality of services. The Community Health Fund established by the UC scheme has raised public awareness and collaboration of community and civil society.²²

CONCLUSION

Universal health coverage as an umbrella for improving diabetes services

The context of UHC is extremely diverse in the 11 countries of the WHO South-East Asia Region. It ranges from an overwhelmingly public system like that in Bhutan to the predominant private-sector financing in India. It is recommended that, in order to improve coverage of diabetes care and prevention, it is essential for countries in the WHO South-East Asia Region to include NCD services, especially

for major NCDs like diabetes, in their UHC strategies. Thailand, for instance, has shown that the comprehensive benefit package should be included and managed effectively using a specific protected budget. The Thai UC scheme has set up a flexible budget to promote specific activities for diabetes screening and rehabilitation.

Furthermore, progress should be assessed and monitored regularly. An important dimension of monitoring and evaluation is to ensure inclusion of equitable access to health services, adequate financial risk protection, quality of services and satisfaction among both patients and providers.

More money for health as a whole and for health promotion and disease prevention

The current situation of health expenditure in the WHO South-East Asia Region is inadequate, not only for health services as a whole but also for health-promotion and public health services. It is inadequate now to achieve a good response to the current situation for NCDs and will be even more inadequate in the face of the expected rise in NCD prevalence in the near future. Therefore, there is an urgent need for greater political commitment to investing more in the health sector – greater efforts at prevention now will reduce the expenditure on treatments that is necessary in the future. An innovative health-financing system, as appropriate with the country context, is another policy recommendation. Furthermore, community engagement, with the Community Health Fund as an example, can be an exciting option, not only to mobilize more resources but also to empower the community and build up more ownership by the community.

More health for money: harnessing efficiency gains by applying a focus on primary care and investing in prevention

As experience from Thailand illustrates, expansion of the infrastructure and facilities for diabetes in the primary care setting, with emphasis on measures for prevention, especially health-promotion measures for diabetes, is the most cost-effective approach. The primary care focus must include an efficient referral mechanism, both to refer to a higher level of care when needed and to accept referrals back from secondary care for patients whose condition is stable. The use of VHVs is one policy recommendation, not only for improved efficiency but also for community participation and engagement.

It is challenging, but not impossible, to ensure effective coverage of diabetes services and to monitor the quality of these services. However, it does require commitment and attention from policy-makers and practitioners and sufficient support from an adequate information system.

Health-system strengthening

Ultimately, it is essential that Member States of the WHO South-East Asia Region should concentrate on health-system strengthening. The national health development plan should include investment in expansion of the health infrastructure to rural and remote areas; in provision of committed, trained and dedicated health workforces; in the availability of quality medicines and equipment; in adequate strengthening of the health information system; and in development of a sustainable and equitable health-financing strategy. Crucially, the action plan for prevention and control of diabetes and other NCDs should be in line with the strategy for health-system strengthening.

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Capacity-building of the allied health workforce to prevent and control diabetes: lessons learnt from the National Initiative to Reinforce and Organize General Diabetes Care in Sri Lanka (NIROGI Lanka) project

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ABSTRACT

In 2008, to tackle the exponential rise in the clinical burden of diabetes that was challenging the health systems in Sri Lanka, a shift in focus towards patient-centred care linked with community health promotion was initiated by the National Initiative to Reinforce and Organize General Diabetes Care in Sri Lanka (NIROGI Lanka) project of the Sri Lanka Medical Association. Specific training of “diabetes educator nursing officers” (DENOs), field staff in maternal and child health, footwear technicians, and health promoters from the community, was instituted to improve knowledge, skills and attitudes in the area of control and prevention of diabetes. This article highlights some of the activities carried out to date with the allied health workforce and volunteer community. Specifically, it describes experiences with the DENO programme: the educational and administrative processes adopted, challenges faced and lessons learnt. It also highlights an approach to prevention and management of complications of chronic diabetic foot through training a cohort of prosthetics and orthotics technicians, in the absence of podiatrists, and an initiative to provide low-cost protective footwear. Harnessing the enthusiasm of volunteers – adults and schoolchildren – to address behavioural risk factors in a culturally appropriate fashion has also been a key part of the NIROGI Lanka strategy.

Key words: allied health workers, capacity-building, diabetes education, health promotion, primary care, Sri Lanka

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BACKGROUND

As in other lower-middle-income countries of South-East Asia, the Sri Lankan health service has been severely challenged in recent decades by a rapid rise in the clinical burden of chronic noncommunicable diseases (NCDs), chiefly diabetes and cardiovascular disease (CVD).¹ Chronic NCDs require a continuum of clinical care, with a holistic outlook that must focus on a patient-centred approach with emphasis on strategies for behavioural modification and self-care at primary level.² The total-care approach translates into empowering the patient and family to tackle chronic disease, with the primary goal of reducing life- and limb-threatening complications and securing

quality of life. This approach also aims at effective prevention and control of chronic NCDs in the community. Appropriate strengthening of the health system towards achieving these goals must target existing systems operating at differing levels of clinical care. At the same time, population-wide health promotion is required, to minimize the risk factors.

More than a decade ago, the Sri Lankan system for health-care delivery was poorly structured to accommodate the demands from the rising numbers of individuals with diabetes, particularly the requirement for appropriately trained health-care providers.³ The National Initiative to Reinforce and Organize General Diabetes Care in Sri Lanka (NIROGI Lanka)

project was initiated in 2008, by a volunteer group of dedicated medical doctors who formed the Diabetes Prevention Task Force of the Sri Lanka Medical Association.⁴ With financial support from the World Diabetes Foundation, the project aimed to streamline diabetes care in Sri Lanka, with a focus on the lower socioeconomic groups. Although these groups are eligible for free state-sector health care, high “out-of-pocket” expenditures are incurred by individuals and families with diabetes and CVD.⁵ Many people with chronic illnesses such as diabetes were not receiving support for self-management, resulting in unacceptably high rates of inadequate disease control and preventable complications – the vast majority of the health workforce focused on curative care and only a minority were involved in preventive activities.⁵ The mismatch between the needs of patients with chronic problems and the traditional health systems caring for them, induced researchers to compile the evidence for appropriately redesigned clinical health-care support systems for managing chronic diseases, using a chronic care model.⁶

The challenges faced in ensuring health-care professionals are trained in supporting patients with chronic incurable diseases requires recognition of the health and long-term care needs for individuals, simple rules for health care, and making the patient perspective a priority in policy and planning. Health systems have been confronted with the challenges of such goals, particularly when they remain conventional in nature. Patient-centred care requires greater empowerment and activation of patients and consumers.⁷ The use of evidence-based care planning, reorganizing practice systems and provider roles, improving support for patient self-management, and increasing access to expertise and clinical information are recognized challenges of reorganizing existing health systems to suit the needs of patients with chronic disease such as diabetes, through primary care or through specialized care settings.⁸ Recognizing the exponential rise in trends and future projections for diabetes,⁹ and taking into account the authors’ opinion that the response of the Sri Lankan state-run health-care system in tertiary care was suboptimal, voluntary support was used for a project that targeted capacity-building of allied health-care professionals and made use of published approaches that were pragmatic and achievable in the local setting.

THE NIROGI LANKA PROJECT

The NIROGI Lanka project started in 2008. The project has several components that have developed in parallel and that share a focus on empowering existing allied health workers and the volunteer community. The first phase of the project provided capacity-building to establish a cohort of “diabetes educator nursing officers” (DENOs) – the first such programme in Sri Lanka. The NIROGI Maatha component enabled field-based public health nursing sisters and midwives to initiate national-level universal screening for diabetes in pregnancy and to support pregnant women with diabetes and their families to adopt healthy lifestyles. In the NIROGI Paadha component, a pioneer cohort of prosthetics and orthotics technicians were trained to provide patient support in the care of diabetic foot, and a shoe manufacturer developed diabetes-specific protective

footwear. In the NIROGI Diviya component, health-promotion volunteers were trained to empower communities from work, school and community settings. This article describes these components, together with the processes adopted and challenges faced in addressing this hitherto relatively neglected area.

CAPACITY-BUILDING OF DIABETES EDUCATOR NURSING OFFICERS

Starting in September 2009, a programme was developed to train a cohort of DENOs to serve throughout all nine provinces of Sri Lanka. The goal was to train 300 nurses. The hospitals from which the nurses were selected for training were required to have at least one specialist doctor (physician, general surgeon, obstetrician or paediatrician) who could supervise the work of the DENOs. Potential DENOs were selected by the hospital administrator and chief nursing officer, according to predetermined selection criteria. The training programme was structured as per International Diabetes Federation modules, with an in-house module developed on gestational diabetes. Each module specified the required behavioural change communication skills required for an educator on diabetes and was reviewed by subject experts. For each module, a grid of competencies to be achieved, which served as the curriculum blueprint, was developed. Lesson plans were then developed by senior experienced nursing tutors. Training was conducted in batches of 50 during a 2-week residential course at the Post Basic Nursing School in Colombo; this was followed by a 3-day refresher course 6–8 months later. Knowledge retention was assessed by pre- and post-training tests. Clear job descriptions were developed, with an outline for monitoring on-the-job functions of trainees by their hospital nursing and physician supervisors. Further recommendations for patient education were developed, based on feedback from clinical supervisors and trainees following their first 6 months of functioning as DENOs. This entailed rational time allocations and feasible numbers of patients to be provided formal diabetes education on an individual basis, for the newly diagnosed patients and for groups of follow-up patients. Data collection and provision of reports to the project office was also encouraged.

Upon project completion in September 2012, 279 nurses from government institutions were trained, representing 131 hospitals based islandwide. In addition, 64 diabetes educator nurses from the private sector (35 hospitals) and 74 health educator nursing officers in state hospitals were trained, in response to the demand. This gave a total of 417 trained nurses, well beyond the original goal.

Teaching aids and methods

A comprehensive training manual and guide with information, education and communication materials were developed. Training was by lectures, group work, role-play and visits to hospital wards and clinics supervised by subject specialists in diabetes, internal medicine, surgery, clinical pharmacology, public health, child health and women’s health. The DENOs

were trained to take a lead role in outpatient clinics, in patient registration, anthropometric measurements and education on healthy lifestyle, smoking cessation, adherence to treatment, complying with follow-up appointments, insulin self-injection, and self-monitoring of blood glucose for those with access to glucometers. A tool kit of teaching aids (leaflets, patient record books, DVDs, flash cards, posters and food tables) was given to each trainee, along with PowerPoint teaching slides and simple screening tools. Certified DENOs were also encouraged to provide on-the-job training to ward-liaison nurses, to ensure expansion of a diabetes-specific nursing service. In parallel, 20 senior nurse tutors were trained, to ensure the sustainability of training that is specific to diabetes education. The final two batches of training were led by these trained tutors.

Review of the utilization of diabetes educator nursing officers' training

The majority of nurses were able to apply their new knowledge and skills at their respective health facilities and were expected to function as DENOs for a minimum of 4 years. A review of the service delivery provided through the trained DENOs was conducted in 2013 by an independent public health expert, who gave a written report to the NIROGI project and thereby the Ministry of Health. This qualitative evaluation involved document analysis, focus group discussions and in-depth interviews of DENOs, patients and supervisory staff of 28 hospitals in five of the nine provinces. Nineteen hospitals and 51/279 DENOs from government institutions participated. Data were triangulated in the analysis.

The results showed that 36 of the 51 (71%) DENOs interviewed were successfully integrated in their workplace and released to perform work related to diabetes. The rest were unable to function, owing to staff shortage and administrative issues. The majority were satisfied with the training they had received and felt competent to deliver diabetes education in the hospital setting. Some, particularly in teaching hospitals, were released for full-time diabetes education. The reviewer proposed that smaller hospitals with staff shortages should develop a working model to retain DENOs' diabetes-education activities, which could be incrementally upgraded to a better model based on the resource levels.

The reviewer noted that a key obstacle was conflicting messages from medical officers and DENOs on diet for individuals with diabetes, which complicated diabetes education and negated patient benefits. The reviewer therefore recommended refresher training on NCDs – particularly diabetes – for medical officers, in order that patients might receive consistent advice. Further challenges to the programme were that some DENOs had unrealistic expectations. Owing to their enthusiasm and commitment, some nurses expected more independence and resources to deliver their services. Although this would be the ideal model, such expectations were not realistic within the overstrained health-care system. One weakness in this evaluation was the absence of formal feedback from the patients.

Further expansion of the activities of diabetes educator nursing officers

The NIROGI Lanka project has continued to arrange an annual 1-day session for all DENOs from 2012 to date. Timed to take place a month before World Diabetes Day, this provides a forum to review DENOs' progress, in the presence of their supervisors, maintain the momentum of their commitment, identify gaps and encourage sharing of achievements, and provide updates on initiatives for gestational diabetes and diabetic foot. Group presentations made from the provinces demonstrate a tremendous level of dedication and work. Common challenges faced are inadequate educational material for teaching to match the demand, lack of separate space, and logistics for providing comprehensive diabetes education for inpatients.

Opportunistic screening has been integrated to the DENO duties. Thus, apart from diabetes clinic days, DENOs perform screening on a regular basis, using a simplified questionnaire. Beyond this, staff screening and outreach programmes arranged by the local health authorities are also undertaken by DENOs, under the supervision of their consultants. Six targeted primary health facilities in the city of Colombo that piloted a model of primary care for diabetes in phase 1 also used DENOs who were specially trained for primary care. Useful actions, such as rewarding the best controlled patients, were introduced by these DENOs, with greater integration of preventive and curative care at community level. Foot care was included in the nurse training module (complementary to the guidelines for management of diabetic foot care developed in phase 2 by NIROGI Paadha), which has enabled improvements in early recognition of the high-risk foot.

To date, the DENOs remain an important human resource in providing quality care to individuals with diabetes, under the supervision of consultants, predominantly in the outpatient department, and supplementing diabetes-specific care for inpatients, along with community education and empowerment. There is still a need to establish a focal point for DENOs to communicate with and obtain support to resolve technical and administrative issues, outside the NIROGI project. The Ministry of Health has accepted this responsibility in principle, and the draft *National Action Plan for NCD Control and Prevention* includes a commitment to sustain diabetes education. Currently, the follow-up system for diabetes education operates mostly in an ad hoc manner. There is no formal information system on the DENO work output. Hence, the authors recommend establishment of a proper system of information on the DENO service. As a step towards sustainability, inclusion of diabetes education in the core nursing curriculum is recommended.

NIROGI MAATHA: FIELD-BASED MATERNAL AND CHILD HEALTH

In the NIROGI Maatha component, the Family Health Bureau, the focal point in the Ministry of Health for training and supervision of the field-based maternal and child health personnel in Sri Lanka, collaborated with the NIROGI project

in developing a training module on screening and management of diabetes complicating pregnancy.¹⁰ Emphasis was put on preconception assessment and universal screening, using field-based glucometers; lifestyle modification through diet and physical activity during pregnancy to supplement tertiary care management of diabetes in pregnancy; and highlighting the need for annual screening well beyond the traditional postpartum period of 6 weeks for these high-risk mothers. Supplementary information, education and communication materials and teaching aids were developed and reviewed by experts. A national-level 1-day training of trainers from throughout the country was conducted for provincial consultant community physicians and district-level medical officers for maternal and child health ($n = 150$), and their feedback on issues of feasibility, implementation of universal screening and collection of data on pregnancy morbidity was obtained. Field-based training was decentralized, where medical officers of health were then trained at district level ($n = 325$), with distribution of information, education and communication material and data-collection formats. At health-divisional level, the medical officers of health, in turn, trained 45 public health nursing sisters, 231 supervisor public health midwives and 5757 public health midwives, giving a total of 6033 field-based primary care health personnel being targeted with pregnancy diabetes-specific training.

At the time of reporting, an evaluation of this intervention led by the Family Health Bureau is being formulated to assess the amount and distribution of field-based activities and challenges faced in relation to gestational diabetes and its management at grassroots level throughout Sri Lanka.

NIROGI PAADHA: PROSTHETICS AND ORTHOTICS OFFICERS

The NIROGI Paadha component started in 2013.¹¹ A group of 10 allied health workers with a diploma in prosthetics and orthotics awarded by the Sri Lanka School of Prosthetics and Orthotics were selected for further diabetes-specific training for 2 weeks, in two centres of excellence in south India – CMC Vellore and Jain Institute Bangalore – as a training of trainers opportunity. Two senior technicians from a shoe manufacturer (the largest local manufacturer with 220 sales outlets and committed to a corporate social responsibility project with the Sri Lanka Medical Association) were also included in this group.

