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Economic Impact of Diabetes in South Asia: the Magnitude of the Problem

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Abstract

Purpose of Review To critically assess and identify gaps in the current literature on the economic impact of diabetes in South Asia.

Recent Findings The total annual (direct medical and non-medical and indirect) costs for diabetes care in South Asia range from $483–$2637 per patient, and on an average 5.8% of patients with diabetes suffer catastrophic spending i.e. when households reduce basic expenditure by 40% to cope with healthcare costs. The mean direct costs per patient are positively associated with a country's gross domestic product (GDP) per capita, although there is wide heterogeneity across South Asian countries.

Summary With an estimated 84 million people suffering from diabetes in South Asia, diabetes imposes a substantial economic burden on individuals, families, and society. Since the disease burden increasingly occurs in the most productive midlife period, it adversely affects workforce productivity and macroeconomic development. Diabetes-related complications lead to markedly higher treatment costs, causing catastrophic medical spending for many households, thus underscoring the importance of preventing diabetes-related complications.

Keywords Diabetes mellitus · Cost-of-illness studies · Economic impact · South Asia

Introduction

South Asia (defined as Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka) is home to one-quarter of the world's population and about half of this large share lives below the poverty line and has limited access to healthcare services. One-fifth of the world's 451 million adults with diabetes currently live in South Asia, a number that is expected to rise by 78% by 2045 [1]. Diabetes causes premature mortality, high morbidity, and disability [2–5]. Diabetes-related disability can have physical, psychological, and social impacts on human functioning. Adults with diabetes experience more depression, anxiety, and cognitive dysfunction than their non-diabetic counterparts do, with adverse impacts on the lives and livelihoods of both the individuals with diabetes and their families [6].

The mounting burden of diabetes is also responsible for huge direct and opportunity costs for society that include

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public spending on healthcare services and lost productivity [7–9]. Globally, an estimated 12% of all direct medical expenditure (US$673 billion) is due to diabetes [10••]. Although 80% of people with diabetes live in low- and middle-income countries (LMICs), including in South Asia, 80% of diabetes-related expenses are incurred in high-income countries (HICs) [7, 10••, 11]. Estimates of the current and future economic burden of diabetes can help decision makers understand the magnitude of the problem, prioritise research efforts, and plan resource allocation to prevent and manage it. In this review, we describe the unique features of the diabetes epidemic in South Asia and critically assess and identify the gaps in the current literature on the economic impact of diabetes in South Asia. We also offer recommendations on ways to mitigate the economic burden of diabetes.

Distinctive Features of the Diabetes Epidemic in South Asia

The prevalence of diabetes and its adverse health effects have risen more rapidly in South Asia than those in the rest of the world except for the Middle East and North Africa (MENA) region [12]. Within South Asia, the prevalence of diabetes in rural populations is already half that of the region's urban populations [13]. A more alarming pattern is the increasing number of young people with diabetes. Diabetes is estimated to occur on average 10 years earlier among Indians than their western counterparts, and almost half of Indian patients with type 2 diabetes (47%) are diagnosed before age 40 [14–16]. An upsurge in the number of early-onset diabetes cases is also associated with higher occurrence of diabetes-related complications such as neuropathy (24.6%), cardiovascular diseases (23.6%), renal diseases (21.1%), diabetic retinopathy (16.6%), and foot ulcers (5.5%) [16].

There are several unique features that characterise the type 2 diabetes epidemic in South Asia. First, there is a high risk of developing diabetes even at lower levels of body mass index (BMI) than observed among western populations [17–19]. Second, there is a high prevalence of glucose intolerance, low levels of HDL cholesterol, and high levels of triglycerides [20, 21]. Third, impaired foetal nutrition, resulting in low birth weight, is common in South Asia and is associated with diabetes and cardiovascular risk [19, 22–24]. Fourth, South Asia is experiencing rapid urbanisation, accompanied by widening income and social inequalities, which is likely to impact the diabetes burden of the rich and the poor differently [25]. For example, the rich are likely to become more physically inactive, while the poor consume fewer servings of fruits and vegetables. As the rich are likely to recognise their risk of developing diabetes earlier and seek medical attention, they will develop a chronic but manageable disease; on the contrary, as the poor are less aware of their risk and less able to seek/access medical care, they will develop a rapidly progressive disease with disabling financial complications and a greater risk of premature mortality.

