WHO Global Coordination Mechanism
on the Prevention and Control of Noncommunicable Diseases

Background paper

Evidence to support efforts to address NCDs
within the wider development agenda

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Dialogue on strengthening international cooperation on noncommunicable diseases

Monday 30 November – Tuesday 1 December 2015
Venue: Executive Boardroom, World Health Organization, 20 Avenue Appia,
Geneva, Switzerland
Mandate of Global Coordination Mechanism on the Prevention and Control of Noncommunicable Diseases (GCM/NCD)

This background paper is addressing objective 5, specifically actions 5.1, 5.2 and 2.3 of the GCM/NCD mandate for 2016–2017, listed below.

Action 5.1: Mobilize relevant and selected participants to conduct 12 studies (two per WHO region) on the national public health burden caused by noncommunicable diseases in developing countries, the relationship between noncommunicable diseases, poverty and social and economic development, the cost of inaction, and the cost of action. The outcome of the studies will be published in 2016 and 2017.

Action 5.2: Establish a web-based platform in 2016 to map existing and potential sources and mechanisms of assistance provided by the participants to developing countries in meeting their commitments to tackle noncommunicable diseases in the post-2015 era.

Action 2.3: Facilitate the exchange of information on noncommunicable disease-related research and its translation, identify barriers to research generation and translation, and facilitate innovation in order to enhance the knowledge base for ongoing national, regional and global action.

Abstract

The paper provides the rationale for addressing NCDs within the wider development agenda in the post-2015 era by summarizing the scientific evidence on the economic impact of NCDs.

A review of available evidence (1984–2014), shows that NCDs can impede sustainable development because of their negative impact on macroeconomic productivity, national incomes, health care budgets, household income and impoverishment. However, as shown in this paper, most of this evidence has been generated from high-income countries. Although 82% of the NCD burden is in low- and middle-income countries, there is a glaring lack of scientific evidence from this part of the world.

To attain the Sustainable Development Goals, North–South, South–South and triangular cooperation need to embrace prevention and control of NCDs as well as capacity strengthening of low- and middle-income countries for research, development and innovation.
Introduction

Noncommunicable diseases (NCDs) have been incorporated in the Sustainable Development Goals within goal 3 as global target 3.4, which aims to reduce, by 2030, premature mortality from NCDs by one third. Human, social and economic costs due to NCDs have been reported to be substantial (1, 2). The projected cumulative lost output due to major NCDs in low- and middle-income countries alone, for 2011–2025, has been estimated at more than US$ 7 trillion (3). In economic terms, the savings from reducing the burden of NCDs through the implementation of cost-effective interventions such as the World Health Organization (WHO) “best buys” has a much lower cost (3).

However, the magnitude of the impact estimated using simulations should be considered only indicative. Most models estimate how much economic benefit could be derived from completely eliminating these diseases. In the real world, the different stages at which countries are at in the evolution of the NCD epidemic, and the challenges in reversing long-term trends in risk factors, among other things, place a limit on how much of the economic impact estimated from models can be avoided. Further, as most of the factors that drive the relationship between NCDs and development are contextual, country-specific evidence is critical to gain an in-depth understanding of ways to negate the human, social and economic impacts of NCDs on sustainable development. Such evidence would be central for shaping country efforts and policies to address NCDs within the wider development agenda. Do we have this evidence from all countries? A review of literature presented here highlights the severe shortage of country-specific research evidence on the human, social and economic impact of NCDs in low- and middle-income countries.

NCDs affect economic growth through three main channels (4). First, NCDs can increase health expenditures for households, companies and governments. Second, NCDs exert a negative macroeconomic impact through labour and productivity losses. Third, NCDs affect the incentives for savings and for investment in both physical and human capital. This paper distils the results of studies conducted from 1984 to 2014 on the impact of NCDs on (a) macroeconomic productivity (Annex 1); (b) households and impoverishment (Annex 2); and (c) health care spending and national income (Annex 3), based on three systematic reviews (5–7).

Key findings

Impact of NCDs on macroeconomic productivity

- Most studies (96%) investigating the macroeconomic impact of NCDs are from high-income countries. Among low- and middle-income countries, there is limited evidence available from Argentina, Brazil, Islamic Republic of Iran, Kenya, South Africa and the United Republic of Tanzania.
• Measures of productivity impact reported in studies included disability-adjusted life-years, labour market participation, return to work, absenteeism, presenteeism, change in hours worked, and medical or sickness leave. Most studies focused on the direct impact on the patient but a minority also examined the impact on caregivers and spouses.

• Evidence from available studies indicates that the major NCDs (cardiovascular disease, cancer, chronic respiratory disease, diabetes and chronic kidney disease) generate a large negative impact on macroeconomic productivity.

• Costs from productivity loss due to NCDs were high. For instance, absenteeism and lower employment due to coronary heart disease cost the Australian economy US$ 13.2 billion annually. Total mortality-related lifetime productivity loss from breast cancer cost the United States economy US$ 5.5 billion.