The 10 trained prosthetics and orthotics officers and technicians from the industry, in conjunction with the Sri Lanka School of Prosthetics and Orthotics, conducted a national-level training programme for 50 other prosthetics and orthotics officers at Ragama Rehabilitation Hospital, targeting the government and private sector. The training was a 7-day full-time in-service programme that included practical inputs on general diabetes care, complications of diabetic foot, and the basis of surgical management, diabetes education, and the need for shoe modification and manufacture. Competency gained

was assessed by pre- and post-test evaluations. From among these trainees, 34 are now placed in prosthetics and orthotics workshops of state hospitals throughout the country. It is too early to assess the impact of this training on delivery of patient care, although the authors believe that the inclusion of this group of allied health professionals has encouraged institutionalization of a concept of total foot care within the Sri Lankan health system. It is noteworthy that, at the time of reporting, 10 prosthetics and orthotics workshops are functioning at teaching and provincial hospitals in Sri Lanka where the trained officers are employed by the government, with a view to developing the services of shoe modifications for individuals with diabetes, while the supply of prosthetic and orthotic devices for amputees still accounts for the bulk of the workload. The Sri Lanka School of Prosthetics and Orthotics has also included a teaching component on the care of diabetic foot in its revised curriculum.

NIROGI DIVIYA: HEALTH-PROMOTION FACILITATORS

The NIROGI Diviya project was initiated in 2009 to establish volunteer-led low-cost health promotion that is applicable in highly urban and semi-urban areas in Sri Lanka.¹² A group of health-promotion facilitators (HPFs) were selected, based on their willingness to work as volunteers with no provision of incentives. They were hand-picked by the medical officers of health of the selected areas, based on the commitment and enthusiasm they displayed during public-health-related work they had previously carried out. HPFs were based in schools, workplaces and the community and showed wide variation in age, sex and educational level – housewives and bank managers were trained alike.

Training was carried out by a central team of experts with experience in health promotion at grassroots levels. Inaugural training included development of soft skills in negotiation, team-building and leadership. Each HPF had to recruit 10–15 persons interested in changing their own behaviour. The health-promotion process was initiated: measuring risk behaviour related to unhealthy diet, physical inactivity, alcohol use and tobacco smoking, and mental well-being; identifying the factors underlying these behaviours; and addressing these factors using culturally appropriate activity-based strategies developed in the local context. The HPF-led groups met regularly. Interventions were all activity based, with social participation. Knowledge, and development of positive attitudes and skills were emphasized, with the HPFs playing only a facilitator role. HPFs also empowered group members to initiate their own settings with 10–15 participants, which led to a rippling effect. Schoolchildren have been trained as “health messengers”, to engage their peer groups and families using a life-cycle approach to prevention of NCD. The health-promotion process has been expanded through organizations like societies for women and children. Table 1 depicts the numbers and settings of the groups initiated each year to date. With regard to sustainability, of the 236 groups that had been started by 2012, 172 (73%) were still functioning in 2015.

Table 1. Numbers of health-promotion groups initiated by year (2009–2015)

Health-promotion groups by type	2009	2010	2011	2012	2013	2014	2015
Schools in highly urban settings	—	—	—	—	8	5	5
Workplaces in highly urban settings	—	—	—	—	5	5	4
Schools in semi-urban settings	8	10	9	7	6	6	6
Workplaces in semi-urban settings	6	7	11	16	14	13	13
Community settings in both highly urban and semi-urban settings	17	37	46	62	54	35	35
Total	31	54	66	85	87	64	63

Table 2. Health-promotion activities: cumulative numbers for project indicators (2012–2015)

Activity	Targeted population	Cumulative number to date
Provided training in primary prevention	Teachers	413
	Primary and secondary schoolchildren	2135
	Parents (via schools)	85
Provided training of trainers	Health-promotion facilitators	195
	Employees in work settings	1810
	Schoolchildren (as “health messengers”)	205
	Community group participants	1052
Sensitized to diabetes control and prevention	Schoolchildren and their families	3948
	Members of the general public	9398

Tools developed and additional activities

Tools developed include health-education material (leaflets and posters), interactive exhibition kits (quiz programme, flip charts, buffet table, food pyramid), a health-promotion book, an annual calendar with health messages based on community art competitions for children, an interactive DVD on physical activity for adolescents and adults, and a calendar (2015) for self-appraisal of health-promotion activities throughout the year. The HPF programme has also been embedded within a wide range of regional and national advocacy activities, including outreach programmes in rural settings and a mobile screening facility for all settings.

The application of this low-cost health-promotion model has been successful in highly urban and semi-urban settings in Sri Lanka in empowering community members, workforces and schoolchildren to engage in healthy lifestyles (see Table 2). Interventions were tailored to address the underlying determinants of behaviour of participants, with an emphasis on the process of changing behaviour rather than conducting one-off activities.

CONCLUSION

NIROGI Lanka has shown that it is feasible, in a south Asian country, to empower allied health staff, consisting of diabetes nurse educators, field-based maternal and child health staff, and prosthetics and orthotics technicians, along with community leaders and the general public, on the multiple actions required for the control and prevention of diabetes and

cardiovascular risks, through the existing health-care system. However, such an approach requires multidisciplinary inputs and advocacy towards a holistic patient-centred approach to managing chronic disease and requires long-term evaluation and monitoring.

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Strengthening policy and governance to address the growing burden of diabetes in Nepal

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ABSTRACT

Diabetes poses a major challenge to Nepal's health-care system. Deaths due to noncommunicable diseases (NCDs) have increased from 51% of all deaths in the country in 2010 to 60% in 2014. In 2014, diabetes and other essential NCDs accounted for 46% of the total deaths and 22% of premature deaths in the country. As diabetes is common in adults of working age, the impact will further impoverish individuals and families in Nepal, where out-of-pocket expenditure for health remains high. To halt the rise in diabetes and obesity, the government of Nepal will have to adopt a public health approach that balances individual and population-level interventions. Awareness, early diagnosis and prevention are key to management and control of diabetes. To date, there has been no nationwide robust programme for diabetes prevention in the country and services are inaccessible to much of the Nepalese population. However, under the NCD Multisectoral Action Plan (2014–2020), there will be phase-wise implementation of the World Health Organization *Package of Essential Noncommunicable (PEN) disease interventions for primary health care in low-resource settings*. The NCD PEN brings opportunities to strengthen the health workforce, diagnostics, medicines and supplies, the health information system, and research and surveillance and to reduce inequity in diabetes care in Nepal.

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BACKGROUND

The World Health Organization (WHO) recognizes diabetes as one of the four high-burden noncommunicable diseases (NCDs). The total number of people with diabetes is projected to rise from 171 million in 2000 to 366 million in 2030.¹ In 2012, an estimated 1.5 million deaths were attributed to diabetes worldwide and more than 80% of these deaths occurred in low- and middle-income countries.²

Diabetes is an emerging public-health epidemic in the WHO South-East Asia Region. The International Diabetes Federation (IDF) estimates that 72 million adults in Bangladesh, India, Nepal and Sri Lanka were living with diabetes in 2013 and, by 2035, the equivalent number is projected to exceed 123 million. These numbers equate with comparative prevalences of 8.1% and 9.4% in 2013 and 2035, respectively.³ A systematic review of data from Bangladesh, India, Maldives, Nepal, Pakistan and Sri Lanka noted that the rate of increase is greater than previously observed in high-income countries, underscoring the need for rapid, low-cost solutions.⁴

Diabetes and other NCDs therefore pose a major challenge to Nepal's health-care system; the proportion of deaths attributable to all NCDs has increased from 51% in 2010 to 60% in 2014.^{5,6} The WHO NCD *Country profiles 2014* reports that cardiovascular disease was responsible for 22% of all deaths in Nepal, followed by chronic respiratory disease (13%), cancer (8%) and diabetes (3%); together, these four NCDs accounted for 22% of all premature deaths in Nepal.⁶

Diabetes is one of the major causes of premature deaths and disability, and people with diabetes are at increased risk of dying from cardiovascular disease.⁷ Exposure to diabetes-related risk factors, and limited access to early diagnosis and management of diabetes, is not only associated with micro- and macrovascular complications but also leads to catastrophic health expenditure. As diabetes is prevalent in adults of working age, it threatens to further impoverish individuals, families and the community as a whole, in a country where out-of-pocket expenditure for health remains high.⁸

DISEASE BURDEN AND DIABETES RISK FACTORS

The global prevalence of diabetes in 2014 was estimated to be 9% among adults aged 18 years and above, and for obesity more than 50%.⁹ WHO estimates that there will be 1 328 000 cases of diabetes in Nepal by 2030. According to the 2011–2012 annual report of the department of health services, 84% of the total number of outpatient visits and 90% of the total number of inpatients discharged in Nepal were attributed to NCDs.¹⁰

There are few national representative studies on diabetes morbidity and mortality in Nepal. Most of the publications are hospital-based cross-sectional studies and some are conducted within a confined geographical area. The *Non communicable disease risk factors: STEPS survey Nepal, 2013* reported the national prevalence of diabetes, based on plasma venous blood glucose ≥ 126 mg/dL and including those on medication, was 3.6% (men 4.6%, women 2.7%). More than 50% of men and women with diabetes were not on medication and 89% of the respondents had never measured their blood glucose.¹¹ These figures are alarming and give an indication of the access to care, utilization of health-care services and level of awareness in the country. The IDF reports the prevalence of diabetes in Nepal was 4.6% among adults aged 20–79 years in 2014.¹² The study reported that 700 000 cases of diabetes and 14 778 deaths among these age groups were due to diabetes.¹² Studies in Nepal also report that the prevalence of diabetes is increasing in urban areas compared to rural areas in the country.^{13–15} In a study conducted in the capital, the prevalence of diabetes was reported to be 26% and a higher proportion of diabetes was reported in males (27.1%) than females (24.8%).¹⁶ Other studies have also reported a higher proportion of type 2 diabetes among males compared with females.^{17,18}

The risk factors for type 2 diabetes are common to those for other NCDs. The Nepal STEPS survey reports an increase in risk factors for diabetes such as tobacco use, alcohol consumption, unhealthy diet and lack of physical activity.¹¹ Nearly one in every two men aged 15–69 years use tobacco (smoke or smokeless) and 99% of the Nepalese population do not meet the recommendation of consuming five servings of fruit and vegetables on a daily basis. Another concern is the high level of salt consumption and increase in unhealthy diets that are high in trans fat and sugar. Risk factors, such as tobacco use, alcohol consumption and raised blood pressure, blood glucose, total cholesterol and triglycerides were more prevalent among men than women, while obesity and low high-density lipoprotein were prevalent among women. Only 0.4% of the populations surveyed were free from NCD risk factors. These lifestyle-related risk factors contribute to increase in blood glucose, blood pressure, blood lipids, overweight and obesity.¹¹ According to *The world health report 2002*, the four behavioural risk factors – tobacco, alcohol, diet and physical activity – and four metabolic risk factors – raised blood pressure, blood glucose, blood cholesterol and overweight/obesity – account for 22% of the NCDs including diabetes.¹⁹

HEALTH WORKFORCE AND SERVICE DELIVERY: CHALLENGES AND GAPS

People with diabetes need access to appropriate medicines and a wide range of health-care services in the course of their disease. Early diagnosis and management are key to prevention and control of diabetes. There are wide variations in the availability of diabetes care services, and their availability and utilization across different socioeconomic and geographical population groups, indicating the challenge of access and equity. Diabetes services are mainly centred in urban areas and are inaccessible to many Nepalese people. There are no government health-financing schemes for diabetes care and none of the services are funded or subsidized by the government. All services such as diagnosis, treatment, medications and laboratory tests are funded by individuals and households out of pocket. There is also a lack of awareness of diabetes and its complications among the general population. There is no nationwide robust programme for diabetes prevention in the country. Some nongovernmental organizations support occasional mass media awareness activities and screening camps and organize national events to commemorate World Diabetes Day and World Sight Day.

Diabetes services in Nepal are provided by the public and private sectors through different levels of health workforce. The availability of diabetes care services and quality of care are not structured and uniform in the country. Appropriate referrals and consultations are not commonly practised. In the absence of national guidelines for diabetes care, service providers use a range of different guidelines. The categories of health workforce providing diabetes care are endocrinologists, ophthalmologists, primary care physicians, ophthalmic assistants and dietitians. The available health workforce in the country is inadequate and not uniformly distributed. The report of the assessment of diabetic retinopathy and diabetic management system in Nepal, 2015, reveals that one endocrinologist is available for 1 000 000 population and one ophthalmologist for 200 000 population (unpublished data). Although the National Academy of Medical Sciences has started a specialization course (Doctor of Medicine in Endocrinology), it is evident that the current health workforce is inadequate to address the growing burden of diabetes and its complications.

The report also highlights lack of diabetes services at the primary health-care level. The majority of the services are clustered in urban areas and are provided by nongovernmental organizations and the private sector. At the public hospitals, services for diabetes and diabetic retinopathy are only available at zonal, regional and tertiary-level health-care centres, which are accessible to only 30% of the population. Diagnostic facilities have improved over the years. However, many of the laboratory facilities are mainly centred in the capital city and there are limited numbers of laboratories providing quality services.

Early diagnosis and referral services are not available at all levels of health-care services, owing to lack of resources

such as trained health professionals, NCD-related drugs and diagnostics, which limits access to diabetes care. In such circumstances, diabetes is often diagnosed late and requires care at tertiary level.

The lack of awareness, inadequate services for diabetes management, including early detection, the cost of services, and the country's topography are barriers to diabetes care.

POLICIES AND PROGRAMMES: THE WAY FORWARD

A multisectoral response is essential to attainment of the WHO target²⁰ and Sustainable Development Goals²¹ to reduce premature mortality due to NCDs by 25% by 2025 and 30% by 2030, respectively. The cost of lifelong diabetes care and loss of productivity negatively impacts the economic growth of individuals and the nation as a whole, and undermines human development. If no action is taken, the World Economic Forum estimates the burden of NCDs including diabetes will cost US\$ 30 trillion globally, over the 20-year period 2010 to 2030.²²

At policy, programme and institutional level, with the exception of the *WHO Framework Convention on Tobacco Control*,²³ NCDs were practically non-existent in Nepal's general health policies and programmes. The Nepal Health Sector Plan (NHSP) I (2004–2009) did not prioritize NCDs.²⁴ However, they were included in NHSP II (2010–2015).²⁵ The focus has been mainly on management of NCDs at tertiary care level and no information on NCD drugs was included on the Ministry of Health and Population national list of essential medicines, 2011.

However, over the years, NCDs in Nepal have received high-level political commitment. As a follow-up on the *Political Declaration of the High-level Meeting of the United Nations General Assembly on the Prevention and Control of Non-communicable Diseases*,²⁶ to which Nepal is a signatory, the Government of Nepal has developed the national *Multisectoral Action Plan for the Prevention and Control of Non Communicable Diseases (2014–2020)*.²⁷ The *Nepal National Health Policy 2014* calls for a people-centred approach to quality health services that are more effective and accountable to the citizens.²⁸ Health is placed central to overall development, building partnerships and establishing multisectoral collaboration. NCDs, including diabetes, are reflected in the *National Health Policy 2014*,²⁸ *Nepal Health Sector Strategy (NHSS) III (2015–2020)*,²⁹ and universal health coverage plans. The basic health service package of NHSS III has incorporated diabetes screening, counselling and laboratory services at all levels of health care.²⁹

One of the objectives of the *Multisectoral Action Plan for the Prevention and Control of Non Communicable Diseases (2014–2020)* is to strengthen and orient health systems to address the prevention and control of NCDs and underlying social determinants, through people-centred primary health care and universal health coverage.²⁷ Early and appropriate

treatments and access to services, particularly primary care, will avoid devastating, irreversible complications of diabetes. In line with the South-East Asia Regional NCD targets, Nepal has also adopted the 10 targets to be achieved by 2025, which include a 25% relative reduction in overall mortality from the four major NCDs.²⁰ The third action area of the Action Plan²⁷ is on health-systems strengthening for early detection and management of NCDs and their risk factors. Actions under this area aim to strengthen health systems, particularly the primary health-care system, by implementing the *WHO Package of Essential Noncommunicable (PEN) disease interventions for primary health care in low-resource settings*.³⁰ PEN is an essential package of cost-effective interventions with high impact, including those for early detection and management of type 2 diabetes, which are feasible for application in resource-poor settings. The package will be introduced in the first two years and then expanded to other districts in the country. In this process, diagnostic services will be made available in primary health-care settings.