The Healthcare Systems in South Asia and Their Influence on Diabetes Care

The health sector in South Asia comprises both public and private providers [26] and little organised financing and thus far from universal health coverage. The health system in India is predominately private, with more than 78% of care provided by the private sector [27]. Health services and government coverage schemes are oriented towards tertiary and curative care. Because of low insurance or other coverage, care is mostly paid for directly by patients in the form of out-of-pocket payment. Pre-paid private spending is rare in India (2.4%), and out-of-pocket payment accounts for most health spending (65.6%) [28]. India's generic drug-manufacturing sector provides it with far greater availability of essential anti-diabetic drugs than its low- and middle-income country peers have [29]. For example, data from the PURE study suggest that metformin and insulin are available in 100% and 76% of pharmacies in India, compared with 64.7% and 10.3% in lower-income country pharmacies, respectively [30]. Availability is only one component of access to care, which also includes affordability. In lower-income countries such as India, 23% and 63% of households could not afford metformin and insulin, respectively [30]. Poor availability and affordability of anti-diabetic drugs is a major driver of lower use of these medicines. For example, 29.6% of patients in lower-income countries (such as South Asia) reported the use of diabetes medicines, compared with 74% of patients in high-income countries [30]. Furthermore, South Asian countries face several challenges in delivering optimal diabetes care [31–33] that have economic implications: (1) a lack of coverage of routine laboratory tests and patients' inability to pay for them leave a high proportion of cases undiagnosed; (2) limited access to routine care and medications (insulin, hypoglycaemic drugs, antihypertensive drugs, and statins), (3) a general lack of health care professionals and infrastructural resources (refrigeration for insulin); and (4) the poor quality of healthcare governance overall, all leading to poor health outcomes.

Economic Impact of Diabetes in South Asia

Diabetes is associated with three types of economic costs or impacts: microeconomic, those related to social welfare, and macroeconomic. The *microeconomic impact* reflects diabetes-related individual and household costs, consumption patterns, and income changes. The *social welfare impact* centres on the

value that individuals place on optimal health and can be estimated by considering individuals' responses to trade-offs between money and health. The *macroeconomic impact* involves the broader economic output of the nation, affected by factors such as diabetes-related changes in productivity; it is often reported in terms of per capita gross domestic product (GDP).

Microeconomic Impact of Diabetes

A global systematic review [34] involving 86 cost-of-illness studies of patients with diabetes found that annual direct costs (expenses for diabetes medication, hospital stays, and treatment of complications) per person ranged from US dollar ($) 242 in Mexico to $11,917 in the USA, while indirect costs (productivity losses associated with morbidity and premature mortality) ranged from $45 in Pakistan to $16,914 in the Bahamas [34]. In contrast to HICs, a substantial part of the cost burden in LMICs, including in South Asia, is the out-of-pocket treatment expenditure borne by patients, leading to a higher occurrence of catastrophic spending [35] (when households reduce basic expenditure by 40% to cope with healthcare costs) and poverty due to distress health financing (when households need to borrow money from other sources to pay for healthcare expenses). Available studies on the impact of diabetes on the labour market (studies that are almost exclusively confined to HICs) have found strong adverse effects, particularly for employment chances among men [34].

Table 1 summarises 25 major cost-of-illness studies of diabetes mellitus in South Asia. Most studies ($n = 19$) were of India; a few were of Pakistan ($n = 4$); one study focused on Bangladesh, and one on Nepal. The mean annual *direct medical costs* (consultation fee, laboratory tests, medicines, and medical supplies) per person for out-patient care ranged from $463 to $951. The range of mean direct medical costs rose slightly to $575–$1216 when hospital admissions were included in direct medical costs. Diabetes complications such as nephropathy and peripheral vascular diseases (minor foot ulcers) incurred lower costs ($246–$502), whereas complications such as cardiovascular diseases, severe foot ulcers, and amputation incurred higher costs ($2087–$4597). *Direct non-medical costs* (transport, food, and escorts) followed similar patterns as direct medical costs, with the lowest costs for out-patients (range $12–$21), higher costs for those also admitted to hospital ($258), and a higher range for those with complications ($50–$470). A wide range of average annual *indirect costs* (lost productivity and missed work days due to illness) has been estimated by studies on diabetes and its complications ($9–$2803). Several studies [44, 47, 48] modelled 2-year expenditure estimates using the data for *total direct costs* (*medical and non-medical*) including costs for diabetes-related complications; these estimates ranged from $2420 to $40,331 (or annual costs of $1210–$20,166). Acute complications, diabetic foot, stroke, ischaemic heart disease, and diabetic nephropathy had the highest costs. The main limitations of these cost-of-illness studies are the quantity of resource utilisation, and unit costs were not reported separately. The sources of costs data and the perspective taken for the study were often not stated. No studies reported longitudinal costs, which is an important consideration given that diabetes requires lifelong care.

A recent systematic review [61•] of cost-of-illness studies from South Asia found that the range of *total annual* (*direct and indirect*) *costs* for diabetes care was $483–$2637 per patient.