• There were considerable differences related to productivity costs between countries. For instance, while productivity costs related to chronic obstructive pulmonary disease were comparable in Germany, the Netherlands and Sweden, costs differed fourfold in Denmark and tenfold in the United States of America.

• There was also a differential impact of each NCD on high-income and low- and middle-income countries. For instance, among women in high-income countries, breast cancer imposes a large productivity burden, whereas cervical cancer has a more dramatic impact in low- and middle-income countries.

• Despite the greater appreciation of the deleterious role of NCDs on households and impoverishment, there is a shortage of information from low- and middle-income countries. More research is required to investigate the true extent of the impact of NCDs in those countries.

**Economic consequences of NCDs for households and impoverishment**

• NCDs pose a heavy financial burden on many affected households. Limited insurance coverage and lack of social security nets force households to spend large amounts of money on out-of-pocket expenses. Low-income households are especially vulnerable to impoverishment from health care spending due to NCDs.

• Financial costs deter many people suffering from NCDs from seeking the care they need. NCDs are likely to become more severe in the absence of treatment, leading to premature death and greater problems for caregivers and households. Given that the ability to work is one of the most important poverty escape routes, the consequences of not seeking care are of particular concern for poor households.

• Overall, out-of-pocket expenditure as a proportion of family income ranged from 2% to 158% across the different NCDs and countries. Financial catastrophe due to the selected
NCDs was seen in all countries and at all income levels, and occurred in 6% to 84% of households, depending on the chosen catastrophe threshold.

- The impact that NCDs exerts on households and impoverishment is likely to be underestimated, as important economic domains, such as coping strategies and the inclusion of marginalized and vulnerable people who do not seek health care due to financial reasons, are overlooked in the literature.

- Given the scarcity of country-specific information for many low- and middle-income countries, further research to estimate the impact of NCDs on households and impoverishment needs to expand the geographical scope. To gain a better understanding of the impact on impoverishment, such studies need to also include certain NCDs hitherto less well studied, such as environmentally induced chronic kidney disease, cervical cancer, rheumatic heart disease and others that are more prevalent among the poor.

**Impact of NCDs on health care spending and national income**

- Reported health care costs associated with NCDs varied across countries and regions, and across the type of NCDs. Reported annual direct costs of NCDs were the highest in the WHO Region of the Americas, followed by the European and Western Pacific Regions.

- Outcome measures reported in different studies included health care expenditure, national income, hospital spending, gross domestic product (GDP), gross national product, net national income, adjusted national income, total costs, direct costs, indirect costs, inpatient costs, outpatient costs, per capita health care spending, aggregate economic outcome, capital loss in production levels in a country, economic growth, per capita income, percentage change in GDP, intensive growth, extensive growth, employment, direct governmental expenditure and nongovernmental expenditure.

- Health care expenditure for cardiovascular diseases (12–16.5%) was the highest; other NCDs ranged between 0.7% and 7.4% of the overall health care budget. Cardiovascular diseases also had the highest reported direct costs. The maximum annual total direct costs per patient reported for cardiovascular diseases were US$ 81,096 in the Americas, US$ 69,440 in the European Region, and US$ 5,693 in the Western Pacific Region. There is an increase in costs with increased severity of and years lived with NCDs.

- NCDs have a large impact on national income, with estimated losses ranging from US$ 4.1 million due to cervical cancer in Malaysia to US$ 71 billion in Germany and US$ 600 billion in the United States due to coronary heart disease.

- The majority of studies (90%) were from high-income countries. There is an information shortage concerning the true economic burden of NCDs in low- and middle-income countries. Further work is also required to standardize the methods used to assess the economic impact of NCDs to enable comparison and to involve hitherto underaddressed low- and middle-income populations across the world.
Conclusions

The review of available evidence shows that overall, NCDs (a) generate a large negative impact on macroeconomic productivity; (b) impose a large and growing impact on households and impoverishment; and (c) pose a significant financial burden on health care budgets and national incomes, which is likely to increase over time. Prevention and control of NCDs in the post-2015 era should therefore be dealt with within the wider development agenda. Additionally, as health-financing systems are reformed to improve financial risk protection for achieving universal health coverage, the financial burden of NCDs needs to be given due consideration.

It must be noted that most of the available studies on the economic impact of NCDs are from high-income countries. There is a glaring shortage of evidence from low- and middle-income countries, which currently bear 82% of the burden of premature NCD deaths. More research is urgently needed to assess the true economic burden of NCDs in low- and middle-income countries in order to be able to avert their negative impact on sustainable development.

