



Type 2 diabetes in south Asia 3

Public health and health systems: implications for the prevention and management of type 2 diabetes in south Asia

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Many non-communicable chronic diseases, including type 2 diabetes, are highly prevalent, costly, and largely preventable. The prevention and management of type 2 diabetes in south Asia requires a combination of lifestyle changes and long-term health-care management. However, public health and health-care systems in south Asian countries face serious challenges, including the need to provide services to many people with inadequate resources, and substantial between-population and within-population inequalities. In this Series paper, we explore the importance and particular challenges of public health and health systems in south Asian countries (Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka) with respect to the provision of culturally appropriate lifestyle modification to prevent and manage diabetes, especially in resource-poor settings. Effective primary prevention strategies are urgently needed to counter risk factors and behaviours preconception, in utero, in infancy, and during childhood and adolescence. A concerted focus on education, training, and capacity building at the community level would ensure the more widespread use of non-physician care, including community health workers. Major investment from governments and other sources will be essential to achieve substantial improvements in the prevention and management of type 2 diabetes in the region.

Introduction

The ambitious WHO Global Action Plan for the Prevention and Control of Non-Communicable Diseases (NCDs) 2013–2020 has been widely adopted in south Asian countries.¹ By backing the more recent UN Sustainable Development Goals agenda, countries in the region have further committed to universal health coverage by 2030. Fully realised, universal health coverage would see most of the population having reasonable access to preventive, primary, and hospital care without financial hardship.² However, at present, national health-care systems in south Asia (Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka) and other regions³ face serious challenges from massive socio-demographic and lifestyle transitions and increasing burdens of NCDs, including type 2 diabetes.⁴

As in other world regions, such as sub-Saharan Africa,³ the full extent and potential burden of diabetes in south Asia is unknown. The epidemiology of type 2 diabetes in south Asia is addressed in detail in Paper 1 of the Series.⁵ Important advances in health care, including new technology and pharmaceutical products, exist alongside traditional health practices. A notable contrast exists between the expectations of the more affluent and educated segments of society in each country and their demands for greater access to health services, and people of lower socioeconomic status, among whom awareness of NCDs is low, with many people not able to access even basic health care.^{4,6}

In this Series paper, we address public health and health system challenges in resource-poor settings in south Asia. Focusing on simple and inexpensive

interventions,^{3,7} we detail opportunities for better use of lifestyle changes (nutrition and physical activity) in the prevention and management of diabetes,^{8,9} while also discussing approaches to improve health systems to better deal with the increasing burden of type 2 diabetes. Other papers in this Series address the epidemiology and determinants of type 2 diabetes⁵ and clinical management of type 2 diabetes¹⁰ in the south Asian context.

Public health challenges in south Asia

Overview

South Asia is home to nearly a quarter of the global population, many of whom are among the poorest people in the world. The region is characterised by great

Key messages

- The greatest population-level benefits in terms of prevention and management of type 2 diabetes are likely to come from modest investments in lifestyle modification
- Strategies to address the low levels of awareness and lack of education of patients and health professionals with respect to diabetes are urgently needed, including training and capacity building at the community level
- Non-medical personnel (eg, teachers) can be efficient disseminators of health information with respect to healthy lifestyles
- Substantial government, non-governmental, and private or philanthropic investment is necessary to finance and build multisectoral capacity for effective multilevel strategies to improve prevention of type 2 diabetes

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This is the third in a Series of three papers about type 2 diabetes in south Asia

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variability in country-level health systems and the management of public health. This situation is partly driven by increasing health costs, disparate within-country and between-country health services and health profession workforces, natural disasters, progressively ageing populations,^{11,12} and increased demand for care.¹³ As discussed in paper 1 of this Series,⁵ low physical activity, increased inactivity and sedentary behaviours, and a rapid escalation in overweight and obesity are key contributors to the increased prevalence of type 2 diabetes. NCDs, including type 2 diabetes, are among the most prevalent, costly, but preventable health problems and require lifestyle changes and long-term health-care management.

