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The Economic Costs of Cardiovascular Disease, Diabetes Mellitus, and Associated Complications in South Asia: A Systematic Review

Ian F. Walker, MPH, MFPH^{1,*†}, Fredrike Garbe, MPH, MFPH, MBBS^{1,†}, Judy Wright, MSc², Ian Newell, BMedSc³, Naveen Athiraman, MBBS, MRCPC⁴, Nida Khan, MSc⁵, Helen Elsey, PhD, FFPH¹

¹Nuffield Centre for International Health and Development, University of Leeds, Leeds, UK; ²Leeds Institute of Health Sciences, University of Leeds, Leeds, UK; ³Faculty of Medicine, University of Birmingham, Birmingham, UK; ⁴Newcastle upon Tyne Hospitals NHS Foundation Trust, Newcastle, UK; ⁵Association for Social Development, Islamabad, Pakistan

ABSTRACT

Background: More than 80% of global deaths caused by cardiovascular disease (CVD) and diabetes mellitus (DM) occur in developing countries. The burden of noncommunicable disease in South Asia is increasing rapidly. **Objectives:** To estimate the costs of CVD and the costs of DM to individuals and society in Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. **Methods:** We systematically searched six health and economic databases for studies identifying costs related to CVD or DM and their respective complications. Costs were extracted from included studies and converted to US \$ for the price year 2015 to enable meaningful comparisons. **Results:** Of the 71 articles suitable for full-text review, 29 studies met the inclusion criteria. Most were cost-of-illness studies ($n = 27$) and were from the patient perspective ($n = 23$). Most collected data since 2000 ($n = 23$) and included data from India ($n = 24$). No studies included longitudinal costs at the patient level. Medical costs for routine management of CVD and DM were broadly

similar. These costs escalate significantly once complications occur, which require treatment, particularly for stroke, major coronary events, and amputations. Costs are mainly borne by the individual and family. Some included studies modeled rapidly rising future costs. Most studies included had methodological weaknesses. **Conclusions:** Marked increases in costs have been identified when complications of these chronic diseases occur, underlining the importance of secondary prevention approaches in disease management in South Asia. Higher quality studies, especially those that include longitudinal costs, are required to establish more robust cost estimates.

Keywords: costs and cost analysis, systematic review, cardiovascular diseases, diabetes mellitus, South Asia, complications.

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Introduction

The prevalence of noncommunicable diseases such as cardiovascular disease (CVD) and diabetes mellitus type 2 (DM) is increasing worldwide, especially in low- and middle-income countries (LMICs) [1]. Ischemic heart disease was the single biggest cause of disability-adjusted life-years in the Global Burden of Disease Study [2], with an estimated 31% of all worldwide deaths being due to CVD [3].

The South Asia region has a population of 1.7 billion people, which has tripled since 1950. Life expectancy in the region has increased dramatically from 39 years in 1950 to 65 years today. India's population is by far the largest, with three-quarter of the region's total [4]. Along with the global trend, the prevalence of CVD and DM in the region is expected to continue to increase in the coming years [5]. In South Asia, some of the

main drivers for this expected rise are economic transition, urbanization, and lifestyle changes [6]. The burden of disease is shifting from infectious, maternal, and childhood diseases to noncommunicable diseases. This epidemiological transition has occurred rapidly and CVD, DM, and their complications now contribute a significant burden of disease in these LMICs [7]. For example, in India CVDs are now the leading cause of death in men and women in both rural and urban areas [1,8]. In addition, India is now the country with the second largest number of people living with diabetes at 65.1 million (second only to China at 98.4 million).

According to the World Bank [9], the South Asian region has been the fastest growing economic region in recent years. In 2015, the combined gross domestic product (GDP) of all countries in the region was US \$2,689,862 million. By far the largest economy in the region is India (2015 GDP US \$2,088,841 million). Other

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* Address correspondence to: Ian F. Walker, Room 10.31, Worsley Building, Clarendon Way, University of Leeds, Leeds LS2 9NL, UK.

E-mail: i.walker@leeds.ac.uk

†Joint first authors.

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Table 1 – Example search terms used in the search strategy.