As countries make plans to attain the Sustainable Development Goals, including the targets related to NCDs, more country-specific research is needed on how NCDs affect productivity and drive health expenditure over time, and what can be done to address NCDs more efficiently with available resources and negate the spending impacts on households. The Global Action Plan for the Prevention and Control of Noncommunicable Diseases 2013–2020, endorsed by 194 Member States, reiterates the need for North–South, South–South and triangular cooperation to strengthen the research capacity in low- and middle-income countries (1). Current international and national efforts to develop a holistic strategy to attain the Sustainable Development Goals present a new opportunity to address these critical evidence gaps in low- and middle-income countries.
References


Annex A

Impact on NCDs on macroeconomic productivity

NCDs affect all countries but the burden of premature death, disease and disability is heavily concentrated in LMICs (1, 2). Studies summarized below (table 1), have been systematically reviewed to investigate the macroeconomic impact of NCDs and to identify research gaps particularly in LMICs (3).

Impact of cardiovascular disease on productivity

There is strong evidence on the macroeconomic impact of cardiovascular disease (heart disease and stroke). Of all DALYs on a population level in Spain, 4.2% were attributable to coronary heart disease [4] with an estimated age-standardized rate of 4.7 per 1000 persons per year. In China, DALYs attributable to coronary heart disease were estimated to more than double from 2000 to 2030 [5]. A study from Kenya estimated the DALY to be 68 per 100,000 person-years of observation [6]. Coronary heart disease related productivity loss in the USA was 8539 USD per person per year, 10175 USD per person per year for absenteeism [7] and 2698 USD per person per year for indirect work-related loss [8]. An estimated 4.7 working days per person per year were lost in the USA owing to coronary heart disease [9]. Also in the USA, the odds of experiencing limited amount of paid work due to illness were significantly higher for those with coronary heart disease compared to the control group [11]. Total absenteeism-related costs in Australia were estimated at 5.69 billion USD, mortality-related costs at 23 million USD and costs related to lower employment at 7.5 billion USD [11]. In Denmark workforce participation increased with increasing time from 37% after 30 days to 65% after 5 years of diagnosis [12].

Stroke accounted for 3.5% of all DALYs [4] and the loss of 418,052 DALYs [13]. A study from Kenya reports a rate of 166 DALYs per 100,000 person-years observed [6]. In Western Australia, the average annual stroke-attributable DALY count is an estimated 26,315 for men and 30,918 for women [14]. In Spain, costs after diagnosis increased over time for caregivers of stroke victims [15]. Productivity losses in South Korea were higher for a severe stroke among men (537,724 USD) than women (171,157 USD) [16]. A prospective surveillance study from Tanzania report a mean costs of productivity loss to be 213 USD [17]. Impact of stroke on return to work has been investigated [18-20]. In Nigeria, 55% returned to work at a mean of 19.5 months after stroke. A report from the United Kingdom (UK) found that 47% were unemployed 1 year after stroke [20].

Impact of cancer on productivity

The DALY and dollar costs of cancer were large. With regard to cervical cancer, there are considerable regional differences in the percentage of DALYs attributable to cervical cancer
ranging from 1.6 % in New Zealand to 13.4 % in Brazil [21, 22]. Cervical cancer patients in Argentina reported negative outcomes after 1 year; 45 % of patients reported reduced labor market participation, 28 % experienced work interruption and 5 % changed work [23]. Compared to the general population, cervical cancer survivors had a lower chance in labor force participation after diagnosis in Finland [24].

Of all the DALYs attributable to cancers among women, 27.3 % in New Zealand and 13.4 % in Brazil are attributable to breast cancer [21, 22]. Total mortality-related lifetime productivity loss costs in the USA were estimated to be 5.5 billion USD [26]. Differential return to work and sick absence rates are observed comparing black and white women in the USA; the percentage of white women returning to work three months after diagnosis was 74.2 % compared to 59.6 % of black women [27]. 1 year after primary surgery in Germany, nearly three times as many cancer survivors had left their job as compared to women in the control group. [28] Various studies suggest higher unemployment among breast cancer survivors, reported by around half after 1 year, 72 % after 2 years [29], 43 % after 6 years and 18 % after 9 years [27, 28, 30–32]. In a study assessing unemployment among the spouses of breast cancer patients, no differences were found [33]. Differences were found between countries in average time to return to work, from 11.4 months in the Netherlands [34] and 7.4 months in Canada [35] to only 3 months in Sweden [36]. Percentage of return to work after 1 year ranged from 54.3 % in France to 82 % in the USA [37, 38].

Of all the DALYs attributable to cancers, 12.9 % among women and 13.5 % among men are attributable to colon cancer in New Zealand [22] and 9.3 % among women and 7.5% among men in Brazil [21]. In Spain, 2.1 % of DALY’s overall are attributable to colon cancer [4]. In Iran the total burden of colorectal cancer in 2008 was 52,534 DALYs [39]. In the USA, annual productivity losses were calculated to be 20.9 billion USD [40], while costs due to absenteeism after 1 year of diagnosis was 4245 USD per patient compared to the general population [41].