Catastrophic Health Spending and Out-of-pocket Treatment Expenditure

The financial burden of diabetes can have catastrophic implications as healthcare financing in South Asia is largely based on out-of-pocket payments rather than through pre-payment mechanisms (private, employment-based, subsidized, public, or some combination) that protect against financial insecurity [62, 63]. In the absence of an adequate health insurance system in South Asia, households use savings, borrow, or sell assets to cope with health shocks (categorised as distress health financing) and may have to sacrifice catastrophic proportions of their available income [64]. Worldwide, every year, about 44 million households (> 150 million people) make catastrophic expenditures, and about 25 million households (> 100 million people) are pushed into poverty by the need to pay for diabetes care [64, 65]. A global analysis of 108 surveys in 86 countries reveals that catastrophic payments incurred by diabetes patients range from less than 1% of households in HICs to 13% in LMICs. Further, up to 5% of households are pushed into poverty [34]. In South Asia, on average 5.8% of diabetes patients suffer catastrophic spending [6, 64]. A recent study from India shows that out-of-pocket expenditure for diabetes care was borne by 72.5% of survey participants [66]. The average cut into monthly household expenditure was Indian rupees INR 1978 ($28) [52].

Social Welfare Impact of Diabetes

The social welfare impact of diabetes relates to the value that individuals place on living a healthy life free from diabetes and its complications. Since this impact cannot be measured through a market price, it is estimated through individuals' willingness to pay for health (corollaries include additional pay for risky jobs or costs of safety equipment). One study from India [44] estimates the intangible costs (those that reduce the quality of life, because of pain, anxiety, and stress) of diabetes, in terms of willingness to pay to stay well using a

Table 1 Cost-of-illness studies of diabetes mellitus in South Asia

No.	Reference	Year of data collection	Country	Key findings—Economic cost of diabetes (US$2016)
1.	Rayappa et al. [36]	1997	India (Bangalore)	Mean total annual cost per person, $982; family, $1861; society, $2492
2.	Shobhana et al. [37]	1998	India (Chennai)	Median total annual cost: private hospital, $624 per patient; public hospital, $34 per patient
3.	Shobhana et al. [38]	1998	India (Chennai)	Mean total cost without foot complications, $605; with foot complications, $2137
4.	Kapur [39]	1999	India	Mean total cost per patient, $2662
5.	Rao et al. [40]	2004	India (national)	Total costs: grade 1 foot ulcer, $248; grade 2, $3440; grade 3, $4510; major amputation, $4245; minor amputation, $4642
6.	Ramachandran et al. [41]	2005	India	Mean cost per hospitalisation, $652
7.	Kumar et al. [42]	2005	India (Delhi)	Median cost: urban patient, $1056; rural patient, $661
8.	Clarke et al. [43]	2001–2006	India (part of multi-country study)	Mean annual total cost, $634 per patient
9.	Tharkar et al. [44]	2007	India	Mean annual total cost, $1058 per patient
10.	Adiga et al. [45]	2008	India (Karnataka)	Mean total costs for diabetes patients with major CHD event, $2107; major CeBVD, $2419; heart failure, $2493; PVD, $507; nephropathy, $296; Withoout CHD, $132; stroke, $122; heart failure, $207; PVD, $169; nephropathy, $163
11.	Tharkar et al. [46]	2009	India	Median total expense for hospital admission over 2 years: non-hypertensive group, $2628; hypertension group, $3567
12.	Kumpatla et al. [47]	2008–2009	India	Mean cost of hospitalisation per patient, $1228
13.	Satyavani et al. [48]	2008–2010	India	Median annual cost per patient, $2068; modelled annual national cost of diabetes to Indian population, $99.2 billion to $148.2 billion
14.	Acharya et al. [49]	2011	India (Karnataka)	Mean total cost of hospitalisation without complications, $365; with complications, $1034–$1549. Estimated 2-year cost with no complications, $2443; with complications, $8145–$23,010
15.	Akari et al. [50]	2012	India (Andhra Pradesh)	Mean total cost per hospitalisation: transplantation group, $32,004; dialysis group, $4982; CKD group, $1030; no complication group, $261
16.	Chandra et al. [51]	2011–2012	India (Pune)	Mean total cost per year: all patients, $488; public sector, $221; private sector, $612
17.	Fernandes et al. [52]	2013–2014	India (Mumbai)	The median total annual cost per patient without any complications, $1595; with complications, $2175
18.	Swain et al. [53]	2016	India (Odisha)	Mean total cost without complications, $31; with complications, $331
19.	Sharma et al. [54]	2016	India	Mean annual direct medical costs per patient, $581; direct non-medical costs, $260; indirect costs, $237
20.	Ali et al. [55]	1997–2004	Pakistan	Mean total costs per patient, $215/month ($2576 annually)
21.	Khowaja et al. [56]	2006	Pakistan (Karachi)	Mean direct annual costs per patient, $72; indirect costs, $252
22.	Hussain et al. [57]	2013	Pakistan (Karachi)	Mean annual total costs per patient for diabetes vs. non-diabetes, $648 vs. $106
23.	Gillani et al. [58]	2016	Pakistan (Punjab)	Mean annual total costs, $864 per patient
24.	Shariful Islam et al. [59]	2014	Bangladesh	Mean annual direct costs per patient in private clinic, $1173; rural setting, $935; government hospital, $124
25.	Shrestha et al. [60]	2010	Nepal	Mean annual direct cost per patient with diabetes was estimated to be $332