Disparate health systems

Health systems in south Asia are highly disparate, which impacts both preventive efforts and the management of existing patients with diabetes. For example, India has a massive population, devolved state-based health systems, and a large private health sector, and out-of-pocket payment for care is widespread. The heavily privatised Indian health system accounts for more than 78% of care, whereas public expenditure is low.¹⁴ Over 70% of the population live in rural settings often in poverty, where awareness and diagnosis of diabetes is low, and access to health care is poor.¹⁵⁻¹⁷ The Indian health system contrasts sharply with the Sri Lankan system, which is characterised by central funding of public health staff and services, standardised training and recruitment of the health workforce, and grassroots service delivery. Indeed, Sri Lanka is an acknowledged leader in health-care provision in the region, having achieved low maternal and neonatal mortality following the introduction of selective primary health care¹⁸ and a life expectancy that exceeds other countries in the region by about 8 years. Bhutan has a free health-care system administered by the government, whereas private practice is limited to a small number of centres.^{19,20} Notably, in a retrospective cohort study,¹⁹ records routinely maintained under the National Diabetes Control Programme were appraised. All patients with type 2 diabetes registered in 2012 in 18 district hospitals of Bhutan were included. About a third of patients with diabetes in Bhutan were lost to follow-up (ie, did not visit a diabetes clinic once in the 12 months since registration). Pakistan is characterised by diverse social, economic, and cultural dimensions, plus poor resources for health. Accordingly, the country faces substantial increases in NCDs and related health problems, including tobacco smoking. Nepal's health system has been described as one of the most deprived in the world,²¹ with low government spending, unevenly distributed health services, poor affordability, low awareness of disease, and poor retention of human resources in rural areas.²² Substantial disparities in health, education, wealth, and access to care are compounded by having to address the

needs of 126 ethnic and caste groups.¹¹ Out-of-pocket expenditure for health is also high in Nepal and accessibility to services is low.²³ By contrast, Bangladesh is homogeneous in ethnicity, but despite improvements in health indicators in the past decade, the country is not well placed to address NCDs, including diabetes.¹³ In summary, inequality, insufficient public funding for health services, and high out-of-pocket payments can lead to further financial disadvantage, impoverishment, and reduced access to health-care services, particularly for poor people.^{24,25} Effective management of diabetes requires an interconnected, broad-based health system,³ which is currently lacking in the south Asian region.

Progress towards universal health coverage

Limitations in the capacity of health systems in the region are further challenged by the paucity of data on diabetes, including complications,¹⁰ with consequences for the development, implementation, and monitoring of clinical and public health responses to diabetes.²⁶ The lack of reliable health data, and indeed of data collection systems, in most low-income and middle-income countries prevents the development of appropriate health-system responses.³ There is often poor interaction between primary, secondary, and tertiary care and often poor integration between the government and the private sector.²⁷

Inequality in coverage of health services is common across south Asia. Indicative trends regarding progress towards universal health coverage across the region were provided in a 2017 study from five countries²⁸ and more recently in relation specifically to Bangladesh.²⁹ The regional analysis by Rahman and colleagues,²⁸ involving four of the south Asian countries comprising the group referenced in this Series, examined health service coverage in terms of access to basic care classified as prevention and treatment, respectively. Mean rates of overall prevention coverage were 69·8% in Pakistan, 74·2% in India, 76·5% in Bangladesh and 76·8% in Nepal. By contrast, mean treatment coverage was 44·8% in Bangladesh, 50·4% in Pakistan, 57·8% in Nepal, and 83·5% in India. Notably, this study also referenced pro-wealthy inequality in diabetes management with only an estimated 38% of patients with diabetes in Bangladesh receiving antidiabetes treatment, compared with 82% in India. No data were available in other south Asian countries. A key global target for universal health coverage is at least 80% for essential health service coverage.³⁰

Importantly, there has been insufficient investment in services necessary to prevent and manage diabetes and related conditions. For example, investment in health as a percentage of gross domestic product across south Asia is very modest and often ineffective, with very few community-based services. Expenditure ranges from meagre 2·6% in Pakistan and 2·8% in Bangladesh, to 3·5% in Sri Lanka, 3·6% in Bhutan, 4·7% in India, and