The government of Nepal therefore has an opportunity to strengthen health-care services via primary health-care facilities, by implementing the essential package of NCD interventions. Phased implementation and escalation of coverage of PEN in all 75 districts³⁰ brings opportunities to strengthen the health workforce, diagnostics, medicines and supplies, the health information system, research and surveillance and reduce inequity in diabetes care in Nepal. To strengthen the roll-out of PEN in Nepal, we recommend revision of the free essential medicines list of the Ministry of Health and Population, to cover essential drugs for management of NCDs.

The growing burden of diabetes in the country can be addressed through a whole-of-society and whole-of-government approach. WHO aims to stimulate and support the adoption of effective policy and strategic measures for the prevention and control of diabetes and its complications in Nepal.

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An approach to diabetes prevention and management: the Bhutan experience

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Quick Response Code:



ABSTRACT

Bhutan has been witnessing a trend of increasing diabetes in recent years. The increase is attributed to a rise in risk factors such as overweight, high blood pressure, unhealthy diet and sedentary lifestyle among the population. To address the rising burden, the health-services response has been to establish diabetes clinics in all hospitals and grade one basic health units. People visiting the health centres who have high risk factors and symptoms for diabetes are screened using the World Health Organization cut-off level for blood glucose. They are then classified into prediabetes and diabetes. Accordingly, diet, medicine and physical activity are recommended as per their body mass index. To improve prevention and control of noncommunicable diseases, which include diabetes, the country piloted the WHO *Package of Essential Noncommunicable (PEN) disease interventions for primary health care in low-resource settings* in 2009, to promote early screening, treatment and follow-up, and adopted it in 2013. The WHO PEN has now been successfully integrated into the primary health-care system nationwide. It is planned that diabetes clinics will be upgraded to NCD clinics.

Key words: Bhutan, diabetes, noncommunicable diseases, prevention, risk factors, screening, treatment

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BACKGROUND

Bhutan is a small country in South Asia with a landmass of 38 000 km² and a population of 757 042.¹ Although a small country, Bhutan, like its South Asian neighbours, is witnessing an increasing trend in diabetes. Administrative data show an increasing burden of diabetes (see Fig. 1). According to the 2014 estimates of the International Diabetes Foundation, approximately 77% of people with diabetes live in low- and middle-income countries, and for Bhutan the number of people with diabetes is estimated to be 33 000 (456 per 10 000 population), with one third of this group undiagnosed and the cost of treating diabetes being US\$ 143 per person.² Further, the national prevalence of diabetes is estimated to be 4.87%, with 124 diabetes-related deaths in 2013.²

The nationwide World Health Organization (WHO) *STEPwise approach to surveillance (STEPS)*³ survey conducted in 2014 among the age group 18–69 years shows that Bhutanese populations are exposed to increased lifestyle-related risk factors: 39.2% were overweight or obese, 35.7% had raised blood pressure, 32.9% had raised blood pressure but were not on medication, 6.4% had raised fasting blood glucose, 6.4% did not have sufficient physical activity and 48.8% did not engage in vigorous physical activity.⁴

HEALTH-CARE SYSTEM AND POLICY IN BHUTAN

Bhutan has a government-administered free health-care system with a strong focus on primary health care. The country has three tertiary care facilities: one national referral hospital and two regional referral hospitals. These are supported by a network of 28 district hospitals, 20 grade 1 basic health units (BHU-Is), 186 grade 2 basic health units (BHU-IIIs) and 562 outreach clinics.¹ Physicians are available at the hospitals but BHUs are staffed by non-physician health workers.

The Bhutan *National Health Policy*, 2011, states that “the prevention strategy for NCD [noncommunicable disease] within the Ministry of Health will focus on addressing the impact of unhealthy dietary habits/lifestyles/traditional practices on the health of the Bhutanese population and their prevention and control through advocacy, risk surveillance and analysis rather than making specific interventions”.⁵ In addition, it also states that the “health promotion, disease prevention and health care services will be incorporated as a vital component in the entire relevant programs, and appropriate measures will be instituted to intensify health promotion interventions that address social determinants causing life style related diseases”.⁵

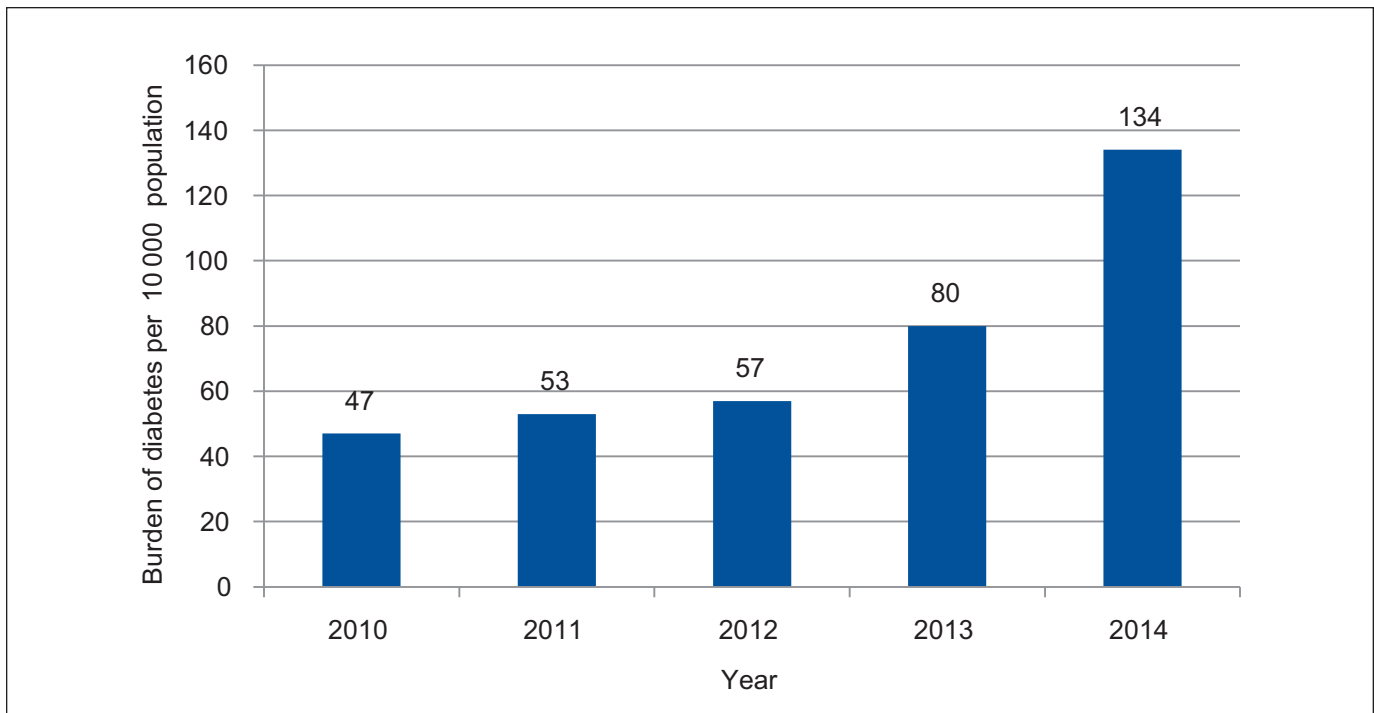


Fig. 1. Diabetes trend in Bhutan¹

In order to address the growing burden of NCDs, the Royal Government of Bhutan has adopted a number of population-based strategies. These include the formulation of a national policy for the prevention and control of NCDs, banning the sale of tobacco and smoking in public places, and policies on promotion of a healthy diet and physical activity. In addition to interventions targeted at the population level, the government has also piloted a package of essential noncommunicable (PEN) disease interventions for individual-level risk reduction and risk management, and rolled this out nationwide.⁶

DIABETES PREVENTION AND CARE PROGRAMME

To address the growing concern about diabetes, the Diabetes Prevention and Care Programme was established within the Ministry of Health in 2005, with the aim of preventing diabetes in the population, minimizing complications and improving the quality of life among those living with diabetes. In order to manage diabetes, diabetes clinics have been established in the referral hospitals, all district hospitals and BHU-Is. The clinics are managed by a focal health-care provider, who is trained on diabetes management and care. One day each week is observed as “diabetes day” in all the districts. During this day, the patients who are diagnosed with diabetes are given health education on diet and physical activity as per their disease conditions, and foot examination is also carried out.

Diabetes screening

Diabetes screening is done at all levels of health facilities. Depending upon the 10-year risk of a fatal or nonfatal

cardiovascular event (low/moderate/high) using the *WHO/ISH* [International Society of Hypertension] *risk prediction charts*,^{7,8} biochemistry services such as fasting blood glucose, postprandial blood glucose and glycosylated haemoglobin (HbA_{1c}) are provided, depending on the level of health facility. At the primary level, diagnostic tests are done using a glucometer to measure random blood glucose. At the secondary, tertiary and referral level, biochemistry tests comprising fasting blood glucose, 2-h postprandial blood glucose and HbA_{1c} are carried out. For diabetes patients at high risk, cholesterol, renal and kidney functions are also assessed. Pregnant women with obesity, a history of gestational diabetes, glycosuria, or family history of diabetes are checked for glucose level, using the oral glucose tolerance test during the antenatal check-up at 24–26 weeks of gestation.⁹

Depending on the results of the diagnostic tests, patients are categorized as having prediabetes or diabetes. The prediabetes stage is one in which the fasting plasma glucose is between 130 and 140 mg/dL and postprandial plasma glucose is between 140 and 199 mg/dL; the diabetes stage is when the random blood glucose is higher than 200 mg/dL with fasting plasma glucose higher than 126 mg/dL; 2-h postprandial glucose is greater than 200 mg/dL and HbA_{1c} is more than 6.5 mg/dL.¹⁰

Diabetes management

Patients with diabetes are registered in the diabetes clinic and are provided individual prescription booklets, which include guidance on the disease, risk factors, diet and foot care, with a few pages of follow-up sheets. Administrative records for the Diabetes Prevention and Care Programme show that Bhutan has more than 12 000 registered cases of diabetes, with more

than 1000 cases registered in 2014 alone. The clinic assesses patients for complications and comorbidities like hypertension (defined as blood pressure of 140/90 mmHg or above).

Patients with prediabetes are prescribed metformin, along with advice on lifestyle modification and physical activity. Patients with diabetes are prescribed oral drugs like metformin, glipezide and insulin – in the form of human (soluble) insulin, human zinc suspension and human mixtard (neutral isophane), which are provided free at the health facility.¹¹ In addition, patients' calorie requirements are calculated, based upon their body mass index (BMI), level of physical activity and disease condition. Adjustment of oral drugs is also done as per the laboratory test results.

In follow-up, to prevent complications related to diabetes, patients are assessed every month for fasting blood glucose, postprandial blood glucose and weight; HbA_{1c} is tested every 3 months; waist circumference and BMI are checked every 6 months; lipids, fundus, and microalbuminuria are checked annually; and renal function tests are carried out twice per year. Blood pressure measurement and foot examination are carried out on every visit. Adjustments to oral drugs are also made as per the laboratory test results.¹²

Good practice

There has been a renewed focus to strengthen the Diabetes Prevention and Care Programme. New and follow-up cases of diabetes are recorded and reported from the districts to the Diabetes Prevention and Care Programme on a monthly basis. Further, annual reports are generated to enable the programme to develop evidence-based plans and strategies.

During occasions like national festivals or global days of observation, awareness and education programmes for the general population are conducted. These programmes include free testing of blood glucose, blood pressure monitoring and BMI measurements. In addition, education on the disease and its risks and symptoms, along with the importance of healthy eating habits and exercise are also carried out. These have contributed immensely to raising awareness and knowledge about diabetes.

The Ministry of Health has also developed a *Food-based dietary guideline* and a *Physical activity guideline*, which have been circulated to all the health facilities for patient education.^{13,14} The guidelines aim to help people develop and practise healthy eating habits. They are based on current scientific knowledge and best public health practices. The guidelines contain up-to-date information on the relationship between diet and disease, nutrients available in the Bhutanese food supply, dietary habits and the profile of morbidity and mortality in Bhutan.^{13,14}

CHALLENGES

Like most low- and middle-income countries, Bhutan is also faced with numerous challenges in combating the rising diabetes epidemic. Despite the free health-care services, a country-wide audit of the records of the Diabetes Prevention

and Care Programme showed that four in ten patients registered with diabetes were lost to follow-up. The incomplete recording of patient data in diabetes clinics was pointed out to be the commonest cause for the loss to follow-up.¹⁵ Among those who come regularly as per the schedules given, glycaemic control was achieved only in one third of all patients.¹⁶ Although diabetes care guidelines have been developed and are available to health-care providers, unstructured and unmonitored clinical care is still being practised. There is little regular or reliable information about the incidence and prevalence of cases, treatment outcomes, morbidity and mortality. Machine breakdown and shortage of laboratory reagents were also found to be occurring regularly in the health-care facilities.¹⁶ Most of the health facilities do not have an HbA_{1c} testing service; therefore, patients often have to travel to the district and regional referral hospitals, leading to frequent delays in accessing timely treatment.

For patients with diabetes and renal diseases, the government of Bhutan currently pays for the cost of vascular-access placement, medications and dialysis. In 2015, Zam et al. noted that, "Although a time limit for finding a living kidney donor has been set at three months, this plan has been found to be untenable in many cases. In reality, patients started on dialysis with no living-related donor stay on this treatment indefinitely, leading to the growth of the dialysis population".¹⁶ Only a limited number of dialysis machines and staff are available, owing to financial constraints and limited space at the hospital. In order to provide dialysis to more patients, treatment schedules have been cut to once weekly for some patients, instead of twice a week.¹⁶

Diabetes and high blood pressure are thought to be the major factors contributing to the occurrence of chronic kidney diseases in the country.¹⁶ Currently, out of the 143 patients on dialysis in the country, 16 have diabetes: 5 of them are in Jigme Dorji Wangchuk National Referral Hospital, 10 in Gelephu Regional Referral Hospital and 1 in Mongar Regional Referral Hospital. As per the records maintained by the Jigme Dorji Wangchuk National Referral Hospital in Thimphu (which handles renal transplant referrals to India), the Royal Government of Bhutan spends an estimated US\$ 8200 per person for renal transplants.

The cost of health care due to NCDs in Bhutan is rapidly increasing. Bhutan refers patients who cannot be treated in-country for treatment abroad. Most of these patients have NCDs. Over the last 3 years, the number of patients referred has increased by 15% annually. However, no data on NCDs and their risk factors are collected systematically and there is no information on complications, quality of health care, or health expenditures for NCDs.¹⁷

THE WORLD HEALTH ORGANIZATION PACKAGE FOR ESSENTIAL NONCOMMUNICABLE DISEASE (PEN) INTERVENTIONS AND DIABETES

The WHO *Package of Essential Noncommunicable (PEN) disease interventions for primary health care in low-resource settings* (WHO PEN) consists of prioritized interventions that can be delivered to an acceptable quality of care in low-

resource primary-care settings.¹⁸ The WHO PEN has been found to be effective in tackling NCDs in an integrated manner, as the PEN protocol covers diabetes, cardiovascular disease, cancer and chronic obstructive pulmonary disease; the pilot was implemented by the health services in real-life conditions through non-physician health workers.⁶ The proportion of patients who were followed up was high, owing to the involvement of non-physician health workers, who also conducted home visits. During the pilot in 2009, the implementation of PEN interventions led to the identification of new NCD cases. On average, every month, each BHU registered five new patients and each hospital registered 15 new patients with NCD. Moreover, opportunistic screening of those aged over 40 years resulted in the identification of patients with high blood pressure and high blood glucose. The PEN pilot project empowered primary health-care workers to extend screening, diagnosis, treatment and counselling services to patients with NCD, from a health facility close to their home. The availability of medicines free of cost and close to home, and counselling by health workers who were well known in the community, improved behaviours and encouraged the regular intake of medicines, which led to better control of high blood pressure and high blood glucose, thereby reducing the risk for cardiovascular disease.⁶

Bhutan has been one of the first countries to pilot this intervention, and it has been gradually expanding the intervention to all its health-care facilities. It is hoped that with roll-out of the PEN nationwide, the Diabetes Prevention and Care Programme will be assimilated into the overall NCD prevention and control programme and the health service will have a holistic NCD control strategy based on the WHO *Global action plan for the prevention and control of noncommunicable diseases 2013–2020*¹⁹ and the *Action plan for the prevention and control of noncommunicable diseases in the South-East Asia Region, 2013–2020*.²⁰

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Gaps and challenges to integrating diabetes care in Myanmar

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Quick Response Code:



ABSTRACT

In common with other low-income countries, diabetes is a growing challenge for Myanmar. Gaps and challenges exist in political commitment, policy development, the health system, treatment-seeking behaviour and the role of traditional medicine. National policies aimed at prevention – such as to promote healthy food, create a healthy environment conducive to increased physical activity, restrict marketing of unhealthy food, and initiate mass awareness-raising programmes – need to be strengthened. Moreover, existing initiatives for prevention of noncommunicable-disease (NCD) are channelled vertically rather than being horizontally integrated. Primary health care is traditionally orientated more towards prevention of infectious diseases and staff often lack training in prevention and control of NCDs. Capacity-building activities have been modest to date, and retaining trained health workers in diabetes-oriented activities is a challenge. The World Health Organization *Package of Essential Noncommunicable (PEN) disease interventions for primary health care in low-resource settings* has been piloted in Yangon Region and country-wide expansion awaits ministerial approval. Recently, the Myanmar Diabetes Care Model was proposed by the Myanmar Diabetes Association, with the aims of both bridging the gap in diabetes care between rural and urban areas and strengthening care at the secondary and tertiary levels. However, implementation will require policy development for essential drugs and equipment, capacity-strengthening of health-care workers, and an appropriate referral and health-information system.

