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REVIEW

The global impact of non-communicable diseases on households and impoverishment: a systematic review

Loes Jaspers · Veronica Colpani · Layal Chaker · Sven J. van der Lee · Taulant Muka · David Imo · Shanthi Mendis · Rajiv Chowdhury · Wichor M. Bramer · Abby Falla · Raha Pazoki · Oscar H. Franco

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Abstract The global economic impact of non-communicable diseases (NCDs) on household expenditures and poverty indicators remains less well understood. To conduct a systematic review and meta-analysis of the literature evaluating the global economic impact of six NCDs [including coronary heart disease, stroke, type 2 diabetes mellitus (DM), cancer (lung, colon, cervical and breast), chronic obstructive pulmonary disease (COPD) and chronic kidney disease (CKD)] on households and impoverishment. Medline, Embase and Google Scholar databases were searched from inception to November 6th 2014. To identify additional publications, reference lists of retrieved studies were searched. Randomized controlled trials, systematic reviews, cohorts, case–control, cross-sectional, modeling and ecological studies carried out in adults and assessing the economic consequences of NCDs on households and impoverishment. No language restrictions. All abstract and full text selection was done by two independent reviewers. Data were extracted by two independent reviewers and checked by a third independent reviewer. Studies were included evaluating the impact of at least one of the selected NCDs and on at least one of the following measures: expenditure on medication, transport, co-morbidities, out-of-pocket (OOP) payments or other indirect costs; impoverishment, poverty line and catastrophic spending; household or individual financial cost. From 3,241 references, 64 studies met the inclusion criteria, 75 % of which originated from the Americas and Western Pacific WHO region. Breast cancer and DM were the most studied NCDs (42 in total); CKD and COPD were the least represented (five and three studies respectively). OOP payments and financial catastrophe, mostly defined as OOP exceeding a certain proportion of household income, were the most studied outcomes. OOP expenditure as a proportion of family income, ranged between 2 and 158 % across the different NCDs and countries. Financial catastrophe due to the selected NCDs was seen in all countries

Loes Jaspers and Veronica Colpani have contributed equally to this work.

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L. Jaspers · V. Colpani · L. Chaker · S. J. van der Lee · T. Muka · D. Imo · R. Pazoki · O. H. Franco (✉)
Department of Epidemiology, Erasmus MC, University Medical Center Rotterdam, Office NA 29-16, PO Box 2040, 3000 CA Rotterdam, The Netherlands
e-mail: o.franco@erasmusmc.nl

L. Chaker
Department of Endocrinology, Erasmus MC, Rotterdam, The Netherlands

S. Mendis
Chronic Diseases Prevention and Management, Department of Chronic Diseases and Health Promotion, World Health Organization, Geneva, Switzerland

R. Chowdhury
Department of Public Health and Primary Care, University of Cambridge, Cambridge, UK

W. M. Bramer
Medical Library, Erasmus MC, Rotterdam, The Netherlands

A. Falla
Department of Public Health, Erasmus MC, Rotterdam, The Netherlands

A. Falla
Division of Infectious Disease Control, Municipal Public Health Service (GGD) Rotterdam-Rijnmond, Rotterdam, The Netherlands

and at all income levels, and occurred in 6–84 % of the households depending on the chosen catastrophe threshold. 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. NCDs impose a large and growing global impact on households and impoverishment, in all continents and levels of income. The true extent, however, remains difficult to determine due to the heterogeneity across existing studies in terms of populations studied, outcomes reported and measures employed. The impact that NCDs exert on households and impoverishment is likely to be underestimated since 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 literature. Given the scarcity of information on specific regions, further research to estimate impact of NCDs on households and impoverishment in LMIC, especially the Middle Eastern, African and Latin American regions is required.

Keywords Non-communicable diseases · Impoverishment · Households · Systematic review

Introduction

Improvements in healthcare, hygiene and sanitation have increased the possibility to live until older age. Together with a growing global population, this has meant that non-communicable diseases (NCDs), including coronary heart disease (CHD), stroke, chronic obstructive pulmonary disorder (COPD), cancer, type 2 diabetes mellitus (DM) and chronic kidney disease (CKD), are now the leading causes of morbidity and mortality worldwide. The burden exerted by NCDs extends beyond morbidity and mortality and generates an enormous societal impact, including on households and impoverishment [1–5].

Limited insurance coverage and lack of social security nets can force households of NCD patients to spend large amounts of money out-of-pocket (OOP). NCDs reduce family income, savings and consumption of non-health items, and prompt early retirement [6, 7]. The impact of NCDs on households is likely to be especially severe in low- and middle-income countries (LMIC) where low-income populations, many of whom already experience extreme absolute poverty and precarious living conditions, are especially vulnerable to impoverishment due to any degree of healthcare spending [1, 8–10]. With some exceptions, such vulnerable groups suffer a double burden of chronic and infectious diseases [2, 10–13]. The interplay between exposure to disease and financial vulnerability among low-income households can drive families and societies into deeper poverty.