In New Zealand, of all cancer-attributable DALYs, 14.4 % among women and 15.9 % among men are attributable to lung cancer [22]. In Brazil, lung cancer accounts for 9.8 % of all cancer-related DALYs among women and 24.5 % among men [21]. In Spain, 3.4 % of all DALYs are attributable to lung cancer [4]. Most of the first year of disease (275 days) is spent in sickness absence in Sweden [36] and between 33 and 79 % of lung cancer patients in the USA were unemployed 15 months after diagnosis [43, 46]. Average time to re-enter the labor market was 484 days for full-time work and 377 for part-time work in the Netherlands [50]. The odds of re-entry into the labor market were significantly lower for lung cancer than the general population [24, 25, 51].

**Impact of chronic obstructive pulmonary disease (COPD) on productivity**

COPD patients have a higher chance of working fewer hours, of absenteeism and of poorer work performance (presenteeism). [11, 52, 53]. A COPD patient loses around 8.5 workdays per year
due to disease [10, 54]. Between 39 and 50 % of people stopped working due to the onset of COPD in the Netherlands [55, 56]. COPD-related productivity losses cost the US economy around 88 million USD or around 482,966 working days per year [57]. Modeled annual costs of COPD, estimated at 1.47 billion USD [58], are higher in Japan than the USA. The productivity loss costs per person per year were somewhat comparable between Germany, Sweden and the Netherlands (566, 749 and 938 USD respectively) [57, 59, 60], but differed four-fold to estimated costs in Denmark [61, 62] and more than tenfold to what was estimated in the USA [63]. In the USA, 8.5 work days are lost per person per year on average [10], while COPD patients take an estimated 8.6 days of sickness absence in the Netherlands during a 2 year follow-up period [54]. Also in the Netherlands, 39 % of COPD patients left the labor force due to disease onset [55].

Impact of chronic kidney disease on productivity

Renal dysfunction was independently associated with labor force non-participation [64]. Evaluation of labor market participation in chronic kidney disease patients specifically after dialysis or transplantation, found that 35 % of these CKD patients were unemployed [65].

Impact of diabetes mellitus on productivity

In Spain, nearly 2 % of all mortality-related DALYs are attributable to diabetes mellitus (DM) [4]. In South Africa, 162,877 DALYs annually are attributable to DM [4, 66]. A study from Kenya reports a rate of 364 DALYs per 100,000 observed person-years [6]. An estimated 7.2 days are lost per person per year due to DM in the USA [10] and DM patients have an increased risk of absenteeism, poor performance at work and inability to work [4, 10, 11, 52, 64, 67–69]. Productivity days lost per year due to diabetes ranged from 3.6 to 7.3 [10, 70]. In the USA, proportion of productivity loss was large due to premature mortality (49 %) and poor performance at work (44 %) and total productivity related costs were estimated to be 1,962,314 USD [71].

Diversity in the macroeconomic measures and outcomes

There were considerable global differences in the NCD-attributable DALY burden, especially the differential impact of each NCD comparing high-income countries (HIC) and low- and middle-income countries (LMIC). Lung and colon cancer account for nearly 30 % of all cancer-attributable DALYs in men in New Zealand whereas in Brazil, lung cancer alone accounts for nearly 25 %. Among women in HIC, breast cancer seems to impose a large productivity burden whereas cervical cancer impacts more dramatically in LMIC [4, 21, 22].

In Australia, absenteeism and lower employment due to CHD cost 13.2 billion USD annually, as
well as an additional 23 million USD in mortality-related costs [11]. Evidence suggests that COPD costs around 88 million USD or nearly 500,000 working days per year in the US compared to 1.47 billion in Japan. While annual COPD-related productivity costs were comparable in Germany, Sweden and the Netherlands, costs differed fourfold in Denmark, tenfold in the USA [57, 59–63]. In the USA, nearly half of the annual 1.96 m USD productivity losses due to DM are attributable to mortality, with 44 % attributable to poor performance of work  and just 4 % to absenteeism In South Korea, productivity losses for a stroke were 68 % higher among men compared to women [16]. Around half of all stroke survivors in unemployed after 1 year [20]. In Tanzania, productivity losses after 6 months following stroke were 213 USD on average although these losses were most acutely experienced by those in higher skill roles [17]. COPD patients experience reduced working hours, unemployment, absenteeism and poor performance at work [10, 11, 52–56]. DM patients also have an increased risk of reduced labor market participation [10, 11, 52, 64].

Total mortality-related lifetime productivity loss due to breast cancer were an estimated 5.5 billion USD in the USA [26] and annual productivity losses due to colon cancer costs the US economy 20.9 billion USD [40]. The evidence for breast cancer-related labor market drop-out shows higher unemployment among survivors 1, 2, 6 and 9 years after diagnosis [29–32].