*Costs from the original study were converted to US $ for the price year 2016 (using the purchasing power parity data from the International Monetary Fund), to enable meaningful comparisons. This was done using an online cost converter (The "CCEMG – EPPI -Centre Cost Converter" v.1.5 last update 29 April 2016 designed for this purpose and found at http://eppi.ioe.ac.uk/costconversion/)

Mean total cost consists of average direct medical (consultation fee, medicines, medical supplies, laboratory investigations, in-patient hospitalisation), direct non-medical (transport, food, and escorts), and indirect (lost productivity and wage loss due to missed work days) costs

CeBVD cerebrovascular disease, *CHD* coronary heart disease, *CKD* chronic kidney disease, *PVD* peripheral vascular disease

bidding method. This study finds that patients with diabetes are willing to pay on an average $1936 annually to stay well, which represented 1.5 times the GDP per capita of India in 2010. However, the willingness-to-pay value considerably varied by a number of complications ($1452 for no complications to $7260 for more than four complications) and by the haemoglobin A1c (HbA1c) level ($484 for patients with HbA1c < 7% to $1936 for HbA1c > 9%) [44]. Such findings reflect the high value that individuals place on health.

Macroeconomic Impact of Diabetes

The South Asia region has experienced remarkable economic growth over the past two decades, along with a concomitant rise in its diabetes burden. Although the different constituent economies of the region are at different stages of demographic and epidemiologic transition, a reduction in communicable disease, rising living standards, urbanisation, changing diets, more sedentary lifestyles, and other risk factors [12] (Fig. 1) have all contributed to an increasing burden of diabetes-related disability-adjusted life years (DALYs) [15]. DALYs—the estimated number of years of life lost due to premature mortality and disability—are often used to express one element of the macroeconomic consequences of disease. As per the Global Burden of Disease (GBD) study's estimates, between 1990 and 2017, the DALYs attributable to diabetes mellitus in South Asia nearly tripled from about 3.7 million to 11.7 million [12].

Figure 2a demonstrates the prevalence of diabetes and the percentage of GDP spent on healthcare in South Asia. Compared with the high prevalence of diabetes in South Asian countries, the percentage of GDP spent on health remains low (~3%) across most South Asian countries except Maldives (11.5%) and Afghanistan (10.3%). The overall health spending per capita rose more than twofold from $86 in 1995 to $210 in 2015, which is related to increased incomes, and a higher prevalence of chronic diseases, including diabetes, and their associated treatment (Fig. 2b). However, the total health spending as a percentage of GDP in South Asia has remained fairly constant (3–4%) over the last two decades with less than 1% of GDP spent on healthcare by the government, and a miniscule 0.2% by pre-paid private insurance, resulting in a large proportion of out-of-pocket healthcare spending (Fig. 2c). Together, these drive catastrophic healthcare spending in the event of major diabetes complications, thereby pushing poor people further into the poverty trap.

A large body of literature has quantified the economic burden of diabetes at the country level. However, the approaches to measuring the macroeconomic impact of diabetes vary. For example, Bloom et al. estimated the macroeconomic impact of diabetes in India and China by taking into account its impact on savings and capital accumulation [67]. The authors estimated that, in 2012–2030, India would incur a loss of $2.6 trillion due to five major chronic diseases (heart disease, stroke, chronic obstructive pulmonary disease, diabetes, and breast cancer) [67].

Bommer et al. [10••] estimated the global cost of diabetes in adults in 2015 based on the medical care expenditure of people with diabetes, above and beyond those of people without. Diabetes costs the global economy nearly $1.31 trillion (95% CI 1.28–1.36) or 1.8% (95% CI 1.8–1.9) of the global GDP. Two-thirds of these total costs are direct medical costs ($857 billion) and one-third are indirect costs i.e. 34.7% (95% CI 34.7–35.0), such as lost productivity. These high indirect cost estimates suggest that a large potential payoff exists for societies when resources are invested in the reduction of indirect costs. HICs contribute the most to the global economic