Despite greater appreciation on the likely deleterious role of NCDs on households and impoverishment, the extent of this impact in various geographical regions, is unclear. While several studies have addressed the issue, they have not been systematically evaluated in a single comprehensive investigation. Therefore, we report a systematic review to investigate the economic consequences of the major NCDs on the micro-economic indicators (1) at the level of households (such as consumption choices, coping strategies, OOP, direct and indirect costs) and (2) of poverty (such as financial burden, catastrophic spending, impoverishment, poverty line and financial vulnerability), across various global regions.

Methods

Conceptual framework

To guide the systematic review of the literature regarding the household impact of NCDs, a conceptual framework was adopted. This theory, previously described by McIntyre and colleagues, focuses on the economic consequences of illness and paying for health care [14]. The economic consequences that NCDs incur on the household level are preceded by levels of perceived illness and the resulting treatment seeking behaviour. Seeking care can lead to economic consequences in the form of direct (e.g. costs for hospitalization, medicines, transportation) and indirect costs (e.g. time costs of informal caregivers, time costs of the ill). The indirect costs associated with not seeking care can exert a similar burden on the microeconomic level. Economic consequences in combination with divergent coping strategies (e.g. household labour substitution, use of savings, changing consumption choices) can result in poverty.

Although the importance of the first two steps (perceived illness and treatment seeking behaviour) is conclusive, the focus of this review was on economic consequences, coping strategies and poverty.

Search strategy and inclusion criteria

We conducted a systematic search of electronic medical databases (Medline, Embase and Google Scholar) from inception to November 6th 2014 to identify scientific articles assessing the economic consequences of NCDs on households and on impoverishment. Given their large burden in populations worldwide, the following NCDs were selected: CHD, stroke, COPD, DM, cancers (lung, colon, breast, and cervical) and CKD [1]. The step-wise

inclusion and exclusion procedure outlined in Fig. 1 was followed. Eligible study designs included randomized controlled trials (RCTs), systematic reviews (used to identify further references), cohort, case–control, cross-sectional, ecological studies and modeling studies. Studies were included evaluating the impact of at least one of the selected NCDs and on at least one of the measures of interest: expenditure on medication, transport, co-morbidities, OOP or other indirect costs; consumption choices, coping strategies, impoverishment, poverty line and catastrophic spending; the household or individual financial cost. Only studies carried out in adults (>18 years old) were included and no language or date restrictions were considered. The search strategy in "Appendix 1" was applied.

Study selection

Two independent reviewers reviewed the abstracts and selected eligible studies. Any disagreements between the two reviewers were resolved through consensus or consultation of a third reviewer. To ensure consistent application of the inclusion criteria, a sample of the full texts was reviewed by a third reviewer. The references of the retrieved studies were scanned to identify additional relevant publications that were missed by the initial search. Authors of included studies were contacted to retrieve missing full texts and to identify any missing studies.

Data extraction

A data collection form was prepared to extract the relevant information from the included full texts, including study design, World Health Organization (WHO) region, characteristics of study participants, and characteristics of the NCDs evaluated and measures included. Local currencies were converted to US dollars (USD) to enhance comparability between the eligible studies, preferably using exchange rates given by the studies, if used. If no exchange rate was given, a conversion rate of the publication year of the study was used. All USD were converted to dollars of 2013 using the consumer price index conversion factors [15].

Quality evaluation

To evaluate the quality of all studies included, the Newcastle–Ottawa Scale (NOS) was applied [16]. NOS scale assesses the quality of the articles in three domains of selection, comparability and exposure. Within the selection category, four items are assessed and maximum one star