Table 1 Overview of studies (between 1984-2014), investigating the impact of major NCDs on productivity

<table>
<thead>
<tr>
<th>Study reference</th>
<th>Type of outcome</th>
<th>Outcome specified include</th>
</tr>
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</table>
| 11, 25, 28, 30-32, 42-46, 48, 51, 55, 56, 61, 62, 64, 65, 69, 72, 74, 85, 96, 98, 101, 102, 121, 124, 127, 131, 135 | Unemployment | Non participation in the labour force  
Limited amount of paid work possible due to illness |
| 10, 27, 34-36, 38, 54, 72, 93, 94, 112, 117, 137 | Sick leave | Duration of sick leave  
Percent taking sick leave |
| 4-6, 13, 14, 21, 22, 39, 66, 73, 95 | DALYs | Rate per 10,000 people age standardized |
| 7-9, 15, 16, 18, 26, 32, 33, 40, 52, 53, 57-60, 61-63, 67, 68, 70, 71, 79, 81, 84, 90, 92, 97, 98, 105, 107, 108, 109, 113, 125, 128, 135 | Productivity loss | Days lost per patient of working age per year  
Mortality-related total lifetime productivity loss  
Cost of productivity time lost |
| 12, 21, 24, 25, 31, 33, 48, 51, 86, 87, 88, 104, 118, 120, 132, 137 | Labour market participation | Age standardized prevalence of employment  
Age standardized prevalence of sick leave |
Return to work at a given point in time after diagnosis. Time to return to full time work after diagnosis.

Absenteeism days total

Costs of reduced time at work

Presenteeism day total

References


Annex B

Economic consequences of NCDs on households and impoverishment

The burden exerted by NCDs extends beyond morbidity and mortality to economic consequences on households [1–5]. This part summarizes the results of studies (table 2) which have been systematically reviewed to investigate the microeconomic impact of major NCDs (6).

**Microeconomic Impact of cardiovascular disease (heart disease and stroke)**

Household income losses after cardiovascular diseases (CVD) diagnosis were 67.5, 14.3, 26.3 and 63.5 % in high-income families in Argentina, China, India and Tanzania respectively, and were even higher in the lower income groups [37].

In the USA, 10.4 % of coronary heart disease patients reported that out of pocket (OOP) spending was more than 20 % of the family income [59]. CVD patients in India spent 30 % of their annual family income on direct CVD health care [20, 49]. In CVD-affected households in India, 30 % borrowed or sold assets to pay for inpatient treatment, compared to 12 % in matched control households [68]. Also in India, the risk of impoverishment due to CVD was 37 % greater than for communicable diseases [49].

With regard to stroke, the average OOP burden as a percentage of income in Japan ranged between 5.1 and 17.2 % [23]. In China, OOP costs in the first 3 months after diagnosis of stroke was 158 % greater than the annual income. Catastrophic spending (e.g. OOP spending [30 % of annual income) was experienced by 71 %, pushing an estimated 23 % of insured and 62 % of uninsured stroke patients below the 1 USD per day poverty line [39]. In the USA, 27.8 % of stroke patients reported OOP spending at[20 % of the family income [59]. Among Australian stroke survivors, an estimated 473 USD were spent in the first year after diagnosis and 61 % perceived financial hardship after 12 months [47, 51].

**Microeconomic impact of cancer**

In the USA, OOP spending as a percentage of annual income was estimated by two different studies at 9.7 and 44 % for breast cancer [22, 62]. In Canada, the percentage was 2.3 % [31]. In these countries, perceived financial hardship (e.g. worries about, or change for the worse in, financial situation) for breast cancer was reported by 1–92 % of women [30, 31, 42]. This perception of financial burden was experienced by 70 % of breast cancer patients in a study from
Pakistan [8]. When comparing early to late expenditures for health care in up to 80 % of breast cancer patients, 10 % increased credit card debt, 7 % borrowed from friends or family and 5 % left some medical bills unpaid [67].

**Microeconomic impact of chronic obstructive pulmonary disease (COPD)**

In Australia, financial hardship (e.g. worries about, or change for the worse in, financial situation) was felt by 36–78 % of COPD patients [36, 48]. Financial catastrophe, at a 10 % income threshold, was experienced by 46 % of COPD patients. In absolute terms, annual OOP expenditure among COPD sufferers was 2048 USD [48].

**Microeconomic impact of chronic kidney disease**

57 % of Australian chronic kidney disease patients reported financial hardship. Using the same income threshold of 10 %, financial catastrophe was experienced by 71 % of patients with chronic kidney disease. This is equivalent in absolute terms to annual OOP expenditure of 3,755 USD [46]. In Japan, mean annual OOP expenditure was 2,604 USD [38]. OOP expenses due to CKD increased by 60 % between 2002 and 2005. About one third of patients with chronic kidney disease spent more than 10 % of their income OOP [57, 59].

**Microeconomic impact of Type 2 diabetes mellitus**

Mean OOP expenditure per in-patient hospital stay for diabetes mellitus increased from 134 USD to 211 USD between 1995 and 2004 and direct total OOP spending per year was estimated at 262–280 USD [19, 40, 49]. The percent wise household consumption spent OOP ranged between 7.7 and 17.5 % [16, 20]. In Japan, the average OOP burden for diabetes mellitus, as a percentage of household income, ranged from 4.8 to 11.3 % [23].