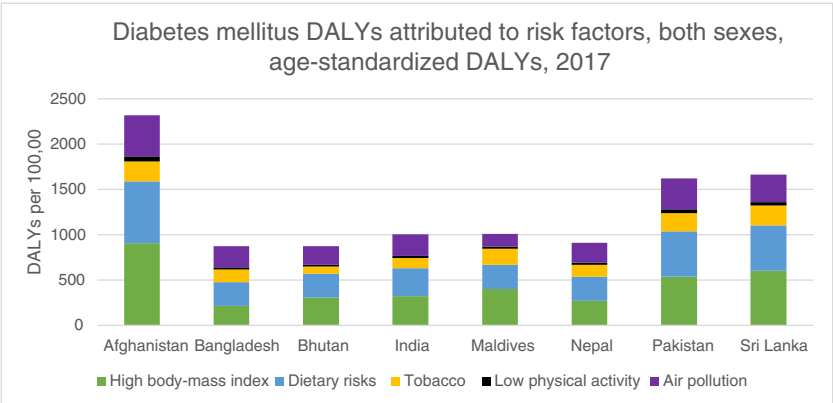

Fig. 1 Diabetes mellitus DALYs (age-standardised rate per 100,000) attributed to various risk factors in South Asian countries. DALYs, disability-adjusted life years (source: Institute for Health Metrics and Evaluation (IHME), 2018; http://vizhub.healthdata.org/gbd-compare). *Dietary risks*: low fruit and vegetables, legumes, whole grains, nuts and seeds, milk, fibre, calcium, omega-3, polyunsaturated fatty acid; and high red meat, processed meat, sweetened beverages, trans fat, sodium. *Tobacco*: smoking, chewing tobacco, and second-hand smoke

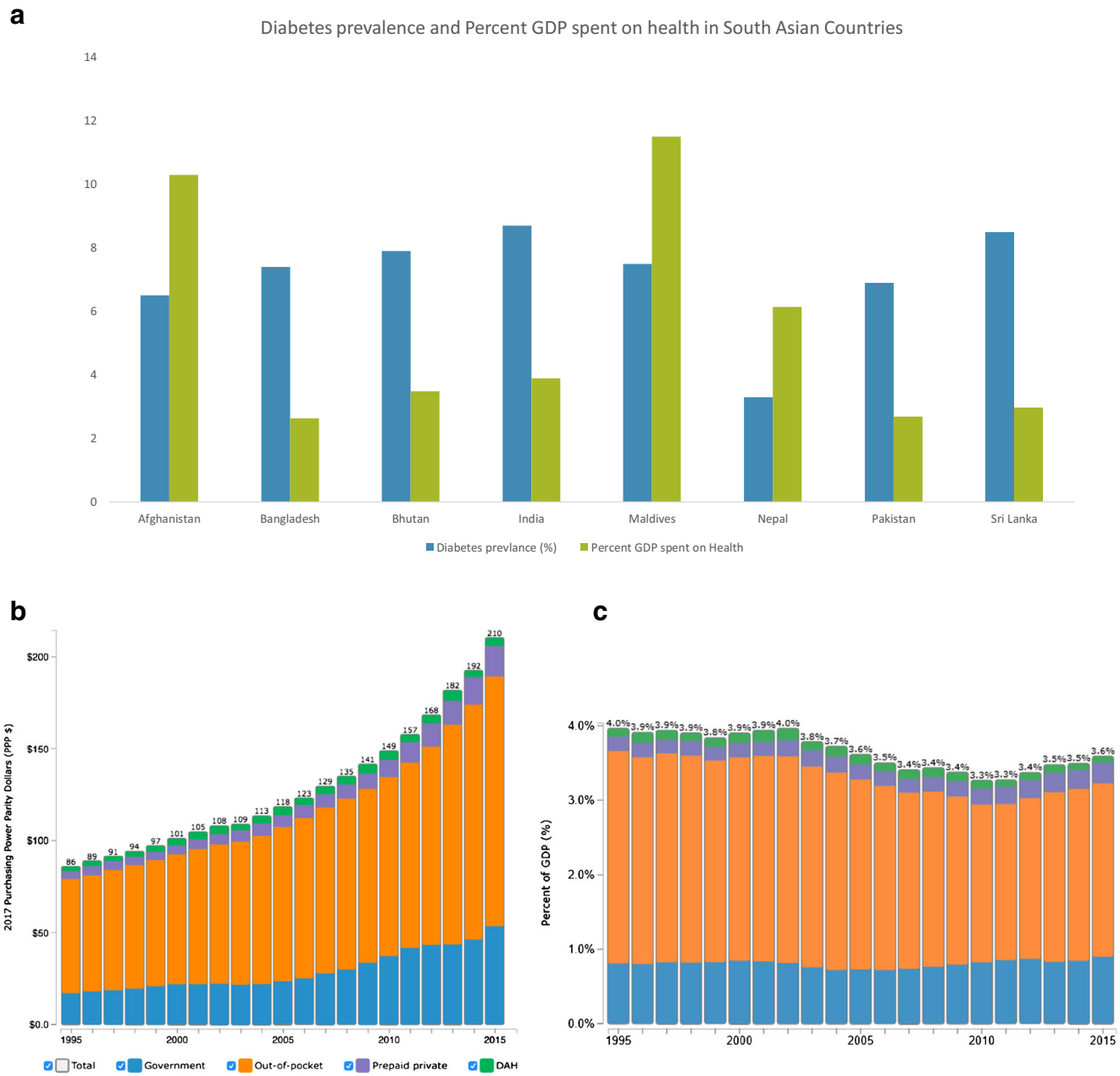

Fig. 2 **a** Diabetes prevalence and percentage of GDP spent on health in South Asia. GDP, gross domestic product (source: International Diabetes Federation (UDF) 2015 estimates; http://www.diabetesatlas.org/resources/2017-atlas.html). **b** Health spending per capita in South Asia for the period 1995–2015. DAH, development assistance for health (source: Institute for Health Metrics and Evaluation (IHME), 2018; http://vizhub.healthdata.org/gbd-compare). **c** Health spending as a percentage of GDP in South Asia for the period 1995–2015. DAH, development assistance for health (source: Institute for Health Metrics and Evaluation (IHME), 2018; http://vizhub.healthdata.org/gbd-compare)