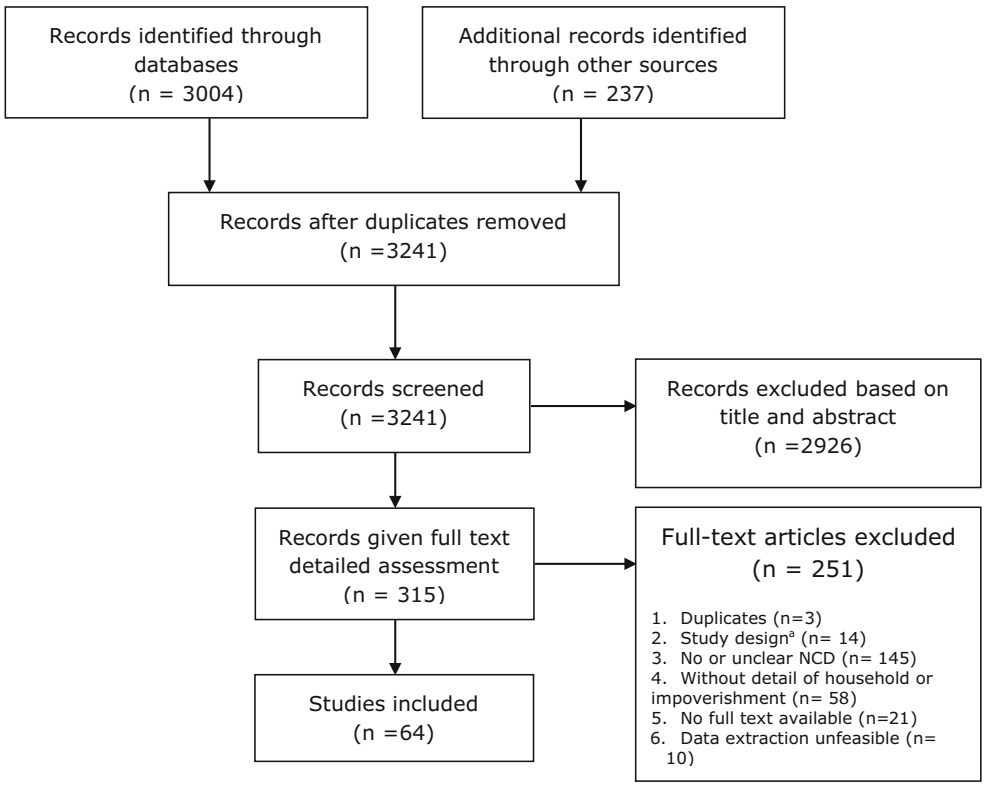

Fig. 1 Flowchart of Studies for the Global Economic Impact of NCDs on Households and Impoverishment. [a]This exclusion criterion includes letters, abstracts and conference proceedings

can be awarded to each item. Two stars can be awarded to the one item within the comparability category. Finally, one star can be awarded to each of the three items in the exposure category. A score was made by adding up the number of stars and therefore, NOS scale can have maximum nine stars for the highest quality. For cross-sectional and descriptive studies, an adapted version of NOS scale was used ("Appendix 2").

Statistical methods

Heterogeneity permitting, we sought to pool the results using a random effects meta-analysis model. If pooled, results were expressed as the pooled estimate and the corresponding 95 % confidence intervals. All costs presented are converted in USD 2013.

Results

From 3,241 references initially identified, 64 studies met the inclusion criteria (Fig. 1; Table 1) [17–80]. The eligible studies were published between 1999 and 2014, and included more than 835 million individuals.

General characteristics of the included studies

Of these 64 studies, three studies focused on multiple WHO regions, 20 studies originated from the WHO Western Pacific region and 25 from the WHO region of the Americas [22 from Canada or the United States of America (USA)]. Thirteen studies were from South-East Asia (eight from India); five studies from Europe and the African region contributed four studies. We found three studies from the Eastern Mediterranean region.

Fifty-seven studies had an observational design, of which twelve were prospective cohort studies, one was retrospective and 44 cross-sectional. One study presented a retrospective analysis of a randomized clinical trial and six were economic modeling studies. Most of the studies (51) used solely self-reported NCDs and economic measures data. Eligible participants were mostly sampled from hospitals, from disease registries or the general population. The remaining thirteen studies used data from regional, national and international databases and insurance data. In less than half of the studies, a control group was present; this was either a sample of the general population or sometimes sought within the same environment as the patients (e.g. same insurance company, same registry).

Sixteen studies focused on the impact of more than one NCD on households and impoverishment. The most frequently studied diseases were breast cancer and DM. Of the studies reporting on cancers, breast cancer was included in 21 studies, followed by colon cancer (eleven studies), lung cancer (eight studies) and cervical cancer (four studies). Two studies mentioned cancer, without specifying cancer types. DM was the NCD of interest in 21 studies, stroke in ten, CVD in eight and CKD in five studies. Three studies focused on COPD and three on NCDs in general terms.

Quality of the included studies

A quality score was appointed to all except 2 of the 64 included studies (Tables 2, 3, 4, 5, 6, 7, 8). In these two studies quality assessment was unfeasible due to their methodology and design. The median quality score over all the studies was 4.5 out of 9 (interquartile range 3–6). Two thirds of the eligible studies scored 5 points or less, indicating that the majority of the studies were of low or moderate quality.

Measures of economic impact on households and impoverishment

There was substantial heterogeneity among the studies in the measurement methods of the economic impact of NCDs on households and impoverishment. Therefore, pooling the outcomes of the included studies was not feasible.

For economic consequences (e.g. direct and indirect costs), OOP cost was the most common measure evaluated and was reported either as absolute costs or as a percentage of varying income proxies (e.g. individual income, family income, monthly non-food expenditure or household capacity to pay). Different OOP definitions were applied and could include the following expense types: cost of treatment or hospitalization (direct medical costs) and, among others, costs for transportation, food and lodging (referred to as direct non-medical costs or indirect costs). For catastrophic spending, mostly defined as a scenario in which OOP costs exceed a certain percentage of household income, different thresholds ranging from 10 to 40 % were used. Studies applying higher thresholds (e.g. 40 %) did not necessarily find lower percentages of households that experience financial catastrophe when compared to studies using lower thresholds (e.g. 10 %). Two other frequently reported measures of micro-economic burden were income loss and perceived financial hardship (e.g. worries about or change for the worse in financial situation), the latter capturing a different, more subjective perspective of the economic impact of NCDs on individuals and households.