In the USA, the mean annual OOP diabetes care cost was 1,237 USD and increased by 23 % from 2002 to 2005 [18, 57]. Nearly 40 % of diabetes mellitus cases in the USA experienced catastrophic spending (using the [10 % threshold); 13 % experienced catastrophic spending even above the 20 % threshold [59]. A cross-country analysis, quantified the impoverishing effects of purchasing medicines for different diseases, including DM. Buying lowest price generic or originator brand glibenclamide would plunge either 2 million (5 %) or 3 million (10 %) chronic patients below the 1.25 USD/ day poverty line, respectively. When stratifying across the 16 countries (Kyrgyzstan, Mali, Nigeria, Pakistan, Tajikistan, Tanzania, Uganda, Uzbekistan, Yemen, El Salvador Indonesia, Jordan, Mongolia, Peru, Philippines, Tunisia), these percentages ranged between 0 and 71 % [25].

In 16 low- and middle-income countries (LMIC), 6–11 % of the total population would be impoverished at a 1.25 US dollar/day poverty line if they would have to purchase lowest price generic diabetes medication (6).
### Table 2: Overview of studies (between 1999-2014), investigating the economic impact of major NCDs on households and impoverishment

<table>
<thead>
<tr>
<th>Study reference</th>
<th>Type of outcome</th>
<th>Outcome specified include</th>
</tr>
</thead>
</table>
| 10, 11, 13, 15, 24, 34, 38, 41, 42, 44, 48, 51, 55, 60, 63, 66 | Financial burden | >10% of disposable income  
Per person annual costs  
Total direct costs per patient per year  
Total non health care costs |
| 7, 9, 10, 14, 16, 18, 19, 20, 22, 23, 26, 28, 29, 31-35, 39, 40, 43, 45, 48, 49, 51-53, 56, 57, 62, 64, 65, 69 | Out of pocket expenditure | OOP expenditure per year  
OOP expenditure as a proportion of annual individual income, annual family income, monthly non-food expenditure or household capacity to pay |
| 11, 13, 14, 37, 39, 48, 49, 52, 59 | Catastrophic expenditure | OOP expenditure exceeds 10-40% of household income |
| 25, 39, 49 | Impoverishment | Patients with income above the poverty line and moved below the poverty line due to OOP |
| 12, 16, 17, 21, 27, 30, 37, 50, 53, 61, 70 | Income loss | Reported income loss per patient  
Decrease in individual income  
Decrease in household income |
| 17, 54, 58, 67, 68 | Coping strategy | Time of paid work and leisure time forgone |
| 8, 28, 30, 31, 36, 42, 46, 47 | Hardship | }
References


15. Shugarman LR, Bird CE, Schuster CR, Lynn J. Age and gender differences in Medicare expenditures at the end


Annex C

Financial burden of NCDs at the macroeconomic level

Most NCDs are long-term health conditions that require prolonged individual care and specialized healthcare services (1, 2). Historically, high-income countries experienced the greatest economic consequences of NCDs (3). Yet, as a result of economic growth, epidemiological transition, ageing populations and healthcare system development, low- and middle-income countries (LMICs) now experience a greater impact of NCDs and their risk factors (1-5).

Literature was systematically reviewed (Table 3) to evaluate the financial burden of major NCDs at the macro-economic level in order to quantify: (i) the costs related to NCDs (ii) the per capita healthcare expenditure on NCDs; and (iii) national economic loss due to NCDs; and (iv) the overall aggregate economic impact of the NCDs on national income and healthcare spending (6).

Direct costs

Reported healthcare costs associated with NCDs varied across countries and regions, and across the type of NCDs (Table 4). Reported annual direct costs of NCDs were the highest in the Americas, followed by European and Western Pacific regions. The minimum and maximum mean reported annual total direct costs for CVD were 6,668 USD [7] and 81,096 USD [8], in the Americas, 1,643 [9] USD and 69,440 USD [10] in the European region, and 3,862 USD [11] and 5,693 USD [12] in the Western Pacific regions, respectively.

Worldwide, of all the selected NCDs, cancer and CVD had the highest reported mean annual total direct costs. Average CVD-related direct costs ranged from 1,643 USD [9] in Poland to 81,096 USD [8] in USA. Among cancers, the estimated mean annual total direct costs varied: from 4,595 USD [14] to 82,794 USD [15] for breast cancer; 4,964 USD [16] to 161,048 USD [15] for lung cancer and 2,208 [17] USD to 197,722 USD [17] for colorectal cancer. Only one study from Singapore reported annual total direct costs for cervical cancer with an average estimate of 8,049 USD [18]. COPD annual direct costs varied substantially, with Norway reporting the lowest direct costs (431 USD [19]) and USA reporting the highest (34,101 USD [20]). The lowest direct costs for CKD were observed in Germany with an average estimate of 5,439 USD [21], whereas mean direct costs for CKD in USA were estimated to be up to 71,824 USD [22].
DM average annual direct costs varied from 162 USD [23] in India to 15,611 USD in USA [24]. Inpatient costs are the main source of direct costs for NCDs. Inpatient costs accounted for 47–58 % of total direct costs of COPD [26] and 63 % of total direct costs for DM [27]. Hospital costs represent the main driver of stroke expenditure, accounting for 90 % [28] of total direct costs. Hospitalization charges represented the greatest economic burden (55 %) [29] for the management of colorectal cancer, followed by medical purchases (24 %) and outpatient care (18 %).