burden with a total of $804.36 billion (1.2% of GDP). By contrast, middle-income countries are substantially more affected than HICs are, with an average burden of 1.8% of GDP. Low-income countries including in the South Asia region bear a lower burden than the rest of the world with an average of 0.7% of GDP. Tables 2 and 3 provide data on country-level totals, direct and indirect costs, as a percentage of GDP along with direct cost estimates as a percentage of total health expenditure, for individuals with diabetes in 2015 and projected costs for 2030. The mean direct costs per patient are positively associated with a country's GDP per capita, although there is wide heterogeneity across South Asian countries. The highest mean direct costs per person are reported for Maldives ($2488 or 1.4% of GDP), followed by Sri Lanka ($183 or 0.3% of

Table 2 Prevalence, deaths, and economic burden attributed to diabetes in South Asia in 2015 and projections of economic burden in 2030

Country	Population in million	GDP per capita	Deaths due to diabetes (95% CI)	Prevalence of diabetes in % (95% CI)	Mean wage in US$	Direct costs per patient in US$	Direct costs as % of total health expenditure	Direct costs in billion US$ 2015	Total costs of diabetes in % of GDP (2015)	Total costs in billion US$ 2030*	Total costs of diabetes in % of GDP 2030*
Afghanistan	32.53	706	16,460 (13,539–21,906)	6.5 (5.2–9.1)	492	143.1	7.14 (5.9–9.57)	0.13 (0.11–0.18)	1.38 (1.13–1.71)	0.53 (0.43–0.63)	1.7 (1.4–2.0)
Bangladesh	161	2109	96,319 (78,001–144,932)	7.4 (5.5–12.5)	711	63.3	8.46 (6.62–12.63)	0.45 (0.35–0.67)	0.78 (0.6–1.2)	4.12 (3.27–4.74)	1.0 (0.8–1.2)
Bhutan	0.77	5111	124 (114–139)	7.9 (7.0–9.3)	1389	168.0	9.9 (8.99–11.36)	0.01 (0.01–0.01)	0.56 (0.51–0.64)	0.04 (0.03–0.04)	0.8 (0.6–1.0)
India	1311.05	3247	696,547 (587,691–807,042)	8.7 (7.0–10.6)	1204	138.5	9.18 (7.67–11.07)	9.58 (8.01–11.56)	1.04 (0.87–1.25)	60.46 (51.4–72.6)	1.2 (1.0–1.5)
Maldives	0.36	17,083	44 (36–54)	7.5 (6.1–9.9)	3916	2488.4	8.33 (7.1–11.02)	0.04 (0.04–0.06)	1.50 (1.27–1.97)	0.14 (0.13–0.18)	1.9 (1.8–2.4)
Nepal	28.51	1167	7603 (5433–17,977)	3.3 (2.3–9.5)	384	74.4	3.40 (2.6–7.76)	0.04 (0.03–0.09)	0.38 (0.28–0.99)	0.19 (0.16–0.24)	0.5 (0.4–0.6)
Pakistan	188.92	1939	58,112 (44,995–76,268)	6.9 (5.0–9.8)	897	78.0	7.69 (5.57–10.50)	0.55 (0.4–0.75)	0.53 (0.38–0.72)	2.97 (2.47–3.51)	0.6 (0.5–0.7)
Sri Lanka	20.72	7400	8506 (6595–11,570)	8.5 (6.1–12.8)	5031	183.3	7.24 (5.59–9.78)	0.21 (0.16–0.29)	1.04 (0.82–1.43)	1.83 (1.57–2.18)	1.1 (1.0–1.4)

All data represent annual costs, wages or rates

*Projections for 2030: numbers represent # baseline scenario (# target scenario, # past scenario)