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Key words: capacity-building, diabetes, management, Myanmar, policy, prevention

BACKGROUND

Diabetes is a personal and social calamity and imposes unacceptably high burdens on individuals, their families and national economies. Diabetes poses an immense global challenge by the steady rise in its prevalence.¹ Building on the United Nations summit of 2011,² global leaders have now signed up to an historic commitment to reduce premature deaths from diabetes and other noncommunicable diseases (NCDs) by 25% by 2025. They have also agreed a Global Action Plan designed to achieve a range of measurable targets for diabetes and NCDs. The Global Action Plan provides Member States, international partners and the World Health Organization (WHO) with a road map and menu of policy options which, when implemented collectively between 2013 and 2020, will contribute to progress on nine voluntary global targets. A specific target on diabetes includes a halt in the rise of diabetes and obesity.³

and NCDs. The International Diabetes Federation has recently estimated the national prevalence of diabetes as 6.5% and there are 2 172 900 adults (aged 20–79 years) with diabetes in Myanmar.⁴ A national survey on the prevalence of diabetes and risk factors for NCDs in 2014 reported the national prevalence of diabetes and risk factors for NCDs in Myanmar (see Table 1).⁵ According to the Global Burden of Disease 2010 report,⁶ the five risk factors that account for the most disability-adjusted life-years lost in Myanmar were dietary risks, tobacco smoking, household air pollution from solid fuels, high blood pressure and high fasting plasma glucose.

In common with other low-income countries, Myanmar is currently facing the double burden of communicable diseases

and NCDs. Many guidelines on diabetes care have been developed. Published national guidelines tend to come from relatively resource-rich countries and may be of limited practical use in less well-resourced countries.⁷ For example, the American Diabetes Association recommends a patient-centred approach, which should include a comprehensive plan to reduce cardiovascular risk by addressing blood pressure and lipid control, smoking cessation, weight management and changes to lifestyle, which include adequate physical activity.⁷ Systems

Table 1. The prevalence of diabetes and risk factors for noncommunicable diseases in Myanmar⁵

Disease/risk factor	Males, prevalence (range), %	Females, prevalence (range), %	Both sexes, prevalence (range), %
Diabetes	9.1 (6.9–11.8)	11.8 (9.6–14.6)	10.5 (8.3–13.1)
Raised blood pressure	24.7 (20.1–29.3)	28.0 (24.8–31.3)	26.4 (23.2–29.5)
Overweight (BMI \geq 25 kg/m ²)	21.5 (21.2–21.8)	23.2 (22.8–23.5)	22.4 (22.0–22.6)
Obesity (BMI \geq 30 kg/m ²)	2.6 (1.8–3.5)	8.4 (6.6–10.1)	5.5 (4.2–6.7)
Raised total cholesterol (\geq 5.0 mmol/L or \geq 190 mg/dL)	30.9 (26.5–35.4)	42.5 (37.7–47.2)	36.7 (32.2–41.2)
Tobacco use	43.8 (40.8–46.7)	8.4 (6.4–10.3)	26.1 (23.8–28.4)
Current alcohol drinker	38.1 (33.9–42.2)	1.5 (0.7–2.3)	19.8 (16.8–22.8)
Eating <5 servings of fruit and/or vegetables on average per day	85.2 (82.0–88.3)	87.9 (85.8–90.1)	86.6 (84.1–89.0)
Physical inactivity (defined as <150 min of moderate-intensity activity per week, or equivalent)	12.5 (9.7–15.3)	18.8 (15.8–21.9)	15.7 (12.9–18.4)

BMI: body mass index.

for health-care delivery in low- and middle-income countries are generally less well oriented towards dealing with chronic NCDs than with infectious diseases. The approach is often unstructured, lacks systematic follow-up and monitoring of chronic clinical care, and provides little information about morbidity or mortality. Moreover, access to essential supplies is often limited and comes at a relatively high cost.³

A primary health-care approach is essential to address NCDs effectively and equitably, and the need to strengthen primary care has been highlighted in the United Nations *Political declaration of the High-level Meeting of the General Assembly on the Prevention and Control of Non-communicable Diseases*.² There are compelling reasons to identify gaps and challenges in the delivery of care for diabetes in Myanmar, before the planning and development of an efficient delivery system of care that is feasible and suitable for the country.

GAPS AND CHALLENGES IN POLITICAL COMMITMENT AND POLICY

Although there are provisions for wide-ranging health services in the current National Constitution (2008),⁸ in reality, there are substantial gaps between policy objectives and effective implementation and outcomes.⁹ The National Health Policy was developed with the initiation and guidance of the National Health Committee in 1993, and has identified, as a prime objective, the goal of “health for all”, using a primary health-care approach.¹⁰ However, emphasis on political stability and economic growth in preference to social development has made the health-for-all policy merely a concept.⁹ There has been a wide gap between policy and the actual implementation and health outcomes of the country. However, since a new civilian government came to power in March 2011, policy for poverty alleviation and rural development has been accorded a priority in the national developmental agenda.¹¹

The government’s *Fifth Five-Year Development Plan (2011–2012 to 2015–2016)*, had a main goal of people-centred development.¹² Among 13 targets for achievement over the 5-year period, there were only two health-related targets: neonatal mortality rate and maternal mortality rate. Among the prioritized plans for the development of the national health sector, it was mentioned that prevention and control of NCDs will be implemented and there will be a plan for people to adopt a more healthy lifestyle. However, this was just a general statement with no detailed action plan for implementation.

The *National Health Plan 2011–2016* is the first phase of the 20-year National Comprehensive Development Plan – Health Sector and focuses on 11 programme areas.¹³ Although prevention and control of NCDs are included, only improvements in cardiopulmonary resuscitation and health education on cardiovascular disease, cancer and chronic respiratory disease in general are specified. Policy developments in promotion of healthy food, improving a healthy environment conducive to physical activities for the public, restricting marketing of unhealthy food, and mass awareness-raising programmes need to be strengthened. The weaknesses in prevention-related policies in these key areas illustrate the magnitude of the challenges faced. Moreover, the planned implementation of activities related to NCDs employs vertical approaches, and horizontal integration remains a significant gap. The funding for these vertical programmes is mainly from the WHO country biennial budget, which is usually shared and distributed among over 40 different programmes. With the limited total budget, funding for each programme is far from sufficient for their activities.

A national policy on NCDs, and a strategic action plan, were developed by the Prevention and Control of Diabetes Project and the University of Medicine 2, Yangon, in which the nine voluntary global targets of the WHO *Global action plan for the prevention and control of noncommunicable diseases 2013–2020*³ were adopted as national targets. The National Health

Committee endorsed the national policy on NCDs in April 2014. However, there have been few activities to translate the policy and strategic action plan to real implementation.

In 2013, the Myanmar Health Sector Coordination Committee (M-HSCC) was established, with the specific objectives of advising the Ministry of Health on strengthening the health sector, providing a space for strategic discussion on health-related issues and acting as a coordination body for the health sector. The Minister for Health chairs the M-HSCC and there are seven technical and strategy groups (TSGs), which are mainly concerned with communicable diseases, reproductive health and disaster preparedness. Significantly, there is no TSG for NCDs.¹⁴

GAPS AND CHALLENGES TO IMPLEMENTING A CHRONIC CARE MODEL FOR DIABETES

The health system comprises a pluralistic mix of public and private systems in both financing and provision. Public health services in Myanmar are delivered to the communities by rural health centres (RHCs) and sub-RHCs, through the corresponding township, district and region, and state health departments that provide technical assistance and support. Basic health staff (BHS) mainly work at the RHC and sub-RHC. The curriculum for training of BHS mainly emphasizes community and environmental health. Primary health care is traditionally orientated more towards prevention of infectious diseases and BHS usually do not have training in prevention and control of NCDs.^{15,16} The Prevention and Control of Diabetes Project has been in operation in Myanmar since 1991, with support from WHO. Prevention and control of diabetes has been included in national health planning since 1996. Activities have been limited mainly to capacity-building of townships' medical officers and BHS on diabetes management and the production of information, education and communication materials on the prevention and control of diabetes. There are over 330 townships in Myanmar but, to date, the Prevention and Control of Diabetes Project has only been able to run workshops for capacity-building on diabetes care in 80 townships. Moreover, frequent rotation of trained medical officers to other duties has greatly impeded implementation of sustainable diabetes services at the township level.

The WHO *Package of Essential Noncommunicable (PEN) disease interventions for primary health care in low-resource settings* comprises cost-effective interventions with high impact, including those for the early detection and management of type 2 diabetes.¹⁷ Implementation of the WHO PEN was piloted in two townships in Yangon Region in 2012. Prevention of cardiovascular disease through the entry point of hypertension and diabetes was found to be feasible and it was recommended that implementation of the PEN project should be extended to the rest of the country. The People's Health Foundation is now planning to implement the WHO PEN in more townships in Yangon Region. The Government of Yangon Region has now committed to implement activities of the PEN project in the rest of the townships of the Yangon Region. Expansion of the WHO PEN to the whole country has been approved by the Ministry of Health. In 2016, the PEN

package will be expanded to 10 townships and it will be scaled up to the whole country (330 townships) within 5–10 years.

The Myanmar Diabetes Care Model (MMDCM) was proposed by the Myanmar Diabetes Association, with the aim of bridging the gap in diabetes care between rural and urban areas.¹¹ Although the activities of the PEN project include strengthening of the health system with a focus on primary health care, improving diabetes care throughout the country also requires strengthening of the health system at the secondary and tertiary levels. The MMDCM aims to improve diabetes care at all three levels, applying the experience of the PEN project and chronic care model of diabetes care in other high-income countries. However, there are large gaps in policy development for essential drugs and equipment, capacity-strengthening of BHS and medical officers from both private and public sectors, development of categories of health workers required specifically for diabetes care (e.g. dietitians, podiatrists and diabetes educators), and an appropriate referral system and health information system.¹¹

GAPS AND CHALLENGES IN THE HEALTH-CARE SYSTEM

Total health expenditure in Myanmar, which was 2.0–2.4% of its gross domestic product (GDP) between 2001 and 2011, is the lowest among countries in the WHO South-East Asia and Western Pacific Regions. General government health expenditure (GGHE) as a percentage of general government expenditure (GGE) is low, at 1% between 2003 and 2011. GGHE as a percentage of GDP amounted to 0.2–0.3% over the same period. GGHE as a percentage of GDP and of GGE in 2012–2013 increased significantly to 0.76% and 3.14%, respectively; however, this level of health investment is still low compared to the demand for health care.^{9,18} There is no separate budget for the prevention and control of diabetes and other NCDs.

The health-system assessment in 2012 noted that the major constraints to service delivery related to the availability, acceptability and accessibility of services to the people.¹⁹

Health care in the private sector is gradually increasing in Myanmar. It is estimated that in 2010, 61% of medical doctors were employed in the private sector. The sector is expanding, particularly in cities and towns, although recently village-level general practices have been set up in some locations.⁸ However, private-sector health care has expanded rapidly and private service providers have had very limited involvement in public health programmes.

People used to seek treatment from local practitioners of traditional medicine. Poor people, and those who could not afford medicines from reputable suppliers, used to buy medicines at local pharmacies, which are run by unqualified sellers who sell a combination of medicines for symptomatic relief without proper training in pharmacology. These kinds of local pharmacies are quite common in the community, owing to the weak regulatory system for pharmacy and poor law

reinforcement. Because of the common practice of inclusion of steroids in these mixed medicines, people are prone to develop steroid-induced diabetes, or control of diabetes can deteriorate, with the development of diabetes-related complications.

Traditional medical practices, which were in existence even before the introduction of modern medicine into the country, are also thriving in both the public and private sectors because of public acceptance and support and encouragement from the government. People tend to believe in herbal medicine far more than in western medicine and, according to a survey done in a diabetes clinic in Yangon General Hospital, more than 70% of people took traditional medicine before coming to the tertiary centre.²⁰ Utilization of traditional medicine is promoted, owing to impressive advertisements in media with unchecked and false information claiming a complete cure for diabetes. Although the government encourages the manufacturers of traditional medicines to produce their medicines in scientific ways, there has been significant weakness in research on traditional medicines and the application of principles of evidence-based medicine.^{20,21}

MEETING THE CHALLENGES: POLICY IMPLICATIONS

Commitment by the highest authority of administration is crucial for effective implementation of prevention and control of NCDs and improvement of diabetes care in the country. It is essential now, more than ever, to implement the policy of “health for all”, as the people are earnestly anticipating the development of their country and hoping to keep pace with neighbouring countries in their national development. Strong leadership of the Ministry of Health is also crucially important, to advocate and lobby policy-makers for investment in prevention and control of NCDs, including an efficient system of care for diabetes. The National Health Policy should be reviewed and revised, to keep it updated and to cover the country’s need, based on the real situation of health of the people. It is necessary to integrate the National Policy on NCDs into the National Health Policy and to develop the strategic action plan with national targets aligned with the global and regional voluntary targets. The existing multisectoral coordination mechanism for the National Health Committee and M-HSCC should be reinvigorated, in order to efficiently implement the revised National Health Policy and strategic action plan for the prevention and control of NCDs. Prevention and control of diabetes by efficient and equitable delivery of care should be integrated with that for the other NCDs like cardiovascular disease, cancer and chronic respiratory disease. Strengthening of the health system with emphasis on primary health care should be prioritized among other requirements for improvement of outcomes for population health. The Myanmar Diabetes Care Model, which applied the experience of the WHO PEN intervention, with further improvement and synergy with specialist care in secondary and tertiary care, should be implemented nationwide. While all building blocks of the health systems are strengthened simultaneously, emphasis should be placed on the production of a competent health workforce, focusing on quantity, quality and the

required categories of health workforce. Sustainable funding and availability of essential medicines and diagnostic facilities, according to the level of health care, should also be assured. Development of traditional medicine using scientific methods, founded on evidence-based practice, should also be prioritized. Attempts should also be made to establish a surveillance system for NCDs and a diabetes registry. Last, but not least, monitoring and evaluation and research on activities for the prevention and control of NCDs, including diabetes, should be strengthened, and proper utilization of the information gathered should be undertaken.

CONCLUSION

Analysis of the gaps and challenges in diabetes care in Myanmar is expected to assist in the formulation and development of a national policy on NCDs and its implementation. This will lead to improvement in the delivery of care for diabetes and other NCDs in an integrated approach, and closure of the gap between rural and urban health care. It will also be of help for development of a national action plan for prevention and control of NCDs, leading to national targets that are aligned with the global targets. Eventually, it is anticipated that, with the improvement in diabetes care in the country, and reduction of the burden of NCDs, this will satisfy the people’s desire for national development and poverty alleviation.