5·8% in Nepal.³¹ WHO's South-East Asia Region (encompassing Bangladesh, Bhutan, India, Indonesia, Maldives, Myanmar, Nepal, North Korea, Sri Lanka, Thailand, and Timor-Leste) has actively promoted universal health coverage in the region through community-based health care.³² The goal of strengthening primary health care is a cost-effective and low-risk approach to maximising health coverage at the population level, with the bold target that no one is left behind by 2030. However, substantial improvements in the prevention and management of diabetes in south Asia will require large-scale investment from government, non-government organisations, and the private sector.³³

Additional considerations

To address the growing problem of type 2 diabetes in south Asia requires a combination of parallel initiatives. These initiatives include a stronger political commitment, identification and scale-up of effective interventions, the development of human and institutional capacity, and the creation of sustainable solutions to finance health systems, including the provision of drugs at affordable prices and a reduction in inequalities.^{28,34}

The estimates of a substantial amount of undiagnosed diabetes in south Asia⁵ underline the urgent need to improve national screening, prevention, and diagnostic approaches.^{16,21} Logically, any increase in the awareness and detection of prediabetes and undiagnosed diabetes would facilitate earlier commencement of a care pathway and substantial cost savings.¹⁶ Improvement of diabetes care of existing patients also has important implications for the prevention of microvascular and macrovascular complications. Far too many people living in predominantly rural areas of south Asia do not have access even to basic health services and therefore the possibility of screening for complications of diabetes is low and risk of the development of advanced complications is high.^{16,35} Another major barrier to prevention of diabetes complications is the substantial out-of-pocket expenses seen in many parts of the region.²¹ Strategies are urgently needed to reduce the cost of prescription drugs to treat diabetes, including improving the availability of generic drugs such as metformin, as well as drugs for the prevention of cardiovascular disease such as statins,^{36–38} and increase the number of free essential medicines.

The earlier engagement of people with prediabetes in lifestyle interventions—ideally, relevant, evidence-based, community interventions—would also assist in preventing and controlling the type 2 diabetes epidemic. The likelihood of success would be increased by education and training of the health workforce, leveraging of primary care, and improvements in care coordination, including among community health workers.^{34,39} Building and enhancing primary health-care networks in each country should include a combined approach of disease screening, prevention, control of risk factors, and health promotion,^{19,21} and should involve

input from and involvement of local communities, which is crucial to changing attitudes to health and lifestyle.^{7,40}

Key action points for prevention of type 2 diabetes

Population-wide approaches to improve diet and physical activity

We propose that given the important contribution of lifestyle factors to type 2 diabetes prevention and management, nutrition and physical activity should be central platforms of the preventive effort,^{8,41} based on culturally relevant advice and support. Such an approach will require increased education of health professionals to provide appropriate advice and support, plus better engagement with patients.^{41,42} There is insufficient understanding of the benefits or perceived need for lifestyle interventions⁴³ (where drugs are available, medication is often prioritised ahead of diet and physical activity), and there is often clinical inertia specific to lifestyle advice.^{42,44–47} Major additional barriers to physical activity in the south Asian context include social and economic disparities between rural and urban populations,⁴⁸ gender and cultural issues, and scarcity of space for physical activity in many settings.^{49,50}

A major paradigm shift in health-care delivery is required in the region to improve diet and physical activity to prevent and manage type 2 diabetes. This shift will require an integrated approach with greater collaboration between public health, primary care, and community health workers. Ideally, the prevention of unhealthy lifestyle behaviours, with aggressive reversal of these behaviours well before the development of type 2 diabetes (primary prevention), should be the top priority. Accordingly, to combat the rising parallel prevalence of obesity and type 2 diabetes, promotion of healthy lifestyles is an intervention of utmost importance.^{51,52} For maximum benefit, a multi-pronged approach should be promoted—ie, sufficient physical activity, a nutritious diet, a healthy bodyweight, and preventing use of tobacco products.⁵³

Country-specific public health campaigns are required to immerse south Asians in a culture of health and wellness. Increased opportunities for all types of physical activity—leisure time, travel (including commuting for work), activities of daily living, and occupational—should be a primary public health focus. A fundamental starting point would be for all south Asian countries to follow Bangladesh, India, and Sri Lanka and have “an operational policy, strategy or action plan to reduce physical inactivity and/or promote physical activity and promote healthy food choices”.⁵⁴