Of the 64 eligible studies, five reported on the impact of NCDs on coping strategies, wherein the applied definitions differed between studies. Impoverishment was reported in three studies and was expressed as the percentage of people

Table 1 General characteristics of the studies included in this review

Source	Period of surveillance	Location	WHO region	Study design	Sampling	Number in analysis	Gender	Ethnicity	Reported NCD
Arozullah et al. [72]	1999–2002	USA	Americas	Cross sectional	Convenience	156	Female	White/Caucasian 26 %, Black/ African 10 %, Latino/Hispanic 5 %, Asian 4 %, other 1 %	Breast cancer
Arrossi et al. [71]	2002–2004	Argentina	Americas	Cross sectional	Convenience	120	Female	NR	Cervical cancer
Baanders and Heijmans [70]	2003	Netherlands	Europe	Cross sectional	Random	1,093	Both	NR	DM,CVD and COPD
Banthin and Bernard [69]	1996–2003	USA	Americas	Economic modeling study	Random	47,992	Both	NR	DM, CVD, stroke, CKD and cancer
Bennett et al. [68]	2007–2008	New Zealand	WPR	Cross sectional	Convenience	68	Both	White 88.2 %, Maori 7.4 %, Pasifica 1.5 %, other 2.9 %	Breast, colon and cervical cancer
Bernard et al. [73]	2001	USA	Americas	Cross sectional	Random	1,660	Both	White, Black, Hispanic	DM, CVD
Campbell et al. [67]	2002–2005	USA	Americas	Cross sectional	Convenience	622,401	Both	NR	DM, CKD
Chang [66]	2006–2007	Taiwan	WPR	Cross sectional	Convenience	498	Both	NR	DM
Chang et al. [74]	1998–2000	USA	Americas	Retrospective matched-cohort control	Convenience	50,836	Both	NR	Lung and colon cancer
Chatterjee et al. [65]	2008	Thailand	SEAR	Cross sectional	Random	190	Both	NR	DM
Chirikos et al. [63]	NR	USA	Americas	Case control	Convenience	210	Female	White 90 %, Hispanic 4 %	Breast cancer
Chirikos et al. [64]	NR	USA	Americas	Case control	Convenience	210	Female	White 90 %, Hispanic 4 %	Breast cancer
Davidoff et al. [62]	1997–2007	USA	Americas	Cohort study	Convenience	1,868	Both	White 82.1 %, Black 8.6 %. Hispanic 5.8 %, other 3.5 %	Breast, lung and colon cancer
Dewey et al. [61]	1997	Australia	WPR	Economic modeling study	Random	263	Both	NR	Stroke
Dewey et al. [75]	1996–1997	Australia	WPR	Cross sectional	Convenience	165	Both	NR	Stroke
Eaker et al. [60]	1993–2003	Sweden	Europe	Cohort study	Random	28,566	Female	NR	Breast cancer
Engelgau et al. [59]	1995–2004	India	SEAR	Cross sectional	Random	1,080,000	NR	NR	DM, CVD and cancer
Essue et al. [58]	2001–2008	Australia	WPR	Cross sectional	Convenience	218	Both	NR	COPD

Table 1 continued

Source	Period of surveillance	Location	WHO region	Study design	Sampling	Number in analysis	Gender	Ethnicity	Reported NCD
Essue et al. [57]	NR	Australia	WPR	Prospective cohort study	Convenience	414	Both	NR	Stroke
Essue et al. [56]	2001–2008	Australia	WPR	Cross sectional	Convenience	247	Both	NR	CKD
Falconer et al. [55]	NR	Vanuatu	WPR	Cross sectional	Convenience	172	Both	NR	DM
Gerzeli et al. [54]	NR	Italy	Europe	Economic modeling study	Random	449	Both	NR	Stroke
Goldhaber-Fiebert et al. [53]	2005–2008	India, China, Thailand and Malaysia	SEAR, WPR	Cross sectional	Convenience	10,875	Both	NR	DM
Gordon et al. [52]	2002–2004	Australia	WPR	Longitudinal study	Random	296	Female	NR	Breast cancer
Gordon et al. [51]	2006–2007	Australia	WPR	Cross sectional	Convenience	139	Female	NR	Breast cancer
Grover et al. [50]	NR	India	SEAR	Cross sectional	Convenience	50	Both	NR	DM
Grunfeld et al. [76]	1997–2000	Australia	WPR	Prospective cohort study	Convenience	89	Both	NR	Breast cancer
Heeley et al. [49]	2006	China	WPR	Prospective cohort study	Convenience	6,416	Both	NR	Stroke
Higashiyama et al. [48]	2002–2003	Japan	WPR	Cohort study	Convenience	4,026	Both	NR	CKD
Huffman et al. [47]	NR	Argentina, China, India, Tanzania	Americas, Africa, SEAR, WPR	Cross sectional	Random	1,655	Both	NR	CVD
Jagsi et al. [77]	2005–2007	USA	Americas	Longitudinal cohort study	Convenience	1,502	Female	White 42.7 %, Black 17.4 %	Breast cancer
Jeon et al. [46]	2007–2008	Australia	WPR	Cross sectional	Convenience	66	Both	NR	COPD, DM
Joshi et al. [45]	Feb-April, 2010	India	SEAR	Cross sectional	Convenience	166	Both	NR	DM
Kang et al. [44]	2001–2004	Korea	WPR	Economic modeling study	Random	50,000,000[a]	NR	NR	Stroke
Karan et al. [78]	2004	India	SEAR	Cross sectional	Convenience	383,000	Both	NR	CVD
Kelley et al. [79]	2002–2008	USA	Americas	Prospective cohort study	Convenience	3,209	Both	White 8.8 %, Black 12.9 %. Hispanic 6.2 %, other 2.1 %	DM, CVD, and CKD
Khowaja et al. [43]	July-Sep 2006	Pakistan	EMR	Cross sectional	Random	345	Both	NR	DM