GDP gross domestic product

Source: International Diabetes Federation (IDF) 2015 estimates

Table 3 Components of the total cost of diabetes in percent of GDP

Country	Total costs of diabetes in % of GDP	Direct costs of diabetes in % of GDP	Indirect costs due to absenteeism in* % of GDP	Indirect costs due to presenteeism[#] in % of GDP	Indirect costs due to labour force drop-out in % of GDP	Indirect costs due to mortality in % of GDP
Afghanistan	1.38 (1.13–1.71)	0.70 (0.58–0.93)	0.01 (0.01–0.02)	0.01 (0.00–0.01)	0.04 (0.03–0.05)	0.63 (0.51–0.86)
Bangladesh	0.78 (0.6–1.2)	0.23 (0.18–0.35)	0.02 (0.01–0.03)	0.01 (0.01–0.02)	0.07 (0.06–0.12)	0.45 (0.34–0.68)
Bhutan	0.56 (0.51–0.64)	0.33 (0.3–0.38)	0.02 (0.02–0.03)	0.01 (0.01–0.01)	0.09 (0.08–0.09)	0.11 (0.1–0.13)
India	1.04 (0.87–1.25)	0.46 (0.39–0.56)	0.02 (0.02–0.03)	0.01 (0.01–0.01)	0.11 (0.09–0.13)	0.44 (0.37–0.52)
Maldives	1.50 (1.27–1.97)	1.36 (11.16–1.80)	0.02 (0.01–0.03)	0.01 (0.01–0.01)	0.06 (0.05–0.08)	0.05 (0.04–0.07)
Nepal	0.38 (0.28–0.99)	0.19 (0.14–0.43)	0.01 (0.00–0.02)	0.00 (0.00–0.00)	0.03 (0.02–0.07)	0.16 (0.11–0.46)
Pakistan	0.53 (0.38–0.72)	0.2 (0.15–0.28)	0.02 (0.01–0.02)	0.01 (0.01–0.01)	0.07 (0.05–0.09)	0.23 (0.17–0.32)
Sri Lanka	1.04 (0.82–1.43)	0.26 (0.20–0.35)	0.04 (0.03–0.06)	0.02 (0.02–0.03)	0.18 (0.14–0.25)	0.54 (0.43–0.74)

*indirect costs due to absenteeism = lost work days due to sickness

[#] Indirect costs due to presenteeism = reduced productivity while working

GDP gross domestic product, *IDF* International Diabetes Federation

Source: IDF 2015 estimates

GDP) and Bhutan ($168 or 0.3% of GDP). The lowest mean direct costs per patient are estimated for Bangladesh ($63 or 0.02% of GDP) [10••].

Bommer et al. [68] have also projected the total global costs of diabetes in adults through the year 2030. The authors modelled the absolute and GDP-relative economic burden of diabetes using epidemiological and demographic data for 180 countries. They created three scenarios to model the cost projections (prevalence and mortality): (1) increased only with urbanisation and population ageing (*baseline scenario*), (2) increased in line with previous trends (*past trends scenario*), and (3) achieved global targets (*target scenario*). The absolute global economic burden would increase from $1.3 trillion (95% CI 1.2–1.4) in 2015 to $2.2 trillion (2.1–2.3) in the baseline, $2.5 trillion (2.4–2.6) according to past trends, and $2.1 trillion (2.1–2.2) in the target scenarios by 2030. Total projected diabetes costs would be 1.9% of GDP in Maldives and 1.2% in India [68].

Implications for Future Research, Practice, and Policy

Much of the research on the economic impact of diabetes and strategies to prevent and treat diabetes has been done in high-income countries. However, distinct features of the diabetes epidemic in South Asia as well as disparate health systems heavily dependent on out-of-pocket payment warrant future research specifically on this region, including longitudinal assessment of the cost of diabetes care, and innovations in harnessing the potential role of the local generic drug industry to enhance availability and affordability of diabetes medicines [29]. Further, the access and use of diabetes medicines can be improved through the use of low-cost technology and task-sharing interventions [69].

The current evidence on the microeconomic impact of diabetes in South Asia is dominated by studies from India. No primary cost-of-illness studies provide data for Sri Lanka, Maldives, Afghanistan, or Bhutan, so the findings cannot easily be generalised to the region as a whole. Also, there is a lack of longitudinal studies to confirm a rising trend in diabetes costs as well as of studies evaluating the impact of diabetes on employment and labour market outcomes in South Asia. More research is needed on the effect of undiagnosed diabetes on the labour market, as the people in the South Asia region with undiagnosed diabetes could potentially be at a particularly high risk of complications.

An economic imperative clearly exists for policymakers in South Asia to increase investment in evaluating cost-effective strategies to manage diabetes and preventative approaches [6, 70] (such as taxation of unhealthy foods, education, food labelling, lifestyle interventions including physical activity and health promotion in schools and worksites), both to decrease the incidence of diabetes and to increase early detection as well as provide access to evidence-based treatments to reduce the prevalence of costly complications. Basu et al. showed that a benefit-based tailored treatment (BTT) strategy aimed at lowering the risk of diabetes complications is more cost-effective than a treat-to-target strategy aimed at achieving target levels of biomarkers (BP < 130/80 mmHg, LDLc < 2.59 mmol/l, HbA1c < 7%) in LMICs such as India [71]. Supplemental Table 1 provides a list of cost-effective or cost-saving interventions for the prevention and management of diabetes in South Asia.