These fundamental ingredients of health promotion fall into the public health purview in all countries and should be universal. Unfortunately, capacity and infrastructure for public health initiatives of scale directed at the prevention and management of NCDs, and type 2 diabetes in particular, are less than optimal in

Panel 1: Best bets for the prevention of type 2 diabetes among south Asians**Awareness**

- Increasing public awareness of the importance of increasing physical activity to prevent and treat chronic disease
- Education and awareness raising in young women and potential mothers regarding the health risks of pregnancy at a young age, advocating for improved sanitation, improved nutrition, and physical activity plus stress reduction^{57,58}
- Promoting physical activity initiatives including campaigns in community, workplace, and school systems
- Creating a built environment more conducive to being physically active where people live, work, and go to school⁶²
- Policies regarding population-wide physical activity and a healthy diet plus physical activity and dietary guidelines for all south Asian countries⁶³
- Population-wide advertising campaigns for healthy foods and lifestyle⁶²

Diet

- Reducing consumption of refined carbohydrates including wheat flour and white rice
- Taxes on sugar and poor quality oils^{59,60}
- Reducing free (added) sugar to less than 10% of total energy intake (ideally less than 5% in high-risk individuals)
- Reducing consumption of high-fat, high-sugar fast foods and trans fats
- Increasing consumption of healthy dairy products such as unsweetened yogurt, nuts such as pistachios and almonds, and pulses and legumes⁶¹

Lifestyle and physical activity

- Reducing physical inactivity and sedentary behaviours and increasing physical activity and exercise opportunities in all settings

Other factors

- Medical care
- Prevention of overweight and obesity early in life⁶⁴
- Weight management preconception (ideally adolescence) and during pregnancy to prevent gestational diabetes and progression to type 2 diabetes^{59,60,65–67}
- Targeted reduction in waist circumference through primary health care (<80 cm for women and <90 cm for men)
- Inclusion of primary prevention in all national health policies across the lifespan⁶⁸
- Monitoring of growth and development of infants and young children⁶⁹

many parts of south Asia and require urgent further development.⁵⁵ Consistency in national capacities to address and respond to NCDs is essential, along with an operational policy, strategy, or action plan for diabetes.⁵⁴

Even if the public health sector were working at optimal capacity, this sector alone would be unable to create an effective culture of health and wellness. Partnerships with other key stakeholders, such as health-care systems, the food industry, government, school systems, community organisations, and employers, are essential to the conceptualisation and implementation of the healthy lifestyle-focused health-care system needed to reverse unhealthy lifestyle patterns.⁵⁶ The public health sector in south Asia can and should be a major player in bringing together key stakeholders to develop effective healthy lifestyle interventions within a given community (panel 1).^{70,71}

Prevention of overweight and obesity

Greater investment is required in cost-effective public health strategies to prevent overweight and obesity⁶⁴ through increased knowledge and understanding of the risks of obesity and the importance of weight reduction.⁷² To design and implement appropriate policies and programmes requires that policy makers have access to recent research data regarding the effectiveness of various strategies. Additionally, policies to improve healthy eating and physical activity must take into account the sociocultural, financial, and political issues influencing health.

Early lifestyle intervention must include the promotion of nutrition and physical activity among all schoolchildren, as overweight and obesity is increasingly common in south Asian children and adolescents.⁶² There is considerable experience in obesity prevention in the region, with the successful implementation of several interventions, particularly in India.^{73,74} In addition to health promotion in schools, ideally with parental involvement and social support, high-risk screening might also be valuable.⁷⁵ Other considerations⁵ include the role of maternal undernutrition and diabetes⁷⁶ plus the greater risk of gestational diabetes in south Asian women.⁷⁷ An estimated 4 million Indian women are diagnosed with gestational diabetes annually and a staggering 50% develop type 2 diabetes within 5 years of pregnancy.⁷⁸ Therefore, preconception health promotion and lifestyle management throughout pregnancy must also be a priority as children of women with gestational diabetes have an increased risk of obesity and adverse long-term health problems.^{79–81} A promising approach in the prevention of diabetes is the so-called life circle concept proposed by Wijesuriya and colleagues,⁶⁸ whereby comprehensive, low-cost, culturally-sensitive, and pragmatic approaches are developed through evidence-based local action plans. This approach stresses that the prevention and management of type 2 diabetes be considered as a continuum from preconception, pregnancy, infancy, and childhood, to adult life, with benefits from entering the circle at any stage.