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Assessment of risk of type 2 diabetes using the Indian Diabetes Risk Score in an urban slum of Pune, Maharashtra, India: a cross-sectional study

Quick Response Code:



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ABSTRACT

Background: The urban poor is a group that is known to be vulnerable to adoption of a more urbanized lifestyle that places them at a higher risk for diabetes. Individuals who are unaware of their disease status are more prone to micro- and macrovascular complications. Hence, it is necessary to detect this large pool of undiagnosed participants with diabetes and offer them early therapy. The aim of this study was to use the Indian Diabetes Risk Score, developed by the Madras Diabetes Research Foundation (MDRF-IDRS), to assess the prevalence of people at high risk for developing diabetes, and the correlation with known risk factors.

Methods: A cross-sectional study was conducted in the field practice area of the urban health training centre of a private medical college in Pune, Maharashtra. A total of 425 participants aged 20 years and above were screened for risk factors, including age, waist circumference, family history of diabetes and physical activity. Random testing of the blood glucose level of participants with a high risk score was carried out using a glucometer. Statistical analysis of the data was performed by using the chi-squared test and logistic regression analysis.

Results: The prevalence of people at high risk of diabetes was 36.55%. Among high-risk participants on univariate analysis, primary education ($P = 0.004$), lower socioeconomic class ($P = 0.002$), less physical activity ($P < 0.001$) and high waist circumference ($P < 0.001$) were major contributing factors, while in the moderate-risk group, lower socioeconomic class and high waist circumference were the prominent risk factors for diabetes. Multivariate analysis showed that higher education, moderate to vigorous activity and high waist circumference were significantly associated with risk status. Out of 140 high-risk participants, 68 (49%) had a random capillary blood glucose level of 110 mg/dL or above.

Conclusion: As the prevalence of people at high risk for diabetes was high, lifestyle changes and awareness regarding risk factors is needed to take control of the diabetes in the study population.

Key words: diabetes, high-risk cases, prevalence, risk score, urban

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BACKGROUND

Epidemiological transitions in India in the 21st century have led to noncommunicable diseases becoming a major public health problem of growing magnitude. One of the important diseases in this respect is diabetes, which is considered a “disease of urbanization”.¹⁻³

While recognizing the increasing prevalence of type 2 diabetes in urban Indian adults, it is important to note that the prevalence of undiagnosed diabetes in the community is also high. In the Chennai Urban Rural Epidemiology Study (CURES), the prevalence of known diabetes was 6.1% in the population studied, and for undiagnosed diabetes was 9.1%. Many such studies have reported a high prevalence of undiagnosed cases.

Hence, it is necessary to detect this large pool of participants with undiagnosed diabetes in India and offer them early therapy. The Indian Diabetes Risk Score, developed by the Madras Diabetes Research Foundation (MDRF-IDRS; shortened to IDRS from here onwards), is based on a multiple logistic regression model, and is a cost-effective method for the detection of undiagnosed diabetes in the community.^{4,5}

Nearly 32.5% of the population of Pune lives in slums. The annual growth in the slum population is much higher than the city's overall population growth rate: in 2001, the annual population growth rate of the city was 4.14%, whereas it was 6.06% for the slum population. The increase in the population of Pune city is largely due to the industrialization and urbanization in and around Pune city, which has attracted many migrants from other parts of the country, resulting in an increase in the number of slums and the slum population. Along with the increase in the number of slums, the health-related problems faced by the slum dwellers are also increasing.⁶

Few data on diabetes and associated risk factors are available from Pune and the surrounding area. Therefore, to enable predictions of the future prevalence of diabetes in urban slums in the Pune area, India, this study aimed to identify and grade individuals at risk for diabetes, in a community setting, using the IDRS and testing of random capillary blood glucose.

The objectives of the study were to:

- identify adults aged over 20 years at high risk for developing type 2 diabetes, using the IDRS;
- estimate the proportion of participants at high risk for developing type 2 diabetes in the study sample;
- determine the association of participants at high risk for developing diabetes with various risk factors, i.e. age, waist circumference, family history of diabetes, physical activity and sociodemographic variables.

METHODS

Study design

This was a community-based cross-sectional study conducted over one year, from September 2011 to August 2012.

Study area

There are a total of 14 wards and 564 slums in Pune city. The field practice area of the urban health training centre of a private medical college, Pune, provides services to three wards covering the approximate population of 60 000. Out of these three wards, three areas, namely Joshiwada, Ganjwewada and Mangwada, with populations of 349, 177 and 243 (total = 769) respectively, were randomly selected for the study.

Study population

The study population was individuals aged 20 years and above who were residents of the area. All adult men and women aged 20 years and above residing in the study area were included. Pregnant and lactating women up to 12 weeks postpartum were excluded, owing to the possibility of impaired glucose tolerance status in this group.⁷

Study methodology

Sample size

In a study done in India by Ramchandran et al. in 2008,⁸ the prevalence of type 2 diabetes was 18.6%. The sample size was calculated at 438 by use of the formula $4pq/L^2$, where $p = 18.6$ and $q = 100 - p$, with an allowable error of 20%.

The number of study participants selected from each area was 199, 100 and 139 from Joshiwada, Ganjwewada and Mangwada respectively. As 13 study participants were not willing to take part, the total sample collected was 425. These 13 non-respondents declined to take part because of the need to earn their daily income or household duties.

All participants aged 20 years and over in each household were included in the study. House-to-house visits were conducted, covering the houses one after the other lane wise. The participants were fully informed regarding the purpose of the study. The patient information sheet was explained to each subject and written consent was obtained. Each interview began with a general discussion to build rapport with the participants and gain their confidence. Participants who could not be contacted on the first visit were contacted subsequently during weekends as per their convenience.

Clearance from the ethics committee of Bharati Vidyapeeth University Medical College, Pune, was obtained prior to initiation of the study.

During each house visit, data were collected using the World Health Organization (WHO) Stepwise approach to surveillance (STEPS),⁹ which includes three steps for assessment of risk factors. The three steps are as follows:

- Step 1: a predesigned, pretested proforma was used to collect data from the study participants; this included information on sociodemographic characteristics, family history of diabetes and physical activity, etc.
- Step 2: anthropometric measurements were taken for all study participants. Measurements included height, weight, waist circumference and hip circumference.

Screening at steps 1 and 2 was done on the basis of the IDRS.^{10,11}

- Step 3: biochemical testing, i.e. random capillary blood glucose was done for high-risk participants (IDRS ≥ 60) who were screened in steps 1 and 2.

The socioeconomic status of subjects was assessed according to a modified Prasad's Classification.¹²

Operational definitions used are listed next.

- High-risk cases of diabetes:¹¹ participants with IDRS ≥ 60 were considered at high risk of diabetes.
- Family history of diabetes:¹³ if either or both of a subject's parents had diabetes, they were considered to have a positive family history.
- Physical activity:⁹ levels were graded based on WHO STEPS definitions of sedentary, mildly, moderately or vigorously physically active.
- Waist circumference:⁷ was measured to the nearest 0.1 cm at the midpoint between the tip of the iliac crest and the last costal margin in the back and at the umbilicus in the front, using a non-stretchable tape, at the end of normal expiration, with the subject standing erect in a relaxed position. Abdominal/central obesity was considered to be present when the waist circumference was ≥ 80 cm in women and ≥ 90 cm in men.
- Blood glucose:¹⁴ estimation of random capillary blood glucose was done only for those found to be at high risk for diabetes (IDRS ≥ 60), using a standardized digital glucometer (Accu-Check, Roche diagnostics, Germany). Participants with known diabetes were not tested for blood sugar levels.
- Occupation:¹⁵
 - labourer: a person involved in occupation for cash or kind; this group included mostly unskilled labourers working for daily wages;
 - business: any well- or semi-established organized business owned by an individual, irrespective of its size and category, if it is meant for profit;
 - unemployed: a person who is able and wishes to work for cash or kind, but cannot get the work;
 - housewife: a person who cares for the home and family; she is alternatively referred to as a home-maker;
 - household worker: a person who is employed for remuneration whether in cash or kind, in any household through any agency or directly, on either a temporary or permanent, part-time or full-time basis, to do the household work, but not including any member of the family of an employer.
- Education:¹¹
 - illiterate: a person, who can neither read nor write, or can only read but cannot write in any language;
 - primary: a person who has completed sixth standard;
 - secondary: a person who has studied from to fifth to tenth standard;

- higher secondary and above: a person who has obtained a higher secondary school certificate from an educational board; a graduate (a person who has obtained a degree from any university); a postgraduate (a person who has obtained a postgraduate degree from any university); and a professional degree/diploma award (a person who has obtained any professional degree/diploma from any university).

Statistical analysis

The prevalence of diabetes among each of the high-risk groups, according to risk factors, was presented as a percentage. The chi squared test was used to establish whether there was an association between the risk of diabetes and each of the potential risk factors. Similarly, the odds of diabetes among the high-risk and moderate-risk groups were assessed for each risk factor, using univariate logistic regression. An adjusted analysis was performed using multivariate logistic regression. All statistical significance was assessed at the 5% significance level. All statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) version 19.

RESULTS

Out of 425 participants, 42 (9.88%) were diagnosed as having diabetes. The baseline characteristics of the remaining participants are shown in Table 1. Of these 383 participants, 140 (36.6%) had a high risk score (IDRS ≥ 60), the majority of participants (209; 54.6%) were in the moderate-risk category (IDRS 30–50) and 34 (8.9%) participants were found to be at low risk for diabetes (IDRS < 30) (see Table 1). More women than men were at high risk (99; 40.4%). The majority (48; 56.5%) of illiterate participants were at high risk; 76 (60.8%) participants with higher secondary and above education were at moderate risk; and 14 (11.8%) with secondary education were at low risk for diabetes. The association between low education status with high risk status was highly significant statistically ($P = 0.001$). Of the 140 high-risk participants, the largest group, i.e. 62, were in socioeconomic class 3, followed by 40 in classes 4 and 5. In addition to this, 89 (57.1%) participants in socioeconomic class 3 were at moderate risk and 17 (17.6%) participants in socioeconomic classes 4 and 5 were at low risk. The association between socioeconomic class and risk status was highly significant statistically ($P = 0.001$).

With respect to age, 94 (67.6%) participants aged ≥ 50 years were at high risk; 135 (73.0%) in the age group 35–49 years were at moderate risk and 30 (50.8%) in the age group 20–34 years were at low risk. The link between risk status and age group was highly significant statistically ($P < 0.001$). Only 24 (57.1%) high-risk participants, 16 (38%) moderate-risk participants and 2 (4.7%) low-risk participants had a family history of diabetes. The majority of participants were involved in sedentary to mild physical activity. In both sexes, a total of 197 (51.4%)

Table 1. Baseline characteristics of the participants included in the study

Characteristics	Total (%), n = 383	High risk (IDRS ≥60), n = 140 (36.6%)	Moderate risk (IDRS 30 to <60), n = 209 (54.6%)	Low risk (IDRS <30, n = 34 (8.9%))	Chi-squared P value
Sex					
Male	138 (36.1)	41 (29.7)	87 (63.1)	10 (7.2)	0.044 ^a
Female	245 (63.9)	99 (40.4)	122 (49.8)	24 (9.8)	
Education					
Illiterate	85 (22.2)	48 (56.5)	35 (41.2)	2 (2.3)	0.001 ^a
Primary	54 (14.1)	20 (37.0)	30 (55.6)	4 (7.4)	
Secondary	119 (31.1)	37 (31.1)	68 (57.1)	14 (11.8)	
Higher secondary and above	125 (32.6)	35 (28.0)	76 (60.8)	14 (11.2)	
Socioeconomic class					
Class 1	31 (8.1)	10 (32.3)	19 (61.3)	2 (6.4)	0.001 ^a
Class 2	99 (25.8)	28 (28.3)	61 (61.6)	10 (10.1)	
Class 3	156 (40.7)	62 (39.7)	89 (57.1)	5 (3.2)	
Class 4 and 5	97 (25.3)	40 (41.2)	40 (41.2)	17 (17.5)	
Occupation					
Business	38 (9.9)	17 (44.7)	19 (50.0)	2 (5.3)	NA
Household worker	39 (10.2)	7 (17.9)	29 (74.4)	3 (7.7)	
Housewife	156 (40.7)	71 (45.5)	70 (44.9)	15 (9.6)	
Labourer	23 (6.0)	3 (13.0)	17 (73.9)	3 (13.0)	
Service	41 (10.7)	10 (24.4)	27 (65.9)	4 (9.8)	
Retired	19 (5.0)	12 (63.2)	7 (36.8)	0 (0)	
Others	67 (17.5)	20 (29.9)	40 (59.7)	7 (10.4)	
Age, years					
20–34	59 (15.4)	0 (0)	29 (49.2)	30 (50.8)	<0.001 ^b
35–49	185 (48.3)	46 (24.9)	135 (73.0)	4 (2.2)	
≥50	139 (36.3)	94 (67.6)	45 (32.4)	0 (0)	
Family history of diabetes					
Yes	42 (11.0)	24 (57.1)	16 (38.1)	2 (4.8)	0.012 ^a
No	341 (89.0)	116 (34.0)	193 (56.6)	32 (9.4)	
Physical activity					
Sedentary to mild	255 (66.6)	121 (47.5)	115 (45.1)	19 (7.5)	<0.001 ^b
Moderate to vigorous	128 (33.4)	19 (14.8)	94 (73.4)	15 (11.7)	
Waist circumference, cm					
Men <90, women <80	186 (48.6)	30 (16.1)	126 (67.7)	30 (16.1)	<0.001 ^b
Men ≥90, women ≥80	197 (51.4)	110 (55.8)	83 (42.1)	4 (2.0)	

IDRS: Madras Diabetes Research Foundation Indian Diabetes Risk Score; NA: not available.

^aSignificant at the $P < 0.05$ level.^bHighly significant at the $P < 0.001$ level.

had high waist circumference and more than half (110; 55.8%) were at high risk. Of those with low waist circumference, 126 (67.7%), were at moderate risk and 30 (16.1%) at low risk. The association between waist circumference and risk status was highly significant statistically ($P < 0.001$).

Univariate analysis for the high-risk group (see Table 2) showed that primary education (odds ratio [OR]: 9.60; 95% confidence interval [CI]: 2.05–44.90; $P = 0.004$) and socioeconomic class 4 and 5 (OR: 5.27; 95% CI: 1.80–15.41; $P = 0.002$) were significantly associated with risk status. Also, a highly significant association was found between physical activity (moderate to vigorous; OR: 0.20; 95% CI: 0.087–0.45) and high waist circumference, in both sexes (OR: 27.50; 95% CI: 8.98–84.17).

On univariate analysis for the moderate-risk group (see Table 3), socioeconomic class 3 (OR: 2.59; 95% CI: 1.07–6.23; $P = 0.033$) and high waist circumference (OR: 4.94; 95% CI: 1.67–14.54; $P = 0.004$) were found to be significantly associated with risk status. The association between socioeconomic class 4 and 5 (OR: 7.56; 95% CI: 2.60–21.93; $P < 0.001$) and risk status was highly significant.

On multiple logistic regression analysis for the high-risk and moderate-risk groups combined (see Table 4), it was found that higher education (higher secondary and above; OR: 0.21; 95% CI: 0.05–0.96; $P = 0.044$) and physical activity (moderate to vigorous; OR: 0.09; 95% CI: 0.02–0.49; $P = 0.005$) were significantly associated with risk status and there was a highly significant association between high waist circumference and risk status (OR: 47.45; 95% CI: 7.52–299.30; $P < 0.001$).

Table 2. Univariate logistic regression analysis of diabetes and associated risk factors among the high-risk group

Characteristics	Number (%) high risk (IDRS ≥ 60), $n = 140$ (36.6%)	Number (%) low risk (IDRS < 30), $n = 34$ (8.9%)	Odds ratio	95% Confidence interval	<i>P</i> value
Sex					
Male	41 (29.3)	10 (29.4)	1	—	—
Female	99 (70.7)	24 (70.6)	1.01	0.44–2.29	0.988 ^a
Education					
Illiterate	48 (34.3)	2 (5.9)	1	—	—
Primary	20 (14.3)	4 (11.8)	9.60	2.05–44.90	0.004 ^b
Secondary	37 (26.4)	14 (41.2)	2.00	0.57–6.91	0.273 ^a
Higher secondary and above	35 (25.0)	14 (41.2)	1.05	0.44–2.53	0.901 ^a
Socioeconomic class					
Class 1	10 (7.1)	2 (5.9)	1	—	—
Class 2	28 (20.0)	10 (29.4)	2.12	0.42–10.74	0.362 ^a
Class 3	62 (44.3)	5 (14.7)	1.19	0.47–2.98	0.071 ^a
Class 4 and 5	40 (28.6)	17 (50.0)	5.27	1.80–15.41	0.002 ^b
Family history of diabetes					
No	116 (82.9)	32 (94.1)	1	—	—
Yes	24 (17.1)	2 (5.9)	3.31	0.74–14.75	0.116 ^a
Physical activity					
Sedentary to mild	121 (86.4)	19 (55.9)	1	—	—
Moderate to vigorous	19 (13.6)	15 (44.1)	0.20	0.09–0.45	<0.001 ^c
Waist circumference, cm					
Men <90, women <80	30 (21.4)	30 (88.2)	1	—	—
Men ≥ 90 , women ≥ 80	110 (78.6)	4 (11.8)	27.50	8.98–84.17	<0.001 ^c

IDRS: Madras Diabetes Research Foundation Indian Diabetes Risk Score.