Concept	Subject headings	Text words
Diabetes mellitus	Diabetes Mellitus/	Diabet*, niddm, mody
CVD	Cardiovascular Diseases/Heart Diseases/Hypertension/	Vascular diseases*, cardiovascular diseases*, stroke, thrombosis, heart attack*
South Asia	India/Pakistan/Bangladesh/ etc...	Indian, India, Pakistan*, Nepal*, Afghanistan*
Cost	Costs and Cost Analysis/Budgets/	Cost* of illness, economic* burden, medical expenditure*, economic evaluation*

economies include Pakistan (US \$271,050 million), Bangladesh (US \$195,079 million), Sri Lanka (US \$82,316 million), Nepal (US \$21,195 million), Afghanistan (US \$19,331 million), Maldives (US \$3,435 million), and Bhutan (US \$2,058 million).

Chronic diseases have a significant health impact on individuals and their families. Analysis of noncommunicable diseases in South Asia highlights that although the burden is currently greatest among affluent groups, many adverse risk factors are concentrated among the poor, portending future increases among those with the least resources to manage their condition [10]. The International Diabetes Foundation estimated diabetes-related health care expenditure in 2014 to be approximately US \$6.9 billion in the South Asia region [11]. With limited capacity within the public health system to effectively identify and manage CVD and DM, health care costs are usually borne as out-of-pocket expenditure by the individual and their families in this region, often with catastrophic financial consequences [12–14].

Although some countries in the region are beginning to explore social insurance schemes to fund health care expenditure, there is limited existing evidence to inform policymakers of these costs [15]. A few literature reviews have been conducted, exploring some relevant aspects of this issue. Brouwer et al.'s [16] review of provider costs related to CVD in LMICs found a wide variation in costs but little evidence from low-income countries. Yesudian et al.'s [17] review of the costs of DM in India found medication to be a large proportion of costs, with the burden falling heaviest on the poor and urban populations. Seuring et al.'s [18] review of the economic costs of DM in relation to levels of national GDP found direct costs to be generally higher than indirect costs, with these direct costs being positively associated with a country's GDP per capita. None of these studies adequately addressed the question of all relevant economic costs, focused specifically on the South Asian region.

The aim of this systematic review was to estimate the costs of CVD and the costs of diabetes to individuals and society, in the LMICs of the South Asia region according to the World Bank definition [19], which includes Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. This review sought to identify and collate data from peer-reviewed studies to address the following question: What are the economic costs related to CVD and the economic costs related to DM and their complications on society, the health sector, individuals, and their families in South Asia?

Methods

This review was undertaken according to the Centre for Reviews and Dissemination guidelines for systematic reviews and meta-analyses [20]. A protocol was developed to plan the review, which is available from the authors on request. The review is reported

according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [21].

Search Strategy

In April 2015, we searched the following databases for studies containing costs of CVD and DM in the countries of South Asia:

- EconPapers (RePec)
- Embase Classic Embase (Ovid) 1947 to April 1, 2015
- Global Health (Ovid) 1973 to 2015 week 12
- Ovid MEDLINE(R) 1946 to March week 5 2015
- Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations April 1, 2015
- NHS Economic Evaluation Database: Issue 1 of 4, January 2015 (Wiley)
- WHOLIS World Health Organization Library & Information Networks for Knowledge Database

The search strategy comprised subject headings and text words identified by the project team and known relevant articles for the search concepts CVD, DM, Costs, and South Asia. The CVD search concept was adapted from a Cochrane CVD review [22]. Table 1 lists some of the terms we used; however, the full search strategy can be found in the appendices in [Supplemental Materials](#) found at <http://dx.doi.org/10.1016/j.vhri.2017.05.003>. The results of the electronic searches were stored and managed in an EndNote library. Relevant references, cited in the identified studies, were also included, as well as any relevant studies that the authors already had from previous work. We did not have the financial and human resources to contact study authors.

Inclusion Criteria

Studies were considered as eligible for inclusion if they related to the specified countries in the World Bank South Asia region and if they related to any aspects of “cost” in relation to CVD or DM.

Our aim was to obtain to the fullest extent possible relevant costs related to CVD, DM, and their complications. We used a broad definition of cost including all perspectives and elements of costs or economic impacts. Therefore, we included costs related to CVD or costs related to DM as incurred by service users and their families, service providers, governmental organizations, and society. We included any types of costs regardless of any categorization made by authors including direct, indirect, and/or intangible costs. Inclusion of studies was not restricted by specific participants or settings with the aim of capturing all relevant costs of CVD, relevant costs of DM, and complications of either disease. Study designs included in the review were randomized controlled trials, observational studies, cost-of-illness studies, and systematic reviews.

We included all participants diagnosed with either DM or CVD (including ischemic heart disease, stroke, hypertension, and congestive heart failure) and their complications. We also included studies that included patients with comorbid CVD and DM. In regard to costs of diabetes, our study aims were focused on type 2 DM. However,

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