Indirect costs

Mean annual estimated indirect costs for NCDs patients were highest for cancer and DM, with estimates up to 24,740 USD [30] and 23,418 USD [31], respectively. Mean annual indirect costs for breast cancer varied extensively, from 2,109 USD [32] to 24,740 USD [30]. The lowest indirect cost for COPD was reported in Japan, with an average estimate of 326 USD [33], and highest in USA (3,393 USD [34]). Mean DM indirect annual costs were estimated at 104 USD in Serbia [35] compared to 7,797 USD in China [27].

Total costs

Cancer and stroke led the total costs with average estimates up to 105,310 USD [30] and 44,937 USD [31] respectively. The mean total cost per patient for breast cancer was estimated at 30,000 USD in Belgium [36] and the USA [37], although the mean costs for metastatic breast cancer were three times higher (105,310 USD [30]). For lung cancer, mean estimates varied from 4,964 USD [16] in Australia to 50,495 USD in USA [38] whereas colorectal cancer total costs were 52,068 USD [38]. Mean COPD total costs were estimated around 1,700 USD in the UK and Japan [33] but exceeded the value of 15,500 USD in Denmark [39]. DM total costs were estimated at an average of 12,920 USD in Sweden [40] whereas estimated mean total costs in Serbia were 1,005 USD [35]. No study reported total costs for cervical cancer or CKD.

Costs of NCDs over time

There was an increase in healthcare costs associated with NCDs over time. One study showed that, despite a 19 % decline in the hospitalization rate for CHD (acute myocardial infarction) in USA, overall healthcare expenditure per patient increased by 17 % from 1998 to 2008 and use of outpatient services increased by 65 % (absolute difference, 1,000 USD) [41] and similarly for heart failure [8]. The average treatment cost of colorectal cancer patients in USA increased by 73 % from 2005 to 2009 [42], mainly driven by the use of new regimens, higher chances of
surgery, and radiation. In USA, COPD-related healthcare costs increased by 5–6% annually [43]. Further, a 29% increase in medical treatment costs for diabetic patients was observed from 1999 to 2001 in Israel [44].

Costs according to disease severity and comorbidity

Overall healthcare costs due to NCDs increased with the severity of the disease, years lived with the condition and co-morbidity [9, 36, 45–55]. Patients with severe stroke had almost a 40% greater increase in costs compared to mild stroke patients [45]. Among cancer patients, given the same stage of diagnosis, those with one, two or three co-morbidities experienced increased costs of 3,737, 4,188 and 10,442 USD respectively [56]. Costs for a diabetic patient tripled between the first and seventh year [57] after diagnosis. An increase in treatment costs of breast cancer by stage was reported [29, 55]. Patients with co-existence of COPD and CVD had 135% higher annual care costs compared with patients without CVD, whereas COPD related total costs were 38% higher [54]. Some studies reported lifetime healthcare costs of NCDs (initial, continuing and terminal care), demonstrating that initial and terminal care are the most costly [13, 15, 58–60].

Healthcare expenditure on NCDs

CVD accounted for 12% of all healthcare expenditure in the European Union (EU) [61]. CHD healthcare-related costs accounted for 14.2–16.5% of the annual healthcare budget in the American region. CKD and cancer accounted for 3.2 and 3.4%, of healthcare expenditure respectively [25, 62]. In the USA, 1.2% of the healthcare budget was spent exclusively on the treatment of breast cancer [25]. The proportion of national healthcare-related expenditure for COPD ranged from 0.7% in Norway [19], 1–3% in the Netherlands [63] and up to 3.8% in Canada [62]. Again in Canada, 3.8% of healthcare expenditure is attributable to DM [62] whereas in the European Union, DM-related healthcare expenditure was an estimated 7.4% [64, 65].