^aNot significant.

^bSignificant at the $P < 0.05$ level.

^cHighly significant at the $P < 0.001$ level.

Table 3. Univariate logistic regression analysis of diabetes and associated risk factors among the moderate-risk group

Characteristics	Number (%) moderate risk (IDRS 30 to <60), n = 209 (54.6%)	Number (%) low risk (IDRS <30), n = 34 (8.9%)	Odds ratio	95% Confidence interval	P value
Sex					
Male	87 (41.6)	10 (29.4)	1	—	—
Female	122 (58.4)	24 (70.6)	0.58	0.26–1.28	0.181 ^a
Education					
Illiterate	35 (16.7)	2 (5.9)	1	—	—
Primary	30 (14.4)	4 (11.8)	3.22	0.69–14.95	0.135 ^a
Secondary	68 (32.5)	14 (41.2)	1.38	0.42–4.53	0.594 ^a
Higher secondary and above	76 (36.4)	14 (41.2)	0.89	0.39–2.01	0.788 ^a
Socioeconomic class					
Class 1	19 (9.1)	2 (5.9)	1	—	—
Class 2	61 (29.2)	10 (29.4)	4.03	0.84–19.28	0.080 ^a
Class 3	89 (42.6)	5 (14.7)	2.59	1.07–6.23	0.033 ^b
Class 4 and 5	40 (19.1)	17 (50.0)	7.56	2.60–21.93	<0.001 ^c
Family history of diabetes					
No	193 (92.3)	32 (94.1)	1	—	—
Yes	16 (7.7)	2 (5.9)	1.32	0.29–6.04	0.715 ^a
Physical activity					
Sedentary to mild	115 (55.0)	19 (55.9)	1	—	—
Moderate to vigorous	94 (45.0)	15 (44.1)	1.03	0.49–2.14	0.926 ^a
Waist circumference, cm					
Men <90, women <80	126 (60.3)	30 (88.2)	1	—	—
Men ≥90, women ≥80	83 (39.7)	4 (11.8)	4.94	1.67–14.54	0.004 ^b

IDRS: Madras Diabetes Research Foundation Indian Diabetes Risk Score.

^aNot significant.^bSignificant at the $P < 0.05$ level.^cHighly significant at the $P < 0.001$ level.

Biochemical analysis showed that out of the total of 140 high-risk participants, 61 (43.6%) had a random capillary blood glucose level of 110–140 mg/dL, while 7 (5.0%) had a level of ≥ 140 mg/dL.

DISCUSSION

This study used the IDRS to identify individuals at risk for diabetes and determine the association of various risk factors with their risk status.

The proportion of individuals at high risk for diabetes was 36.55%. Similar findings were published by Gupta et al., who reported that 31.2% of the population in urban Pondicherry had a high risk score.¹⁶ However, a study conducted by Mohan et al., in the metropolitan city of Chennai, found 43% of the population was in the high-risk category.¹⁰ The difference in risk prevalence between the current study and the one in

Chennai may be due to variance in lifestyles of the populations. The present study noted 54.6% of participants with moderate risk and 8.9% of participants with low risk, while Gupta et al. found 50.3% of participants at moderate risk and 18.5% at low risk for diabetes.¹⁶ Pune is an evolving metropolitan city, owing to changes in physical activity and eating habits of the people, and the current study shows very few participants in the low-risk category compared to the high-risk category.

Similar to the present study, Arora et al. noted that more high-risk cases were women than men in urban Haryana, and there was a statistically significant association.¹⁷ However, a study done by Misra et al. in an urban slum of Delhi showed no statistically significant association by sex.³ Arora et al. also found a higher prevalence of risk in the lower middle class, though their results were not significant,¹⁷ while in the present study there was a significant association between the lower socioeconomic classes and risk status. This suggests that diabetes is no longer a disease of the affluent, or a “rich

Table 4. Multivariate logistic regression analysis for the high- and moderate-risk groups against the low-risk group and associated risk factors

Characteristics	Odds ratio	95% Confidence interval	P value
Sex			
Male	1	—	—
Female	0.38	0.09–1.61	0.193 ^a
Education			
Illiterate	1	—	—
Primary	0.60	0.019–19.71	0.777 ^a
Secondary	0.65	0.09–4.96	0.684 ^a
Higher secondary and above	0.21	0.05–0.96	0.044 ^b
Socioeconomic class			
Class 1	1	—	—
Class 2	2.45	0.21–28.86	0.475 ^a
Class 3	0.95	0.20–4.47	0.953 ^a
Class 4 and 5	2.05	0.41–10.32	0.380 ^a
Family history of diabetes			
No	1	—	—
Yes	12.42	0.93–165.80	0.057 ^a
Physical activity			
Sedentary to mild	1	—	—
Moderate to vigorous	0.09	0.02–0.49	0.005 ^b
Waist circumference, cm			
Men <90, women <80	1	—	—
Men ≥90, women ≥80	47.45	7.52–299.30	<0.001 ^c

^aNot significant.

^bSignificant at the $P < 0.05$ level.

^cHighly significant at the $P < 0.001$ level.

man's disease". It is becoming a problem even among the middle-income and poorer sections of society. This may be due to changes in the lifestyle and standard of living of people from urban slum areas, as a result of urbanization. However, Mohan et al. in 2003 found a significant association between diabetes and higher socioeconomic class.¹⁸ The present study noted that a high proportion of housewives were at high risk for developing diabetes. Arora et al. observed similar findings, with the highest prevalence in housewives among occupational groups in their study carried out in urban Haryana.¹⁷ The probable reason for this is that housewives are not doing any other physical activity apart from their household work and are not involved in any other day-to-day exercise. However Rao et al. found that people engaged in service jobs were associated with a high risk for diabetes.⁷

The current study noted that, as age increases, the risk for diabetes also increases. Several other studies have noted similar findings.^{18–20} Two further studies found a positive association between higher age and undiagnosed diabetes.^{21, 22}

A high incidence of diabetes is seen among first-degree relatives where one has diabetes, and the risk of a child with a parental history of diabetes developing diabetes themselves is more than 50%.²³ Two other studies have shown that increased risk for diabetes was associated with a family history of diabetes.^{13, 20} Thus, family history of diabetes is one of the major contributors for diabetes. Arora et al. noted that the majority of individuals with prediabetes had a family history.¹⁷ Hadaegh et al., and Wang et al., in their studies done in an Iranian urban population and in Guangzhou urban community respectively, found an association between undiagnosed cases of diabetes and a family history of diabetes, as in the current study.^{21, 22}

Physical activity is one of the important modifiable risk factors for diabetes. Globally, physical inactivity accounts for 14% of diabetes,²⁴ and it also acts as a major risk factor for obesity, which again has a significant relationship with diabetes. Over the past few decades, a huge proportion of the working population has shifted from manual labour associated with the agriculture sector to less physically demanding office jobs.

India is undergoing rapid urbanization, which is associated with increasing obesity and decreasing physical activity, owing to changes in lifestyle and diet and a change from manual work to less physical occupations.^{10,19,23} Gupta et al. reported similar findings to those of the present study, that individuals with a sedentary lifestyle or who undertook only mild physical activity, had a higher risk for diabetes;¹⁶ also, the Chennai Urban Population Study (CUPS-14) conducted by Mohan et al. found a significant association between light physical activity and undiagnosed diabetes.¹⁸

Despite having a lower prevalence of obesity as defined by body mass index, Asian-Indians tend to have a higher waist circumference and waist-to-hip ratio compared to white Caucasians, thus having a greater degree of central obesity. Waist circumference is a more powerful determinant of a subsequent risk of diabetes mellitus.¹⁰ Several other studies have noted a significant association between waist circumference and undiagnosed diabetes, which is similar to the findings of the present study.^{8,21,23,25,26}

The scientific tests most frequently used to screen for diabetes are fasting plasma glucose and a 2-h oral glucose tolerance test. However, while these tests are useful for epidemiological studies, they are difficult, and relatively expensive, to do on a mass scale in a community setting. The most convenient way to screen a large number of people is to measure the random capillary blood glucose. This has the advantage that it can be undertaken at any time of the day, does not require a venipuncture and can even be performed by non-medically trained people. The present study observed that 43.6% of participants had a random capillary blood glucose level between 110 and 140 mg/dL, while a further 5.0% had a level above 140 mg/dL. Definitive testing by oral glucose tolerance test is recommended for these individuals, to detect their diabetes status. Mohan et al. observed in their study that 60% of those with high IDRS had a random capillary blood glucose level of ≥ 110 mg/dL.¹⁴

Conclusion

The IDRS was a simple tool used in a community-based study to detect individuals at high risk for diabetes. Non-modifiable risk factors like increasing age and family history of diabetes, and modifiable risk factors like lack of physical activity and central obesity were the most common factors found in participants who were at high risk for diabetes.

Use of a cost-effective tool like the IDRS for routine screening of people aged over 35 years is advisable for identification of participants at high risk for development of diabetes.

Definitive testing by oral glucose tolerance test is recommended to detect the status of diabetes in participants with a random capillary blood glucose above 110 mg/dL.

Development of suitable primary and secondary preventive approaches, including lifestyle and dietary modifications, is recommended for these high-risk participants.

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Metabolic syndrome among elderly care-home residents in southern India: a cross-sectional study

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Quick Response Code:



ABSTRACT

Background: The health of the elderly population and the emergence of noncommunicable diseases have become major public health issues in recent years. Metabolic syndrome is thought to be the main driving force for the global epidemic of cardiovascular diseases, as well as for type 2 diabetes. This cross-sectional study aimed to determine the prevalence of metabolic syndrome and its correlates among the residents of care homes for the elderly in Hyderabad city, India.

Methods: A total 114 elderly persons (aged ≥ 60 years) were evaluated in a cross-sectional study. Metabolic syndrome was defined by the 2005 criteria of the International Diabetes Federation. Data were collected on selected sociodemographic, behavioural and nutritional variables and cardiometabolic risk factors. Blood pressure and anthropometric measurements were also recorded. Fasting blood samples were collected for measurement of blood glucose and serum lipid levels. Univariable logistic regression was applied to investigate the associations between metabolic syndrome and known risk factors; adjusted analysis was then done by multivariable logistic regression for significant variables.

Results: The overall prevalence of metabolic syndrome was 42.1% (48/114) among the study population. A higher prevalence (50.9%; 27/53) was found among women. High blood pressure or taking antihypertensive medication was found to be the most common (95.8%; 46/48) cardiometabolic component. The risk of metabolic syndrome did not differ significantly by age group, sex, caste, religion, type of diet (vegetarian or non-vegetarian), educational status, behavioural factors such as tobacco use and alcohol intake, physical activity (assessed by modified Eastern Cooperative Oncology Group [ECOG] scale), or physical exercise. However, a body mass index ≥ 23 kg/m² was associated with metabolic syndrome (unadjusted odds ratio [OR]: 8.97; 95% confidence interval [CI]: 3.78–21.28); adjusted OR: 9.31; 95% CI: 4.12–22.14)

Conclusion: The overall prevalence of metabolic syndrome in this study population of elderly care-home residents in India was more than 40%. Further research on the burden of metabolic syndrome in the elderly population is warranted.

Key words: cardiometabolic risk factors, care home, elderly, metabolic syndrome, noncommunicable disease

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BACKGROUND

Rapid urbanization and lifestyle changes, coupled with nutritional transition, has led to the emergence of noncommunicable diseases in the last few decades, especially in low- and middle-income countries. Metabolic syndrome, a clustering of impaired glucose metabolism, dyslipidaemia, hypertension and central obesity, is associated with the

subsequent development of cardiovascular diseases and type 2 diabetes. Individuals with metabolic syndrome are at greater risk of cardiovascular mortality and morbidities.^{1,2} Previous studies have shown a high prevalence of various components of metabolic syndrome among the Indian population compared to the population of high-income countries, probably because of a higher prevalence of abdominal obesity and insulin resistance.^{3–5}

Population ageing has become a major concern in the last few decades, especially in low- and middle-income countries, which are often least prepared to meet the challenges of rapidly ageing societies. The size of the elderly population (aged ≥ 60 years) is increasing rapidly in India: in 1991 it accounted for 6.7% of the total population, rising to 7.4% by the turn of the new millennium, and is expected to increase to around 10.7% by 2021, as a result of demographic transition.⁶ For a populous country like India, this is likely to pose mounting pressures on various aspects of society, including a burden on health-care facilities and health expenditures. Studies have revealed that nearly one third of the urban population in India has metabolic syndrome,^{7,8} but there is little information available on metabolic syndrome among the elderly population in the country. It is vitally important to understand the prevalence and determinants of metabolic syndrome among the elderly population, in order to apply medical and social interventions to improve the health status, and thus quality of life, for this population. Taking these considerations into account, this study aimed to investigate the prevalence of metabolic syndrome and its correlates among the residents of care homes for the elderly in Hyderabad City, India.

METHODS

Study design, setting and participants

A cross-sectional study was conducted among the residents of two care homes for the elderly situated in the greater Hyderabad Municipal Corporation, around 8 km and 5 km respectively away from Hyderabad City, in the state of Andhra Pradesh, India. The study was carried out between January and March 2013 and included all the residents of the two care homes who were willing to participate voluntarily.

Sample size and sampling technique:

A total 127 elderly persons (aged ≥ 60 years) lived in the two care homes. Of these, 96.9% (123/127) voluntarily participated in the study. A total of nine individuals were excluded from the study, for various reasons (six were seriously ill and confined to bed owing to the presence of comorbidities during the data collection and another three were not willing to fast overnight). Thus, a total 114 elderly persons were included in the study.

Ethical issues approval

The study was approved by the institutional ethical committee of the National Institute of Nutrition, Hyderabad, India. The purpose and outcome, as well as the methods of study were explained to the management authority of the residential care homes, to ensure sustained cooperation. Informed written consent was obtained from each of the study participants. Those who were found to have either metabolic syndrome or modifiable risk factors for development of chronic lifestyle disorders were taken to the nearest Gandhi Hospital for further management.

Data collection and measurements

After obtaining the necessary permission from the management authorities of the care homes, and informed written consent from the study participants, a trained person interviewed the elderly residents using a pretested and predesigned structured questionnaire to collect information on individual characteristics (e.g. age, sex, educational level, history of cardiovascular diseases, diabetes or hypertension, etc.) and personal habits (e.g. type of diet [vegetarian or non-vegetarian], tobacco use and alcohol intake). The types of tobacco used considered in the present study included smoked (cigarettes, beedis and cigars), oral (chewed tobacco, pan masala, etc.) and inhaled forms (snuff) of tobacco. For tobacco use and alcohol consumption, current users were considered to be those who had been using for least one year continuously (smoking one small [ten-cigarette] pack or more per day; chewing betel nut/pan masala 3–4 times or more per day; inhaling snuff 3–4 times or more per day; consuming alcohol 3 times or more per week, irrespective of the quantity of alcohol) without interruption. Former users were those who had ever used previously (total lifetime consumption of >100 packs; chewing betel nut/pan masala 3–4 times or more per day; inhaling snuff 3–4 times or more per day; consuming alcohol 3 times or more per week, irrespective of the quantity of alcohol) but had stopped using more than one year ago. A never user was an individual who had never used, apart from occasional social intake.