Table 1 continued

Source	Period of surveillance	Location	WHO region	Study design	Sampling	Number in analysis	Gender	Ethnicity	Reported NCD
Lauzier et al. [40]	2003	Canada	Americas	Prospective cohort study	Convenience	459	Female	NR	Breast cancer
Lauzier et al. [42]	2003	Canada	Americas	Prospective cohort study	Convenience	693	Female	NR	Breast cancer
Lauzier et al. [41]	2003–2004	Canada	Americas	Prospective cohort study	Convenience	1,191	Both	NR	Breast cancer
Longo and Bereza [39]	NR	Canada	Americas	Cross sectional	Convenience	282	Both	NR	Breast, lung and colon cancer
Markman and Luce [38]	May, 2008	USA	Americas	Cross sectional	Convenience	1,767	Both	NR	Breast, lung and colon cancer
McKevitt et al. [37]	Feb-Jun 2009	UK	Europe	Cross sectional	Convenience	799	Both	White 90 %, Black 6 %	Stroke
Moore [36]	NR	USA	Americas	Cross sectional	Convenience	30	Female	White 43 %, Black 53 %, Asian/ Pacific 3 %	Breast cancer
Niens et al. [35]	2000–2006	16 Countries	All except Europe	Economic modeling study	Random	763,234,000[a]	NR	NR	DM
Obi and Ozumba [34]	1995–2004	Nigeria	Africa	Cross sectional	Convenience	144	Women	NR	Cervical cancer
Okumura and Ito [33]	2007	Japan	WPR	Cross sectional	Random	20,736	Both	NR	DM, CVD and stroke
Pisu et al. [32]	NR	USA	Americas	Retrospective trial analysis	Random	261	Female	Caucasian 82 %, Minority 18 %	Breast cancer
Ramachandran et al. [31]	1998–2005	India	SEAR	Cross sectional	Random	556	Both	NR	DM
Rao et al. [30]	2004	India	SEAR	Cross sectional	Random	2,567	Both	NR	DM and CVD
Rayappa et al. [29]	NR	India	SEAR	Cross sectional	Convenience	620	Both	NR	DM
Riewpaiboon et al. [80]	2006	Thailand	SEAR	Cross sectional	Convenience	101	Both	NR	Stroke
Rodbard et al. [28]	2005–2006	USA	Americas	Cross sectional	Random	3,551	Both	White 85 %	DM
Shankaran et al. [27]	2008–2010	USA	Americas	Cross sectional	Convenience	555	Both	White 83.5 %, nonwhite 16.5 %	Colon cancer
Shobhana et al. [26]	NR	India	SEAR	Cross sectional	Convenience	596	Both	NR	DM
Shugarman et al. [25]	1996–1999	USA	Americas	Cross sectional	Convenience	6,657	Both	White 91.2 %, Black 8.8 %	Colon cancer
Su et al. [24]	2000–2001	Burkina Faso	Africa	Cross sectional	Convenience	6,192	NR	NR	NCD
Sun et al. [23]	2005–2006	China	WPR	Cross sectional	Random	3,944	Both	NR	NCD

Table 1 continued

Source	Period of surveillance	Location	WHO region	Study design	Sampling	Number in analysis	Gender	Ethnicity	Reported NCD
Syse and Tonnessen [22]	2008	Norway	Europe	Economic modeling study	Random	1,039,100	Both	NR	Breast, cervical, colon and lung cancer
Thuan et al. [21]	2001–2002	Vietnam	WPR	Cross sectional	Random	2,727	NR	NR	NCD
van Houtven et al. [20]	2005	USA	Americas	Cross sectional	Convenience	1,629	Both	White 77.8 %, Black/African 14.1 %, Latino 5.4 %, other 13.3 %	Colorectal and lung cancer
Yabroff et al. [19]	1999–2003	USA	Americas	Cross sectional	Convenience	718,907	Both	NR	Breast, lung and colorectal cancer
Zaidi et al. [18]	2009–2010	Pakistan	EMR	Cross sectional	Convenience	67	Female	NR	Breast cancer
Zhou et al. [17]	2005–2006	China	SEAR	Cross sectional	Convenience	1,631	Both	NR	Breast, lung and colorectal cancer

COPD chronic obstructive pulmonary disease, *CKD* chronic kidney disease, *CVD* cardiovascular disease, *DM* diabetes mellitus, *EMR* Eastern Mediterranean region, *NCD* noncommunicable diseases, *NR* not reported, *SEAR* South-East Asia Region, *UK* United Kingdom, *USA* United States of America, *WHO* World Health Organization, *WPR* Western Pacific region

[a] Population numbers based on World Bank Data, http://www.worldbank.org/

dropping below the 1, 1.25 or 2 USD per day poverty line due to the economic burden of treatment.