In absolute terms, annual CVD hospital costs in the USA reached an estimated 400 billion USD in 2008, doubling the 195 billion USD in 1995 [66, 67]. In USA, CHD-related hospital costs were estimated at 59.1 million USD in 1995 whereas the CVD-related hospital costs were 130 USD billion in 2010 [68]. In the EU, CVD-related hospital costs were estimated at 151 billion USD in 2003, with CHD accounting for 32.9 billion USD [61]. In Australia, annual hospital costs due to CVD were estimated at 164 million USD in 1997 [69]. In France and Hungary the annual estimated colorectal cancer health-related costs were 565 million USD and 43 million USD respectively [70, 71]. In Iran, the minimum annual healthcare-related cost for colorectal
cancer was estimated at 39 million USD for the period between 2005 and 2010 [72]. For cervical cancer, the estimated costs were 1.83 million USD in Singapore [18], 18.2 million USD in Spain [73], and 12.98 million USD in Malaysia [74]. The estimated total healthcare costs in the USA for lung, colorectal, cervical and breast cancer combined were 5.2 billion [75]. In USA, health-related costs for COPD and CKD in 2005 were an estimated 9.2 billion USD [24]. COPD costs accounted for 232 million USD in Iceland [19] whereas both COPD and DM accounted for 162 million USD in Australia [76]. DM hospital-related costs varied from 9.7 billion USA in the African Region [77], to 41.1 billion USD [65] in Europe and to 160 billion USD in USA [78].

A data series of hospital expenditure on CVD was only available in the USA. This showed a twofold increase in healthcare share from 1995 to 2008, with estimated health costs of 195 billion USD in 1995 to 400 billion USD in 2008 [66, 67]. An increase in healthcare expenditure was also seen for colorectal cancer in Brazil, from 18.54 million USD in 1996 to 37.64 million USD in 2008 [79]. There has been a sharp increase in healthcare spending on most chronic diseases from 2000 to 2008[80].

The estimated cost of CVD in Germany in 1999 was 108.9 billion USD whereas for the entire EU, the estimate was 244.3 billion USD for the year 2003[61, 81]. Stroke costs were up to 1.3 billion USD in Australia, 3.47 billion USD in Canada and 72.4 billion USD in USA [69, 87, 88]. Worldwide, colorectal, lung, breast and cervical cancer made up 41 % (127.8 billion USD) of the 310.15 billion USD aggregate cost of new cancer cases in 2009, with lung cancer posing the highest economic burden (57.4 billion USD) [84]. In the USA, colorectal cancer and lung cancer total costs were 2.5 billion USD [38] each whereas in France, the total colorectal cancer costs were estimated at 1.24 billion USD [70]. In Malaysia, the total estimated cervical cancer costs were 17.1 million [74]. Total COPD costs varied from 133.7 million in the Netherlands to 1.1 billion USD in Sweden and 9.1 billion USD in Japan [33, 47, 85]. Total estimated costs of DM increased from 142.5 billion USD in 1997, to 171 billion USD in 2002 and to 195.5 billion USD in 2007 [78, 86, 89]. DM imposed 30.4 billion USD in costs on the African region and 46.7 billion USD in costs in China [27, 77].

**Impact on national income**

In general, NCDs have a large impact on national income mainly due to loss of productivity as a result of absenteeism and inability to work. There was a 463 billion USD increase in economic loss in USA due to CVD for the period 1993–2008 [66]. In the EU, estimated economic loss in 2003 was 92.9 billion USD for CVD. Estimated loss in national income from CHD-related productivity loss in 1996 was 71 billion USD in Germany [81]. Economic loss from stroke in 1997 was 51.7 million USD in Australia [82] whereas CHD-related productivity loss was 2.2 billion USD in 2004 [83]. Worldwide, economic loss from colorectal, lung, breast and cervical cancer at 2009 year were 13.7, 8.2, 1.7 and 8.4 billion USD respectively [84]. In Malaysia,
estimated income losses from cervical cancer-related productivity loss were 4.1 million USD. In the Netherlands, estimated losses in national income from COPD were 388 million USD [74, 85]. National income losses from DM were estimated at 20.8 billion in the African region in 2000 and at 65.2 billion in 2007 in USA [77, 86].

Table 3 Overview of studies (between 1999-2014), investigating the health care costs of major NCDs

<table>
<thead>
<tr>
<th>Study reference</th>
<th>Type of outcome</th>
<th>Outcome specified include</th>
</tr>
</thead>
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<td>Patient/year</td>
</tr>
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<td>Patient/year</td>
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<td>Direct costs CKD</td>
<td>Patient/year</td>
</tr>
<tr>
<td>9, 27, 30-40, 47, 61, 66, 69, 70, 74, 77, 78, 81-89, 116, 136, 139, 179</td>
<td>Indirect costs NCDs</td>
<td>Patient/year</td>
</tr>
<tr>
<td>9, 16, 27, 30, 31, 33, 35-39, 40, 47, 77, 92, 93, 95, 98, 112, 113, 116, 139, 179</td>
<td>Annual total costs NCDs</td>
<td>Per year</td>
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Table 4. Economic Impact of NCDs by World Health Organization Regions (6)

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35 | Page
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</table>

AMR: American Region; CKD: Chronic Kidney Disease; COPD: Chronic Obstructive Pulmonary Disease; CVD: Cardiovascular disease; DM: Diabetes Mellitus; EUR: European Region; WPR: Western Pacific Region
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