Guidelines for the prevention and management of type 2 diabetes

One of the major opportunities for health authorities across south Asia is to develop comprehensive strategies for the prevention and management of diabetes in low-resource settings.^{16,82} Regular surveillance and monitoring of NCDs and risk factors, plus local diabetes prevention and management guidelines, are key markers of health-system preparedness and capability. To date, surveillance and monitoring have been largely ad hoc across south Asia, based mostly on sub-national surveys. Similarly, the insufficient availability and implementation of evidence-based national diabetes guidelines, protocols, or standards of care reflect the nature of national responses to diabetes.³³ In Pakistan, more work has been done on the prevention and management of diabetes than on other NCDs^{83,84} and guidelines for management of diabetes have been developed by the Pakistan Endocrine Society.⁸⁵ The development of policies for the prevention and management of diabetes and its complications, the active engagement of all stakeholders, adequate funding, affordable medicines and technologies, accessibility to services, and an effective monitoring and surveillance system are essential components of a national action plan. However, as Sherin⁸⁴ has reported in relation to Pakistan, a major impediment is the failure to implement such plans and thereby meet targets set by international agencies. In Nepal, results from the 2015 National Health Facility Survey indicate that among facilities offering diabetes services, only 4% had guidelines for the diagnosis and management of diabetes.⁸⁶

Public health physical activity guidelines for adults are widely available.^{44,63,87,88} Misra and colleagues⁶³ published the first activity guidelines in the south Asia region, having earlier developed dietary guidelines.⁸⁹ Generic activity guidelines include recommendations for the minimum dose of aerobic activity to achieve cardiovascular health benefits, currently 150 min of moderate-intensity aerobic activity, such as brisk walking, per week (across a minimum of 3 days),⁴⁴ or 90 min of vigorous-intensity aerobic activity in individuals without cardiovascular or musculoskeletal contraindications.⁹⁰ Shorter bouts of high-intensity exercise might also increase enjoyment of and intention to continue exercising in the future.⁹¹ The American College of Sports Medicine and American Diabetes Association joint guidelines (not specific to Asian ethnicities) also include resistance or strength training on a minimum of two non-consecutive days per week.^{41,44}

Family physicians, allied health practitioners, and educators in south Asian communities must take greater responsibility for the promotion of physical activity because, despite a general understanding of the benefits of activity for type 2 diabetes risk reduction,⁹² attitudes tend to be fatalistic, resulting in inaction and increasing risk.^{93,94} There would also be merit in the development of multilevel strategies to increase physical activity and

fitness, as south Asians have lower cardiorespiratory fitness than white Europeans at all levels of physical activity.^{95,96} Lower fitness levels account for an estimated two-thirds of the ethnic difference in insulin resistance.⁹⁵

Dietary strategies

Diet is a key determinant of risk of type 2 diabetes^{8,33} and increased affluence has provided many south Asians with greater purchasing power, including access to a wider selection of foods. Health promotion strategies are needed to educate the population about the risks associated with non-traditional diets that are high in saturated fats, cholesterol, and refined carbohydrates and low in polyunsaturated fatty acids and fibre,^{4,97} which are commonly processed fast-foods and locally made fast-foods sold by street vendors. These foods have a high content of trans fatty acids associated with deep-frying with low-cost partially hydrogenated vegetable oils.⁹⁷

A public health priority should be the education of health professionals regarding the dietary management of type 2 diabetes, particularly lowering carbohydrate intake given the potential to reduce HbA_{1c}.⁶⁵ Feinman and colleagues⁶⁶ contend that carbohydrate restriction per se should be the first option in the management of type 2 diabetes—a logical public health focus, since south Asians have a tradition of high carbohydrate intake.⁴ There might also be merit in promoting greater consumption of nuts, particularly considering their low glycaemic index and high monounsaturated fatty acid content.⁶⁷