Impact of cardiovascular disease

Huffman et al. (Table 2) reported that 14.3 % of high-income families in China experienced some form of household income loss due to cardiovascular disease (CVD) hospitalization, rising to 26.3 % in India, to 63.5 % in Tanzania, and to 67.5 % in Argentina. This impact was patterned by socio-economic position, as greater household CVD-attributable income losses were reported for lower income groups [47]. In the USA, 10.4 % of CHD patients reported that OOP spending was more than 20 % of the family income [69]. CVD patients in India spent 30 % of their annual family income on direct CVD health care, where mean OOP per hospitalization increased from 364 USD in 1995–575 USD in 2004 [30, 59]. In CVD-affected households in India, >30 % borrowed or sold assets to pay for inpatient treatment, compared to 12 % in matched control households [78]. Also in India, the risk of impoverishment due to CVD was 37 % greater than for communicable diseases [95 % confidence interval (CI) 1.2–1.5] [59].

Impact of stroke

The average OOP burden as a percentage of income in Japan ranged between 5.1 and 17.2 % (Table 3) [33]. 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 [49]. In the USA, 27.8 % of stroke patients reported OOP spending at >20 % of the family income [69]. Among Australian stroke survivors, an estimated 473 USD were spent in the first year after diagnosis and 61 % perceived financial hardship after 12 months [57, 61].

Impact of cancer

All but five of the 28 studies reporting on cancer originated from high-income countries (Table 4). OOP spending as a percentage of annual income was estimated by two different studies at 9.7 and 44 % for breast cancer in the USA [32, 72]. In Canada, the percentage was 2.3 % [41]. 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 [40, 41, 52]. This perception of financial burden was experienced by 70 % of breast cancer patients in a study from Pakistan [18]. When comparing early to late expenditures for

Table 2 Results of the included studies investigating the impact of cardiovascular disease on households and impoverishment

Study	Type of outcome	Outcome Specified as	Assessment type	Point estimate	SD for mean	95 % CI	Quality score
Baanders and Heijmans [70]	Financial burden	Economic consequences perceived by the partners	B coefficient[b]	0.03	NA	NA	3
Banthin and Bernard [69]	Catastrophic expenditure	>20 % of family income, per year	Percent	10.4	NA	NA	8
Bernard et al. [73]	Financial burden	>10 % of disposable income, in nonelderly adults	Percent	36.5	NA	NA	4
	Financial burden	>10 % of disposable income, in elderly adults	Percent	67.5	NA	NA	
Engelgau et al. [59]	OOP	Per hospital stay, private + public (1995–1996)	Mean, $	364	NA	NA	7
	OOP	Per hospital stay, private + public (2004)	Mean, $	575	NA	NA	
	Catastrophic expenditure	Patients with CVD and injuries versus CDs	OR	1.12	NA	(0.99; 1.27)	
	Impoverishment	Patients with CVD and injuries versus CDs	OR	1.37	NA	(1.23; 1.53)	
Huffman et al. [47]	Income loss	Decrease in individual income in high income group, in Argentina	Percent	57.3	NA	NA	5
	Income loss	Decrease in household income in high income group, in Argentina	Percent	67.5	NA	NA	
	Catastrophic expenditure	>40 % OOP of non-food expenditures and distress financing, in Argentina	Percent	11.0	NA	NA	
	Income loss	Decrease in individual income in high income group, in China	Percent	13.1	NA	NA	
	Income loss	Decrease in household income in high income group, in China	Percent	14.3	NA	NA	
	Catastrophic expenditure	>40 % OOP of non-food expenditures and distress financing, in China	Percent	56.6	NA	NA	
	Income loss	Decrease in individual income in high income group, in India	Percent	25.1	NA	NA	
	Income loss	Decrease in household income in high income group, in India	Percent	26.3	NA	NA	
	Catastrophic expenditure	>40 % OOP of non-food expenditures and distress financing, in India	Percent	82.0	NA	NA	
	Income loss	Decrease in individual income in high income group, in Tanzania	Percent	63.0	NA	NA	
	Income loss	Decrease in household income in high income group, in Tanzania	Percent	63.5	NA	NA	
	Catastrophic expenditure	>40 % OOP of non-food expenditures and distress financing, in Tanzania	Percent	84.3	NA	NA	
Karan et al. [78]	Coping strategy	Borrowed or sold assets to pay for inpatient treatment, in affected households	Percent	32.6	NA	30.74–34.59	8
	Coping strategy	Borrowed or sold assets to pay for inpatient treatment, in matched control households	Percent	12.8	NA	11.41–14.20	
Kelley et al. [79]	OOP	OOP spending in the last 5 years of life	Mean, $	41,906	NA	NA	3
Okumura and Ito [33]	OOP	Average OOP burden for IHD + SPD	Percent	11.1	NA	NA	5
	OOP	Average OOP burden for IHD + MPD	Percent	6.6	NA	NA	
	OOP	Average OOP burden for IHD + noncase	Percent	9.5	NA	NA	
Rao et al. [30]	OOP	Household consumption expenditure, per year	Percent	30.0[a]	NA	NA	1
	OOP	OOP per hospitalization	Mean, $	284	NA	NA	