The physical activity or performance status of the subjects was assessed by modified ECOG (Eastern Cooperative Oncology Group) scale, as reported by Lin et al.⁹ The initial ECOG was defined in five categories:

- ECOG 0: fully active, able to carry on all pre-disease performance without restriction
- ECOG 1: restricted in strenuous physical activities, but ambulatory and able to carry out work of a light or sedentary nature, e.g. light housework, office work, etc.
- ECOG 2: ambulatory and capable of all self-care needs, but unable to carry out any work activities whatsoever, though up and about for more than 50% of their waking hours
- ECOG 3: capable of performing only limited self-care needs, confined to bed or a chair for more than 50% of their waking hours
- ECOG 4: completely disabled, unable to carry on by themselves, totally confined to bed or a chair.

The modified ECOG grading used was as follows:

- ECOG Grade 1: ECOG 0
- ECOG Grade 2: ECOG 1 or 2
- ECOG Grade 3: ECOG 3 or 4.

Subjects' pattern of physical exercise was assessed by means of the total time spent each day walking and/or engaging in regular exercise, such as yoga or pranayama, or any other forms of exercise (for at least 30 minutes per day for a minimum of 5 days per week).

Anthropometric measurements like weight and height were obtained using a digital weighing scale and portable stadiometer (both manufactured by SECA, Germany), using standard techniques to measure to the nearest 0.1 kg and 0.1 cm respectively. Waist circumference was also measured to the nearest 0.1 cm, at the end of normal expiration, on subjects with a bare belly, using a flexible fibreglass measuring tape positioned midway between the lowermost infracostal margin and the highest point of the iliac crest at the level of the mid-axillary line.¹⁰ For interpretation of anthropometric measurements, body mass index (BMI) was calculated as weight divided by height squared (kg/m^2). For cut-off values of BMI, the World Health Organization (WHO) recommendations for defining moderate to high health risks associated with BMI amongst Asians were used.¹¹ Blood pressure was recorded three times (to the nearest 2 mmHg), using a mercury sphygmomanometer (Diamond Co, India) on the right arm, with subjects in a sitting position and a 10-minute rest before each recording. The mean of the lowest two readings of systolic and diastolic blood pressures was recorded.

Biochemical analysis

About 10 mL of blood was taken from each participant after overnight fasting. Fasting blood glucose was measured by the glucose oxidase–peroxidase method.¹² Serum triglyceride was measured by the GPO-PAP (glycerol phosphate oxidase-*p*-aminophenazone) method,¹³ and high-density lipoprotein (HDL) cholesterol by an enzymatic colorimetric test, using a Hitachi 747 auto analyser.¹⁴

Definition of metabolic syndrome

The 2005 criteria of the International Diabetes Federation (IDF) were used to define metabolic syndrome.¹⁵ To diagnose central obesity, the ethnic-specific (for south Asians) cut-off value of waist circumference was used.¹⁵ Thus, metabolic syndrome was defined as:

1. the presence of central obesity (waist circumference ≥ 90 cm in men and ≥ 80 cm in women), *plus* ≥ 2 of the following following criteria:
2. blood pressure $\geq 130/85$ mmHg or taking drug treatment for hypertension;
3. serum triglyceride ≥ 150 mg/dL or taking specific treatment for this lipid abnormality;
4. serum HDL cholesterol (HDLc) < 40 mg/dL in men and < 50 mg/dL in women, or taking specific treatment for this lipid abnormality;
5. fasting blood glucose ≥ 100 mg/dL, or previously diagnosed type 2 diabetes and taking specific drug treatment.

Statistical analysis

Statistical analysis was done using the SPSS 12.0.1 software package (SPSS for windows, version 12.0.1.2001.Chicago: SPSS Inc.). The continuous variables were presented by mean

and standard deviation and categorical variables expressed in percentages. The chi squared test was applied to test for associations between two categorical variables. Univariable logistic regression was applied to investigate associations between metabolic syndrome and known risk factors. An adjusted analysis was performed using a multivariable logistic regression for any factor that was found to be significant on unadjusted analysis. For all statistical tests, $P < 0.05$ was considered as statistically significant.

RESULTS

Study subjects

The baseline characteristics of the study participants are given in Table 1. Regarding modifiable factors, most participants (66.7%; 76/114) were primarily non-vegetarian. Among the study participants, 13.2% (15/114) gave a history of any form of current tobacco use, while another 26.3% (30/114) gave a past history of use. Regarding alcohol intake, 5.3% (6/114) of participants gave a history of current alcohol consumption and another 21.9% (25/114) were former drinkers. Nearly half of the study participants (48.2%; 55/114) had BMI cut-off values (≥ 23 kg/m^2) associated with mild to moderate health risks as per WHO recommendations for Asian populations.¹¹ While considering physical activity, one quarter (25.4%; 29/114) of the study participants were found to be fully active and able to carry out all work without any restriction (modified ECOG Grade 1). Another one third (32.5%; 37/114) were found to be ambulatory but mainly sedentary, restricted in strenuous physical activities and able to carry out light work, including all self-care needs (modified ECOG Grade 2), and the remaining 42.1% (48/114) were either capable of performing only limited self-care, confined to bed or a chair for $> 50\%$ of their working hours or completely disabled (modified ECOG Grade 3). Among the study participants, 30.7% (35/114) never engaged in any form of exercise (see Table 1).

Cardiometabolic characteristics

Among the 114 study participants, 49.1% (56/114) had been previously diagnosed with hypertension and were taking antihypertensive drugs; 29.8% (34/114) were taking antidiabetes drugs for type 2 diabetes; 14.0% (16/114) were taking antidyslipidaemic drugs; and 42.1% (48/114) fulfilled the criteria for metabolic syndrome. The participants' cardiometabolic parameters are summarized in Table 2.

Components of metabolic syndrome

The prevalence of central obesity in the study participants was 59.6% (68/114). Also, 72.2% (88/114) either had raised blood pressure or were taking drug treatment for hypertension. Serum triglyceride levels were raised among 28.1% (32/114) of the elderly subjects, while 23.7% (27/114) either had lower serum HDLc levels than cut-off values or were taking antidyslipidaemic medication. Raised fasting blood glucose or previously diagnosed type 2 diabetes was present in 47.4% (54/114) (see Table 3).

Table 1. Baseline characteristics of the study participants

Baseline characteristics	Number (n = 114)	Percentage	Baseline characteristics	Number (n = 114)	Percentage
Age group, years			Type of diet		
60–69	32	28.1	Vegetarian	38	33.3
70–79	43	37.7	Non-vegetarian	76	66.7
≥80	39	34.2	Physical activity (modified ECOG grade) ^a		
Sex			Grade 1	29	25.4
Male	61	53.5	Grade 2	37	32.5
Female	53	46.5	Grade 3	48	42.1
Caste			Physical exercise		
General	58	50.9	≥30 min/day, ≥5 days/week	30	26.3
Other backward caste	48	42.1	<30 min/day	49	43.0
Scheduled caste/scheduled tribe	8	7.0	Never	35	30.7
Religion			Tobacco use		
Christian	75	65.8	Current	15	13.2
Other	39	34.2	Ex-tobacco user	30	26.3
Reason for living in a care home for the elderly			Never	69	60.5
No children	12	10.5	Alcohol consumption		
Children not taken responsibility for care	49	43.0	Current	6	5.3
Destitute	8	7.0	Ex-drinker	25	21.9
Other	45	39.5	Never	83	72.8
Education			BMI, kg/m ²		
Illiterate	38	33.3	<23	59	51.8
Up to secondary	64	56.1	≥23	55	48.2
More than secondary	12	10.5	Waist circumference, cm		
Previous occupation			≥90 (men); ≥80 (women)	66	57.9
Unemployed/housework	21	18.4	<90 (men); <80 (women)	48	42.1
Skilled worker	17	15.0			
Agriculture (land owner)	21	18.4			
Unskilled worker	25	21.9			
Service and business	30	26.3			

BMI: body mass index; ECOG: Eastern Cooperative Oncology Group.

^aModified ECOG scale:

- ECOG Grade 1: fully active, able to carry on all pre-disease performance without restriction
- ECOG Grade 2: restricted in strenuous physical activities, but ambulatory and able to carry out work of a light or sedentary nature, e.g. light housework, office work, etc., or ambulatory and capable of all self-care needs, but unable to carry out any work activities whatsoever, though up and about for more than 50% of their waking hours.
- ECOG Grade 3: capable of performing only limited self-care needs, confined to bed or a chair for more than 50% of their waking hours, or completely disabled, unable to carry on by themselves, totally confined to bed or a chair.

Table 2. Mean values of cardiometabolic parameters of the study participants

Cardiometabolic parameters	Mean (SD)		
	Metabolic syndrome (n = 48)	No metabolic syndrome (n = 66)	Total (n = 114)
Systolic blood pressure (mmHg)	146.0 (6.3)	130.0 (9.7)	138.0 (11.6)
Diastolic blood pressure (mmHg)	96.2 (3.8)	88.0 (3.8)	92.0 (5.5)
Waist circumference (cm)	91.7 (2.7)	78.4 (5.6)	85.2 (8.0)
Body mass index (kg/m ²)	25.2 (2.8)	22.0 (3.8)	23.6 (3.8)
Serum triglyceride (mg/dL)	155.4 (10.2)	123.4 (7.7)	139.4 (18.1)
Serum HDL cholesterol (mg/dL)	38.4 (3.2)	46.4 (3.6)	32.4 (5.2)
Fasting blood glucose (mg/dL)	114.6 (10.9)	74.6 (3.4)	94.6 (21.3)

HDL: high-density lipoprotein; SD: standard deviation.

Table 3. Proportions of components of metabolic syndrome among the study participants

Component of metabolic syndrome	Number (%) with metabolic syndrome (n = 48)	Number (%) with no metabolic syndrome (n = 66)	Total number (%) (n = 114)
High blood pressure ($\geq 130/85$ mmHg) or taking drug treatment for hypertension	46 (95.8)	42 (63.6)	88 (77.2)
Central obesity (waist circumference ≥ 90 cm in men and ≥ 80 cm in women]	48 (100.0)	20 (30.3)	68 (59.6)
Raised serum triglycerides (≥ 150 mg/dL) or taking specific drug treatment for this lipid abnormality	23 (47.9)	9 (13.6)	32 (28.1)
Serum HDLc < 40 mg/dL in men and < 50 mg/dL in women or taking specific drug treatment for this	19 (39.6)	8 (12.1)	27 (23.7)
Fasting blood glucose ≥ 100 mg/dL or previously diagnosed type 2 diabetes taking specific drug treatment	38 (79.2)	16 (24.2)	54 (47.4)

HDLc: high-density lipoprotein cholesterol.

^aAs per IDF 2005 criteria.¹⁵

Table 4. Prevalence of and associated risk factors for metabolic syndrome

Variables	Total number (%)	Number (%) with metabolic syndrome	Crude OR (95% CI)	Adjusted OR (95% CI)
Overall ^a	114 (100)	48 (42.1)	—	
Age group, years				
60–69	32 (28.1)	13 (40.6)	1.00	NA
70–79	43 (37.7)	17 (39.5)	0.96 (0.34–2.71)	
≥80	39 (34.2)	18 (46.2)	1.25 (0.44–3.59)	
Sex				
Male	61 (53.5)	21 (34.4)	1.00	NA
Female	53 (46.5)	27 (50.9)	1.97 (0.93–4.21)	
Caste				
General	58 (50.9)	26 (44.8)	1.35 (0.24–9.50)	NA
Other backward caste	48 (42.1)	19 (39.6)	1.09 (0.19–7.85)	
Scheduled caste/scheduled tribe	8 (7.0)	03 (37.5)	1.00	
Religion				
Christian	75 (65.8)	30 (40.0)	1.00	NA
Other	39 (34.2)	18 (46.2)	1.29 (0.55–3.01)	
Education				
Illiterate	38 (33.3)	16 (42.1)	1.45 (0.32–7.73)	NA
Up to secondary	64 (56.1)	28 (43.8)	1.56 (0.37–7.75)	
More than secondary	12 (10.6)	4 (33.3)	1.00	
Type of diet				
Vegetarian	38 (33.3)	15 (39.5)	1.00	NA
Non-vegetarian	76 (66.7)	33 (43.4)	1.18 (0.50–2.83)	
Physical activity (modified ECOG grade) ^b				
Grade 1	29 (25.4)	16 (55.2)	1.00	NA
Grade 2	37 (32.5)	14 (37.8)	0.49 (0.16–1.48)	
Grade 3	48 (42.1)	18 (37.5)	0.49 (0.17–1.38)	
Physical exercise				
≥30 min/day, ≥5 days/week	30 (26.3)	14 (46.7)	1.00	NA
<30 min/day	49 (43.0)	19 (38.8)	0.72 (0.26–2.01)	
Never	35 (30.7)	15 (42.9)	0.86 (0.29–2.56)	
Tobacco use, current and ever				
Yes	45 (39.5)	17 (37.8)	0.74 (0.32–1.71)	NA
No	69 (60.5)	31 (44.9)	1.00	

Variables	Total number (%)	Number (%) with metabolic syndrome	Crude OR (95% CI)	Adjusted OR (95% CI)
Alcohol consumption, current and ever				
Yes	31 (27.2)	9 (29.0)	0.46 (0.17–1.20)	NA
No	83 (72.8)	39 (47.0)	1.00	
BMI, kg/m ²				
<23	59 (51.8)	11 (18.6)	1.00	
≥23	55 (48.2)	37 (67.3)	8.97 (3.78–21.28)	9.31 ^c (4.12–22.14)

BMI: body mass index; CI: confidence interval; NA: not available; OR: odds ratio.

^aAs per the 2005 criteria of the International Diabetes Federation.¹⁵

^bModified ECOG scale:

- ECOG Grade 1: fully active, able to carry on all pre-disease performance without restriction
- ECOG Grade 2: restricted in strenuous physical activities, but ambulatory and able to carry out work of a light or sedentary nature, e.g. light housework, office work, etc., or ambulatory and capable of all self-care needs, but unable to carry out any work activities whatsoever, though up and about for more than 50% of their waking hours.
- ECOG Grade 3: capable of performing only limited self-care needs, confined to bed or a chair for more than 50% of their waking hours, or completely disabled, unable to carry on by themselves, totally confined to bed or a chair.

^cVariables adjusted for: age, sex, type of diet, tobacco use, alcohol intake, physical activity status and physical exercise.

Metabolic syndrome and risk factors

The overall prevalence of metabolic syndrome among the study participants, as defined by IDF 2005 criteria,¹⁵ was 42.1% (48/114). The proportions with metabolic syndrome did not differ significantly by age group, sex, caste, religion, type of diet (vegetarian or non-vegetarian), educational status, behavioural factors such as tobacco use and alcohol intake, physical activity (assessed by modified ECOG scale), or physical exercise (see Table 4). However, in univariable analysis, BMI was found to be strongly associated with metabolic syndrome (crude odds ratio [OR]: 8.97; 95% confidence interval [CI]: 3.78–21.28). In multivariable logistic regression, after adjustment for age, sex, caste, religion, type of diet (vegetarian or non-vegetarian), tobacco use, alcohol intake, physical activity status, and physical exercise, elderly subjects with BMI ≥23 kg/m² had 9.31 times (95% CI: 4.12–22.14) higher odds of metabolic syndrome as compared to those with BMI <23 kg/m² (see Table 4).

DISCUSSION

In the elderly population investigated in this study, the overall prevalence of metabolic syndrome was found to be 42.1%, with a higher prevalence among women (50.9%) than men (34.4%). Although a similar study among an elderly population from south India living in a care home for the elderly, which used the same IDF 2005 criteria, reported a much higher prevalence of metabolic syndrome (57%), the higher prevalence among women reported in the present study was also found in this study from South India.¹⁶ A study from north India reported a similar prevalence (40.2%) among urban adults (≥18 years).¹⁷ He et al.

reported a prevalence of metabolic syndrome of 46.3% among an elderly population in China and also a higher prevalence (54.1%) among women, which was very similar to the present findings.¹⁸ Another study from the United States of America reported a similar prevalence (43.5% and 42.0% in individuals aged 60–69 years and ≥70 years respectively).¹⁹ However, a few studies from Taiwan reported a lower prevalence of metabolic syndrome in an elderly population, ranging from 21.5% to 30.2%.^{20–22} The differences in prevalence were probably due to different criteria used for metabolic syndrome. All of the above studies, including the present one, found a higher prevalence among women than men. In the present study, a higher prevalence of metabolic syndrome among elderly women was probably due to hormonal effects after menopause. Lin et al. also demonstrated a higher prevalence of metabolic syndrome among postmenopausal women than among premenopausal women.²³

The majority of Indian studies have reported a lower prevalence of metabolic syndrome than found in the present study, ranging from 9.3% to 31.4%, probably because of the lower age (<60 years) of study participants.^{24–26} Many studies have evidenced that metabolic syndrome increases with age, and is more prevalent among smokers, consumers of alcohol and those who undertake less physical activity.^{17,26–29} However, in the present study, metabolic syndrome was not significantly associated with age, type of diet (vegetarian versus non-vegetarian), personal habits such as intake of tobacco and alcohol, physical activity, or physical exercise. The majority of published studies have been conducted among a general adolescent and adult population; thus their findings differed from the present study, which was conducted only among an elderly population.