Key policy initiatives should include programmes to support the consumption of healthy whole foods, such as fruits, vegetables, nuts, and low-fat dairy, instead of refined foods and beverages. Government subsidies for healthy foods could be one approach. Other prevention strategies could include taxation on high-sugar products,⁵⁹ a fat tax (on junk food typically high in poor quality fat and sugar),⁶⁰ promotion of healthy oils and foods,⁹⁷ and restrictions on advertisements for junk foods on television and elsewhere.⁶² Gulati and Misra⁹⁸ suggest that a stronger regulatory framework is needed—including taxes on sugar-sweetened beverages and dietary fats (including poor quality oils such as palm oil), and limiting the use of trans fats.

National prevention programmes

NCD prevention programmes, including for prevention of type 2 diabetes, have been incorporated into national health-care policies of south Asian countries for about a decade, with operational components slowly evolving across the region.^{6,9,33} Salient features of prevention programmes include the reduction of risk factors, behaviour change, opportunistic screening, ensuring availability of medicines at low cost, integration of an NCD programme in primary health care, and capacity building for care providers. In India, the first phase of the National Program for Prevention and Control of

Panel 2: Major impediments to prevention and management of diabetes in the region

- Low levels of education and training plus paucity of health professionals including diabetes educators, teachers, general practitioners, and specialist physicians¹¹⁰
- Cultural barriers including lack of understanding of the optimal lifestyle modification to impact prevention and progression of type 2 diabetes and related conditions in south Asians
- Lack of affordable services including medicines, professional advice, and support, including from community level health workers
- Limited resources—eg, lack of facilities for HbA_{1c}, fundus, and foot assessment at primary and secondary care levels
- The large scale of the type 2 diabetes epidemic and related conditions such as overweight and obesity, coupled with lack of personnel, social inequity, and low patient understanding with respect to disease management^{48,111}

Cancer, Diabetes, Cardiovascular Disease and Stroke was launched in 100 districts in 2010, with strong screening and monitoring components, and subsequently strengthened in 2013–14.⁹ The Indian Government has also developed an operational plan for universal screening of diabetes and hypertension,⁹⁹ and national programmes have been launched in other countries in the region during the same period,^{100–106} however, impact assessments of these programmes remain to be done.

In Nepal, a 2012 National Health Communication Policy was released to raise health awareness and knowledge, promote healthy behaviours, plus intensify and strengthen preventive action against tobacco use, excessive alcohol consumption, unhealthy diets, and physical inactivity.¹⁰⁷ However, according to reports,^{86,108} the growing burden of NCDs in Nepal, including diabetes, is not receiving the necessary attention from all key players, including the government, development partners, and the university sector. Pilot projects have also been implemented in Sri Lanka and Bhutan to integrate the management of diabetes and hypertension into primary health care.¹⁰⁹ However, evidence regarding effective interventions for the prevention of NCDs in south Asia is still insufficient.³³ Major impediments to prevention and management of type 2 diabetes in the south Asian context are listed in panel 2.

Culturally relevant activities

The cultural relevance of type 2 diabetes prevention and management initiatives is particularly important—cultural adaptations to prevention programmes developed elsewhere must be examined carefully, ideally utilising evidence-based processes.¹¹² Motivational drivers also provide useful clues to the development of effective and culturally relevant health-promotion strategies.¹¹³ Good examples are the health benefits reported by

women who engage in cultural forms of physical activity, such as Bollywood and Bhangra dance classes.^{114,115}

Education and training of health professionals and non-physician care

The education and training of health professionals and educators, ideally tailored to ethnic groups and culturally modulated, should also be a public health priority.⁸⁷ A multisectoral approach to education, training, and awareness-raising would help to develop the capacity to prevent and manage prediabetes, overweight and obesity, and diabetes complications.