Furthermore, the National Health Policy in India (2014) aims to promote health insurance as the key to financial risk protection and recommends the purchase of secondary and

tertiary care services from empanelled public hospitals and private providers [72]. With this policy, the Indian government also makes the case of a tax-funded primary care delivery system with services provided by the public sector and not-for-profit private sector [73]. Although private and social health insurance may be an effective health financing model, it alone cannot substitute for a well-equipped and functional public health system. Sustained improvements in diabetes prevention and care could potentially be achieved by integration of various existing insurance schemes and vertical programmes into a "national health assurance fund" and conversion of the National Health Mission into the Universal Health Coverage mission [72]. Universal health coverage that includes care for diabetes and related chronic diseases would provide benefits beyond individual health, including financial protection for families. However, the mechanisms for achieving universal health coverage are not clearly defined, and debates continue regarding the role of the private sector and insurance [26, 74, 75].

Recommendations on Ways to Mitigate the Economic Impact of Diabetes in South Asia

As South Asian countries find themselves in the midst of a major diabetes epidemic due to a rapid rise in population numbers, increased longevity, high ethnic susceptibility to diabetes, rapid urbanisation, and a shift away from traditional lifestyles, it is important that governments take major steps to minimise the future economic impact of diabetes in South Asia. We offer the following recommendations to policymakers:

1. *Monitor the current burden of diabetes with a focus on the economic burden and the quality of care* to understand the impact of diabetes prevention and control programmes and financial protection policies in real time [76].
2. *Focus on the screening and prevention of diabetes and its risk factors* to decrease microeconomic, social welfare, and macroeconomic costs/impacts [77–80]. Particular emphasis should be placed on a comprehensive and healthy diet, physical activity and tobacco control programs [81–83] and policies outside the health sector, such as those in agriculture, labour, commerce, urban planning, and finance [84].
3. *Strengthen the government health facilities and primary care services*, and improve and monitor the quality of services provided to reduce the economic impact of diabetes in South Asia [85, 86]. Awareness campaigns and information, education, and communication (IEC) activities related to not only the physical and financial implications of diabetes but also the services and facilities provided by the government should be conducted. This will help patients with diabetes evaluate their medical expenditures, plan their finances, and benefit from government schemes, thereby reducing the financial burden of diabetes on individual households.
4. *Expand access to affordable, essential medicines* to improve primary, secondary, and tertiary prevention of diabetes [30, 87] in concert with the robust generic drug-manufacturing sector in the region, especially in India [29]. Diabetes often requires lifelong treatment and so decreasing financial barriers to these medicines, such as by reducing out-of-pocket payments or increasing the availability of generic drugs throughout the South Asia region could reduce the disease burden without increasing the financial risk. Adherence to treatment should be ensured by promoting public awareness campaigns regarding the adverse consequences of diabetes complications, and through strategies such as care coordination, direct patient education, and decision support mechanisms [88, 89].
5. *Prioritise the investment of resources in cost-effective or cost-saving and easy-to-use interventions*. The World Bank recommends that intensive blood pressure control and the self-management of diabetes care by, for example, controlling glucose, blood pressure, and cholesterol levels, as well as annual preventive examinations (eye, microalbuminuria), are the most cost-effective interventions, irrespective of a country's income level [6]. Population-wide approaches to preventing type 2 diabetes such as cost reductions in healthy foods, taxation of unhealthy foods, policies to promote physical activity, and nutritional education and informative food labelling are also found to be cost-effective [84, 90]. Further research on how cost-effective interventions can be implemented in and tailored to specific South Asian countries and urban/rural contexts would be of importance.
6. *Provide greater financial protection through universal health coverage*, financed through increased public spending on health from 1 to 6% of GDP and 15% of tax revenues, along with the integration of the private sector to reduce the financial risk associated with diabetes [74]. Equitable financial protection schemes that reduce out-of-pocket spending at the point of care can provide a safety net to reduce catastrophic health spending, particularly among the poor and vulnerable. While both the rich and poor are susceptible to financial risk and distress from diabetes and its complications, the poor are the most vulnerable and need greater protection [73]. To avoid catastrophic health expenditures, insurance schemes covering direct medical costs in patients with diabetes need to be developed by governments in the region [91].

Conclusion

With an estimated 84 million people suffering from diabetes in South Asia, diabetes imposes a substantial economic burden on individuals, families, and society. Moreover, since the disease burden increasingly occurs in the most productive midlife period, it adversely affects workforce productivity and macroeconomic development. Diabetes-related complications lead to markedly higher treatment costs, causing catastrophic medical spending and illness-induced poverty for many households, thus underscoring the importance of secondary prevention. To mitigate the disabling consequences of diabetes, policymakers need to take urgent action focused on cost-effective (especially cost-saving) interventions to prevent diabetes and control its risk factors, strengthen health system capacity to efficiently manage diabetes, provide financial protection to vulnerable populations (such as through insurance schemes targeted at the poor), and increase public awareness about and policy innovations responding to the economic implications of diabetes.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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- • Of importance
- •• Of major importance

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