CD Communicable Diseases, *CI* Confidence Interval, *CVD* Cardiovascular Disease, *IHD* Ischemic Heart Disease, *MPD* mild psychological distress, *NCD* Non-communicable Diseases, *NA* Not Applicable, *OOP* out-of-pocket, *OR* Odds Ratio, *SD* Standard Deviation, *SPD* Serious Psychological Distress

[a] value adjusted for insurance reimbursement

[b] model includes disease characteristics

Table 3 Results of the included studies on the impact of stroke on households and impoverishment

Study	Type of outcome	Outcome specified as	Assessment type	Point estimate	SD for mean	95 % CI	Quality score
Banthin and Bernard [69]	Catastrophic expenditure	>20 % of family income, per year	Percent	27.8	NA	NA	8
Dewey et al. [61]	OOP	OOP costs, for first ever stroke, in first year	Mean, $	473	NA	NA	4
	OOP	Indirect costs, for first ever stroke, in first year	Mean, $	900	NA	NA	
	Financial burden	Total costs per case, for first ever stroke, in first year	Mean, $	14,593	NA	NA	
Dewey et al. [75]	OOP	OOP costs over 12 months after stroke	Mean, $	1,399	NA	NA	3
	OOP	Personal transport costs, per year	Mean, $	257	NA	NA	
Essue et al. [57]	Hardship	Participants that reported hardship after disease	Percent	61.0	NA	NA	4
Gerzeli et al. [54]	Financial burden	Total social costs per patient in, per year	Mean, $[a]	37,577	37198	(−35,331; 110,486)	3
	Financial burden	Total health care costs per patient, per year	Mean, $[a]	19,784	NA	NA	
	Financial burden	Total direct costs per patient, per year	Mean, $[a]	34,369	NA	NA	
	Financial burden	Total non-health care costs per patient, per year	Mean, $[a]	14,588	NA	NA	
Heeley et al. [49]	OOP	OOP expenses, per year	Mean, $[a]	9,230	10,061	(−10,489; 28,951)	4
	OOP	OOP expenses in the first 3 months as a proportion of total annual income	Percent	158	NA	NA	
	Catastrophic expenditure	>30 % family income, per year	Percent	71.0	NA	NA	
	Impoverishment	Patients with income above the poverty line and moved below the poverty line due to OOP[b]	Percent	37.0	NA	NA	
Kang et al. [44]	Financial burden	Per person annual costs of nonfatal stroke in first year, for men	Mean, $	5,545	NA	NA	NA
	Financial burden	Per person annual costs of nonfatal stroke in first year, for women	Mean, $	4,483	NA	NA	
	Financial burden	Costs of fatal stroke, for men	Mean, $	7,981	NA	NA	
	Financial burden	Costs of fatal stroke, for women	Mean, $	42,171	NA	NA	
	OOP	Per person annual OOP costs of nonfatal stroke in first year, for men and women	Mean, $	1,490	NA	NA	
McKevitt et al. [37]	Income loss	Reported income loss, per patient	Percent	18	NA	NA	7
Okumura and Ito [33]	OOP	Average OOP burden for stroke + MPD	Percent	5.1	NA	NA	5
	OOP	Average OOP burden for stroke + noncase	Percent	7.4	NA	NA	
	OOP	Average OOP burden for stroke + SPD	Percent	17.2	NA	NA	
Riewpaiboon et al. [80]	Hardship	Time of paid work and leisure time forgone, per month	Percent	28.0	NA	NA	3

CI Confidence interval, *MPD* mild psychological distress, *NA* not applicable, *OOP* out-of-pocket, *SD* standard deviation, *SPD* serious psychological distress

[a] Per month or per quarter means and SD were recalculated to annual values to make the eligible studies better comparable. Per month mean and SD: times 12; per quarter mean and SD: times 4

[b] Poverty line defined as US$ 1,00/day

Table 4 Results of the included studies on the impact of cancers on households and impoverishment