Studies have been done to assess multicomponent quality improvement strategies (non-physician care coordinator and decision-support algorithm nested within an electronic health record) in patients with chronic diseases, including type 2 diabetes.^{116–119} Family-based education programmes should also be a core management strategy given the high prevalence of type 2 diabetes in families and the preference of many patients with diabetes in south Asia to live in extended family structures.¹²⁰ There is also early evidence of the potential of training peer leaders to facilitate type 2 diabetes self-management¹²¹ and, most recently, Selvam and colleagues¹²² have documented the cascading benefits of the training of teachers as disseminators of health information on lifestyle-related diseases. The community-based, peer-led diabetes prevention programme in Kerala includes four components: group-based peer support, peer leader training, resource materials, and strategies for broader community engagement.

Community health workers play an important part in delivering health-care services to underserved populations in south Asia.¹²³ Community health worker programmes have become prominent in Pakistan, Bangladesh, and Nepal, primarily in response to the public health challenge of high maternal, neonatal, and under-5 mortality.¹²⁴ However, such approaches could also be systematically employed for prevention of type 2 diabetes. Primary prevention programmes for cardiovascular disease and type 2 diabetes, with a focus on lifestyle modification of risk factors, including diet, physical activity, and smoking, have been successfully utilised in India¹²⁵ and Pakistan,¹²⁶ and for community-based screening in Pakistan.¹²⁷ In Bangladesh, community health workers linked to the organisation Building Resources Across Communities have a range of independent or linked roles with several informal, formal, and traditional sources of care and healing.¹²⁸ Kok and colleagues did a systematic review of studies to identify factors related to community health workers' performance.¹²⁹ Good performance was associated with intervention designs involving a mix of incentives, frequent supervision, continuous training, community involvement, and strong coordination and communication between community health workers and health professionals. In short, community health workers have the potential to

play an increasing role, with different mixes of prevention, promotion, treatment, and social mobilisation.¹²⁴

Best practice sharing

Where possible, strong features of country-specific health systems should be considered for translation to other settings across the south Asia region. For example, components of Sri Lanka's successful approach to improving population health might be suitable and cost-effective for adoption by other countries to strengthen health-service provision. This translation could include standardised recruitment and training of health professionals plus grassroots service delivery by public health staff at the community level.^{129,130} Similarly, WHO's package of essential non-communicable disease interventions (PEN) for primary care in resource-poor settings¹³¹ provides examples of how to adapt primary care to the region.²⁰ Bhutan was one of the first countries to pilot PEN, with an integrated approach including type 2 diabetes management and involving non-physician health workers.¹³² An example specific to diabetes is the Diabetes Community Lifestyle Improvement Program (D-CLIP) trial, which involved a low-cost, model community-based Indian programme with potential application to other low-income and middle-income settings.¹³³ This study found that the stepwise provision of expert guidelines for diabetes prevention (lifestyle intervention plus metformin) among people with prediabetes reduced diabetes incidence by a third in community settings.

Technology-assisted and mobile support

Greater use of technology provides an important opportunity to improve the public health of south Asian populations. For example, electronic health (eHealth) and mobile phone health (mHealth) applications might be useful for prevention and management of type 2 diabetes in resource-poor settings, including for education³ and the promotion of health literacy.³⁹ The use of simple and effective technology solutions also enables more relevant and locally delivered care.³ A systematic review examined the effectiveness of eHealth and mHealth interventions in resource-poor countries, including India, and reported that 50% of the interventions were effective in increasing physical activity. Atun and colleagues³ have detailed the important aims of education as a priority for diabetes care. At the personal level, patients with type 2 diabetes should be active players rather than passive recipients of health education.³⁹ Understanding and awareness should be the aim at the community level and the focus of education of health professionals should be on both awareness raising and the simplicity of treatment.

Technology-mediated comprehensive care can be used through telemedicine and periodic diet, exercise, and glycaemia assessment and education to empower patients

and provide 24-h advice on lifestyle modifications.^{39,134} However, the scalability and systemic uptake of such innovations are susceptible to regulatory (eg, licensing), financial (eg, the inability of insurance systems to provide coverage), and institutional (eg, multiple non-coordinated agencies being responsible for different components of an innovation) barriers.¹³⁵

Since quality health care cannot be afforded by underprivileged populations across the south Asian region, customised vehicles, such as those used to deliver prevention advice and diabetes care in south and north India, could be a viable innovation.¹³⁶ Mobile units could be used for early detection of type 2 diabetes (and other NCDs), provision of prevention advice, and standard care and management at the doorsteps of underprivileged populations. These units include communications technology (ie, video chat and voice call services) for consultation with experts at tertiary care centres and transmission of images (eg, fundus images), vibration perception testing (neuropathy), and ankle brachial index testing.