Conclusion

There is definite cause for concern regarding the high prevalence of metabolic syndrome among the elderly population in this study, since both this demographic segment and the prevalence of metabolic syndrome are showing a fast-rising trend in India, as a result of rapid changes in sociodemographic, lifestyle and disease-related factors. This cross-sectional study was limited to elderly care-home residents and used a small sample size, thus the findings cannot be generalized. Further cohort studies are necessary to ascertain the exact situation and possible correlates of metabolic syndrome among the general elderly population in India and elsewhere.

This issue calls for urgent attention by health-care providers and policy-makers, since awareness and identification of cardiometabolic risk factors in older persons is important for the prevention of consequent cardiovascular diseases and diabetes.

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Prevalence of hypercholesterolaemia among adults aged over 30 years in a rural area of north Kerala, India: a cross-sectional study

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ABSTRACT

Background: Cardiovascular disease is a leading cause of death in India. In order to reduce the burden of the disease, it is important to know the level of modifiable risk factors in the population. The aim of this study was to estimate the prevalence of hypercholesterolaemia and associated factors among the population aged over 30 years in a rural area in north Kerala, India.

Methods: A cross-sectional study was carried out to find the prevalence of hypercholesterolaemia among 533 residents of Kulappuram village. The fasting blood glucose level, total serum cholesterol level, blood pressure and body mass index of the residents were also assessed. The significance of association of hypercholesterolaemia with age, sex, body mass index and blood pressure was tested using the chi-squared test. Logistic regression was carried out to estimate the adjusted odds ratios (OR).

Results: The prevalence of hypercholesterolaemia was 63.8%. It was more prevalent in women (adjusted OR: 1.56; 95% confidence interval [CI]: 1.07–2.27), in those with body mass index in the range 23.0–24.9 kg/m² (adjusted OR: 1.78; 95% CI: 1.04–3.02) and in those with blood pressure \geq 140/90 mmHg (adjusted OR: 1.62; 95% CI: 1.1–2.38).

Conclusion: The prevalence of hypercholesterolaemia is high in the study population.

Key words: hypercholesterolaemia, India, prevalence, rural

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BACKGROUND

Cardiovascular disease is the leading cause of morbidity and mortality among the population of India. It contributes to nearly one quarter of the deaths in the working age group of 25–65 years in the country.^{1,2} The average age of onset of cardiovascular disease is found to be lower among Indians when compared to other populations.³ A rise in the prevalence of cardiovascular disease has been attributed to changes in lifestyle and dietary practices in the country.⁴

The total serum cholesterol level is considered to be an important modifiable risk factor for cardiovascular disease.⁵ Studies from different parts of India show that the prevalence of hypercholesterolaemia is high among Indians.^{6–8} Surveillance

of cardiovascular risk factors conducted by the Indian Council of Medical Research (ICMR) in different Indian states showed that the urban Indian population has a higher prevalence of hypercholesterolaemia than the rural population.⁹ Considerable differences in the prevalence of hypercholesterolaemia were observed among rural populations in different Indian states, with Kerala reporting the highest prevalence.⁹ Kerala is one state in India with a high burden of cardiovascular disease,¹⁰ but there is no significant difference in the prevalence of cardiovascular risk factors in the urban and rural populations in Kerala.¹¹ A possible explanation for this might be the fact that the state is undergoing rapid urban transformation, with increasing numbers of the population in rural areas engaging in non-agricultural occupations.¹²

In order to formulate plans to reduce the morbidity associated with cardiovascular disease, it is important to assess the level of risk factors in the population. Hence, this study was carried out to estimate the prevalence of hypercholesterolaemia among the population aged over 30 years in Kulappuram village, Kannur district in Kerala and to study the relationship between hypercholesterolaemia and age, sex, body mass index (BMI), fasting blood glucose and blood pressure.

METHODS

The study was carried out in Kulappuram village, which comes under Cheruthazham Panchayat in Kannur district, Kerala. The village has a total of 520 houses and 2206 residents. The local nongovernmental organization, Kulappuram Vayanashala, in association with the Department of Community Medicine, Pariyaram Medical College is running a health-promotion initiative in the area, "the model health village project". Various health-education and screening activities are carried out through the project. For the project, the village is divided into 20 clusters based on geography.

As a part of the health-promotion and screening campaign, a series of screening camps were organized in Kulappuram village by Kulappuram Vayanashala, in association with the Department of Community Medicine, Pariyaram Medical College, to screen for diabetes, hypertension and hypercholesterolaemia. For the campaign, volunteers conducted house visits to identify persons aged 30 years or more and encouraged them to attend the screening camp for investigation. A total of five screening camps were conducted, with one camp for four clusters. Screening was done between December 2011 and January 2012.

In the screening camp, blood samples were collected after 10–12 h of overnight fasting. The fasting levels of blood glucose and total serum cholesterol were analysed using a standard automated procedure (Beckman Coulter AU400 autoanalyser, 2009). Blood glucose was estimated by end-point method, using the hexokinase glucose-6-phosphate dehydrogenase method, and serum cholesterol was estimated using the CHOP-PAP (cholesterol oxidase/peroxidase, phenol, 4-aminoantipyrine) method. Blood pressure measurement was carried out on the right arm of seated subjects, using a mercury sphygmomanometer (Diamond 2009, precision 2 mmHg). The height of the participants was measured (to the nearest millimetre) using a stadiometer (Seca 213) while they were standing erect without footwear and with their head positioned such that the external auditory meatus was level with the inferior margin of the orbit. Weight was measured (to the nearest 0.5 kg) using a mechanical weighing scale (Krupps, 2009) while subjects were standing unsupported without footwear or heavy clothing. The results of the screening were entered into a screening record and a copy was given to the participants through the community volunteers. The participants with a fasting blood glucose >125 mg/dL and fasting serum cholesterol >199 mg/dL were referred for a free physician consultation at Pariyaram Medical College.

For the current study, the data in the screening records were reviewed to estimate the prevalence of hypercholesterolaemia among the participants who had attended the screening camp. Clearance for analysis of the records was obtained from the ethics committee of the Academy of Medical Sciences, Pariyaram. The data were entered using EpiData version 3.1 software and analysed using EpiInfo 7.1.1.14 (Centers for Disease Control and Prevention, Atlanta, United States of America). A total serum cholesterol level of ≥ 200 mg/dL was considered as hypercholesterolaemia. The significance of association of hypercholesterolaemia with age, sex, BMI and blood pressure was tested using the chi-squared test. Logistic regression was carried out to estimate the adjusted odds ratio (OR).

RESULTS

In the study area, all the 1070 persons aged above 30 years were contacted by home visit and encouraged to attend screening by the volunteers. Of these, 533 attended the screening programme. Table 1 shows the general characteristics of the study participants. Women constituted 61.9% of the total sample. BMI was ≥ 25 kg/m² in 32.6% of the participants and ranged between 23 kg/m² and 24.9 kg/m² in 18.2% of the participants. The fasting blood glucose was >126 mg/dL in 9.2% and was in the range 110–126 mg/dL in 7.9% of the participants. Blood pressure of <140/90 mmHg was seen in only 46% of the study participants.

The proportion of participants with hypercholesterolaemia (total cholesterol level ≥ 200 mg/dL) was 63.8%. The total cholesterol level ranged between 200 mg/dL and 239 mg/dL in 44.7% and was above 240 mg/dL in 19.1% of the study participants. Table 2 shows that the prevalence of hypercholesterolaemia was similar across different age groups and was higher in women (67.6%) than men (57.6%; $P = 0.02$). It was also more prevalent in those who had a BMI ≥ 25 kg/m² (69%) and in those with BMI in the range 23–24.9 kg/m² (71.1%) when compared to normal (18–22.9 kg/m²; 59%). No statistically significant relationship was found between fasting blood glucose level and hypercholesterolaemia.

Hypercholesterolaemia was seen more in those who had either systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg (68.8%) when compared with those who had blood pressure <140/90 mmHg (58%) ($P < 0.001$). Among those who had diastolic blood pressure in the range 90–99 mmHg and those with diastolic blood pressure ≥ 100 mmHg, the prevalence of hypercholesterolaemia was 71.1% and 69.2% respectively. This was found to be significantly higher than in those with diastolic blood pressure <80 mmHg (51.3%) ($P = 0.008$).

Logistic regression analysis (see Table 3) showed that the odds of having hypercholesterolaemia were higher in women than in men (adjusted OR: 1.56; 95% confidence interval [CI]: 1.07–2.27). Also, a significant association was seen with a BMI in the range 23.0–24.9 kg/m² (adjusted OR: 1.78; 95% CI: 1.04–3.02) and blood pressure $\geq 140/90$ mmHg (adjusted OR: 1.62; 95% CI: 1.1–2.38).

Table 1. Characteristics of study participants (n = 533)

Characteristics	Frequency	Percentage
Age group, years		
30–39	43	8.1
40–49	172	32.3
50–59	145	27.2
≥60	173	32.5
Sex		
Men	203	38.1
Women	330	61.9
Body mass index, kg/m ²		
<18.5	67	12.6
18.5–22.9	195	36.6
23–24.9	97	18.2
≥25	174	32.6
Fasting blood glucose (mg/dL)		
<110	442	82.9
110–126	42	7.9
>126	49	9.2
Systolic blood pressure, mmHg		
<120	97	18.2
120–139	211	39.6
140–159	169	31.7
≥160	56	10.5
Diastolic blood pressure, mmHg		
<80	113	21.2
80–89	207	38.8
90–99	135	25.3
≥100	78	14.6
Blood pressure control		
Systolic pressure <140 mmHg and diastolic pressure <90 mmHg	245	46.0
Systolic pressure ≥140 mmHg or diastolic pressure ≥90 mmHg	288	54.0

DISCUSSION

Hypercholesterolaemia was found in 63.8% of the participants of this study. Studies carried out in rural populations of other Indian states in the past decade have reported prevalences of hypercholesterolaemia in the range of 12–30%.^{6,13–15} The prevalence in the study sample was found to be more than double that reported in other rural Indian populations.^{6,13–15} The prevalence was also higher than that in the urban Indian population, which has been reported to range between 19% and 44%.^{6,14–17} However, the result was similar to the findings of studies conducted in rural population in central and southern Kerala, which report a prevalence between 37% and 57%.^{8,11} The prevalence of hypercholesterolaemia in the study sample

was more than the global average of 39% reported by the World Health Organization.¹⁸

Hypercholesterolaemia was found to be more prevalent in women, in those with high BMI (23.5–24.9 kg/m²) and in those with blood pressure ≥140/90 mmHg. A similar association with female sex, high BMI and hypertension was seen in the ICMR–INDIAB (India Diabetes) study.⁶ In the present study, the prevalence of hypercholesterolaemia was similar in different age groups; this is in sharp contrast to other studies, which report an increase in prevalence with advanced age. In the present study, even the young age group of 30–39 years had a prevalence of 54%. A similar result (49%) was found in participants aged 25–35 years in a study in Kerala by Thankappan et al. in 2009.¹¹

Table 2. Prevalence of hypercholesterolaemia in different groups based on demography, anthropometry, fasting blood glucose and blood pressure (n = 533)

Characteristics	Serum total cholesterol				Chi-squared P value
	<200 mg/dL		≥200 mg/dL		
	n	%	n	%	
Age group, years					
30–39	20	46.5	23	53.5	0.2
40–49	59	34.3	113	65.7	
50–59	46	31.7	99	68.3	
≥60	68	39.3	105	60.7	
Sex					
Men	86	42.4	117	57.6	0.02
Women	107	32.4	223	67.6	
Body mass index, kg/m ²					
<18.5	31	46.3	36	53.7	0.02
18.5–22.9	80	41.0	115	59.0	
23–24.9	28	28.9	69	71.1	
≥25	54	31.0	120	69.0	
Fasting blood glucose (mg/dL)					
<110	161	36.4	281	63.6	0.6
110–126	17	40.5	25	59.5	
>126	15	30.6	34	69.4	
Systolic blood pressure, mmHg					
<120	37	38.5	59	61.5	0.7
120–139	77	36.3	135	63.7	
140–159	62	36.7	107	63.3	
≥160	17	30.4	39	69.6	
Diastolic blood pressure, mmHg					
<80	55	48.7	58	51.3	0.008
80–89	75	36.2	132	63.8	
90–99	39	28.9	96	71.1	
≥100	24	30.8	54	69.2	
Blood pressure control					
Systolic pressure <140 mmHg and diastolic pressure <90 mmHg	103	42.0	142	58.0	0.01
Systolic pressure ≥140 mmHg or diastolic pressure ≥90 mmHg	90	31.3	198	68.8	
Total	193	36.2	340	63.8	

Table 3. Factors associated with hypercholesterolaemia in the study sample (n = 533)

Characteristics	Crude odds ratio	95% CI	Adjusted odds ratio	95% CI
Fasting blood glucose, mg/dL				
<110	Reference			
110–126	0.84	0.44–1.61	0.79	0.40–1.54
>126	1.30	0.68–2.45	1.18	0.61–2.30
Age group, years				
30–39	Reference			
40–49	1.67	0.85–3.28	1.56	0.78–3.11
50–59	1.87	0.94–3.75	1.75	0.86–3.57
≥60	1.34	0.69–2.63	1.20	0.59–2.42
Sex				
Men	Reference			
Women	1.53	1.07–2.2	1.56	1.07–2.27
Body mass index, kg/m ²				
<18.5	0.81	0.46–1.41	0.80	0.45–1.42
18.5–22.9	Reference			
23–24.9	1.71	1.02–2.89	1.78	1.04–3.02
≥25	1.55	1.01–2.38	1.34	0.86–2.10
Blood pressure control				
Systolic pressure <140 mmHg and diastolic pressure <90 mmHg	Reference			
Systolic pressure ≥140 mmHg or diastolic pressure ≥90 mmHg	1.59	1.12	1.62	1.10

CI: confidence interval.

It is important to consider the factors that can explain the high burden of hypercholesterolaemia in the study population. Low physical activity and high intake of saturated fat and red meat are some of the factors that are traditionally attributed to hypercholesterolaemia.¹⁹ The ICMR noncommunicable diseases risk factor survey in Kerala showed that more than 95% of households in Kerala are using oils like coconut oil or palm oil, which have a saturated fatty acid content of more than 90%. The use of oils that are rich in saturated fats is low in all other states in which surveys have been carried out. The daily consumption of food items that are rich in saturated fats and cholesterol, like fried foods, red meat and eggs is also high in the state.²⁰ The level of physical activity was found to be low in 75% of the population aged over 15 years in the state.²⁰ A study conducted in the same area showed that a low level of physical activity was seen among 66% of the population aged over 15 years.²¹

The study has certain limitations. Individuals who were eligible for the study were identified by home visits and were encouraged to attend a screening camp organized in their vicinity. As the response rate was only 50%, this process may have resulted in an over-estimation of prevalence. However, a prevalence of 32% is seen even when it is estimated by using the total population

aged over 30 years as the denominator (340/1070). This is still higher than that seen in studies from north India. Also, the study only assessed the prevalence of hypercholesterolaemia, which is only one form of dyslipidaemia. Measurements of the levels of high-density lipoprotein (HDL), low-density lipoprotein (LDL) and triglycerides are needed to ascertain the true extent of dyslipidaemia in the population. Another limitation is that the study did not assess the presence of behavioural risk factors in cardiovascular disease, such as physical activity, misuse of alcohol, diet and central obesity.

Conclusion

The study concludes that the prevalence of hypercholesterolaemia is high in this study population in rural Kerala. In order to reduce the burden of cardiovascular diseases, efforts need to be made to reduce the prevalence of modifiable risk factors like hypercholesterolaemia. Practices like diet modification and recreational physical activity should be encouraged to achieve this aim. As a high prevalence of hypercholesterolaemia was seen even in younger age groups, early screening should be carried out.

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