Conclusions and future directions

Much of the research to inform guidelines to prevent and treat type 2 diabetes has been done in high-income countries. Distinct differences in the progression of diabetes in south Asians, as detailed in this Series, as well as socioeconomic conditions in south Asian countries, warrant future research to improve the evidence base (panel 3).¹³⁹

Lifestyle interventions are cost-effective to prevent and treat type 2 diabetes in south Asia. However, a range

Panel 3: Action points for research in public health and health systems development

- Redress the imbalance in public health and health systems research regarding the prevention of type 2 diabetes by undertaking more intervention studies in south Asia
- Prioritise research capacity building to inform decision making regarding the use of limited public health resources
- Develop research skills in practitioners, researchers, and policy makers to include the synthesis of evidence in systematic reviews to help facilitate the interpretation and extrapolation of findings to south Asian settings
- Harness the plethora of new initiatives for integration into local primary health-care systems and coherent national programmes¹²⁴
- Develop a better understanding of the health-information-seeking behaviours of south Asians and barriers to effective management, particularly in women and people of low socioeconomic status
- Given the enormity of the socioeconomic burden of diabetes on individuals, families, and national health systems, extend the work of Shrivastava and colleagues¹⁸ regarding the effect of disparities in socioeconomic status, place of residence, gender, education, and level of awareness of diabetes and its impact¹³⁷
- Test the cultural appropriateness of the Mediterranean diet, Dietary Approaches to Stop Hypertension (DASH) diet, and the Nordic Diet in south Asians¹³⁸
- Develop community interventions for culturally appropriate aerobic and resistance exercise for people with obesity and type 2 diabetes

Search strategy and selection criteria

We searched electronic databases (PubMed, Google Scholar, Web of Science, and Embase) for articles published in English from Jan 1, 1970, to Apr 16, 2018, using the search terms “south Asia”, “lifestyle”, “diabetes”, “health promotion”, “health systems”, and “public health”, in various combinations. We also searched using the names of the countries included in the definition of south Asia used for the Series (Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka). Our searches identified various article types including research studies, review articles, and systematic reviews. Additional references were identified from the reference lists of articles identified in the database searches and other papers were identified by coauthors from their existing knowledge of the scientific literature. APH and SJS selected references for inclusion on the basis of quality, relevance, and priority, given limitations on the number of references than could be cited.

of challenges exist, including the under-prescription of physical activity by health professionals in favour of medication and dietary prescriptions; insufficient effectiveness of such prescriptions when they do occur; and cultural, gender-based, socioeconomic, and geographical impediments to the uptake of physical activity. In resource-poor settings in particular, great progress is possible with emphasis in these areas.

The scarcity of health professionals in south Asia highlights the need to involve community-based health workers, teachers, volunteers, and family members in the prevention and management of type 2 diabetes. Training and capacity building at the community level would facilitate the more widespread use of community health workers.

In summary, sustainable prevention and management of type 2 diabetes in south Asia requires the integration of strategies into normal daily life to address the major risk factors of unhealthy diet and physical inactivity. Approaches will need to differ according to life stage, culture, and socioeconomic context, and take into account underlying economic, gender, behavioural, and environmental factors. Greatest attention should be paid to primary prevention strategies to counter risk factors and behaviours in preconception, in utero, in infancy, and during childhood and adolescence.^{81,94}

Contributors

APH and AM proposed the Series. SJS did the literature search. APH drafted the Series paper and AM, JMRG, NMB, MJS, AR, LP, SJS, RJ, KK, and RA provided important input to its development and revision. All authors read, revised, and approved the final version. APH had primary responsibility for final content.

Declaration of interests

AM has been a consultant and speaker for Novartis, Sanofi-Aventis, Lupin, Janssen, AstraZeneca, Boehringer Ingelheim, Glenmark Pharmaceuticals, Dr Reddy's Laboratories, Herbalife, and Sun Pharmaceuticals. Some trials in which AM was involved were supported

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