Study	Type of outcome	Outcome specified as	Assessment type	Point ESTIMATE	SD for mean	95 % CI	Reported NCD	Quality score
Arozullah et al. [72]	OOP	Direct medical cost, per year	Mean, $[a]	8,833	14,249	(−19,094; 36,761)	Breast cancer	2
	OOP	Direct medical cost ratio	Percent	24.0[b]	82.0	NA	Breast cancer	
	OOP	Direct non-medical cost, per year	Mean, $[a]	1,938	335	(−4,644; 8,521)	Breast cancer	
	OOP	Direct non-medical cost ratio	Percent	3.0[b]	5.0	NA	Breast cancer	
	OOP	Indirect cost, per year	Mean, $[a]	10,757	29,652	(−47,361; 68,875)	Breast cancer	
	OOP	Indirect medical cost ratio	Percent	17.0[b]	37.0	NA	Breast cancer	
	OOP	Total OOP and lost income costs, per year	Mean, $[a]	21,528	35,008	(21,528; 35,008)	Breast cancer	
	OOP	Total OOP and lost income costs	Percent	44.0[b]	94.0	NA	Breast cancer	
Arrossi et al. [71]	Income loss	Loss of family income, for patient	Percent	39.0	NA	NA	Cervical cancer	4
	Income loss	Loss of family income, for caregiver	Percent	16.0	NA	NA	Cervical cancer	
	Income loss	Loss of family income versus non compliance	OR	3.1	NA	(1.4; 7)	Cervical cancer	
Banthin and Bernard [69]	Catastrophic expenditure	>20 % of family income, per year	Percent	6.7	NA	NA	Colon cancer	8
Bennett et al. [68]	Coping strategy	Continued to work at the same level	Percent	61.0	NA	NA	Breast cancer	6
	Coping strategy	Worked less or quit work	Percent	27.0	NA	NA	Breast cancer	
	Coping strategy	Continued to work at the same level	Percent	NA	NA	NA	Cervical cancer	
	Coping strategy	Worked less or quit work	Percent	11	NA	NA	Cervical cancer	
	Coping strategy	Continued to work at the same level	Percent	10	NA	NA	Colon cancer	
	Coping strategy	Worked less or quit work	Percent	NA	NA	NA	Colon cancer	
	Coping strategy	Reported at least one type of economizing	Percent	72	NA	NA	Cancer	
Chang et al. [74]	OOP	Office Visit Associated With Antineoplastic Drug Treatment, per month	Mean, $	193	581	NA	Colon cancer	7
	OOP	Outpatient Pharmacy-Dispensed Antineoplastic Treatment, per month	Mean, $	7	43	NA	Colon cancer	
	OOP	Office Visit Associated With Antineoplastic Drug Treatment, per month	Mean, $	762	2,160	NA	Lung cancer	
	OOP	Outpatient Pharmacy-Dispensed Antineoplastic Treatment, per month	Mean, $	14	67.5	NA	Lung cancer	
Chirikos et al. [63]	Income loss	Total household income growth in newly impaired women, between 1995–2000 (lowest quartile value)	Percent	37	NA	NA	Breast cancer	8
	Income loss	Total household income growth in other women, between 1995–2000 (lowest quartile value)	Percent	22	NA	NA	Breast cancer	
	OOP	Above average medical expenses in newly impaired women	Percent	41	NA	NA	Breast cancer	
	OOP	Above average medical expenses in in other women	Percent	20	NA	NA	Breast cancer	

Table 4 continued

Study	Type of outcome	Outcome specified as	Assessment type	Point ESTIMATE	SD for mean	95 % CI	Reported NCD	Quality score
Chirikos et al. [64]	Coping strategy	Household income in breast cancer group, change over 5 years	Mean, $	−5	21	NA	Breast cancer	7
	Coping strategy	Household income in control group, change over 5 years	Mean, $	10	21	NA	Breast cancer	
	Coping strategy	Value of household assets in breast cancer group, change over 5 years	Mean, $	82	169	NA	Breast cancer	
	Coping strategy	Value of household assets in control group, change over 5 years	Mean, $	118	204	NA	Breast cancer	
Davidoff et al. [62]	OOP	Total OOP per income	Percent	23.9	NA	NA	Cancer	9
	Catastrophic expenditure	>20 % income	Percent	27.6	NA	NA	Cancer	
	OOP	OOP expenditure, per year	Mean, $	3,850	NA	NA	Lung cancer	
	OOP	OOP expenditure, per year	Mean, $	4,600	NA	NA	Breast cancer	
	OOP	OOP expenditure, per year	Mean, $	4,200	NA	NA	Colon cancer	
Eaker et al. [60]	Income loss	Income increase >20 %, women with breast cancer	Percent	30.6	NA	NA	Breast cancer	7
	Income loss	Income increase >20 %, women without breast cancer	Percent	32.4	NA	NA	Breast cancer	
	Income loss	Income increase >20 %, adjusted for education	Risk Ratio	0.99	NA	(0.96; 1.01)	Breast cancer	
Engelgau et al. [59]	OOP	Per hospital stay, private + public (1995–1996)	Mean, $	307	NA	NA	Cancer	7
	OOP	Per hospital stay, private + public (2004)	Mean, $	498	NA	NA	Cancer	
	Catastrophic expenditure	Patients with cancer versus CD	OR	2.7	NA	(2.1; 3.1)	Cancer	
	Impoverishment	Patients with cancer versus CD	OR	2.3	NA	(1.9; 2.9)	Cancer	
Gordon et al. [52]	Financial Burden	Indirect costs	Mean, $[a]	5,036	7,221	(−9,117; 19,191)	Breast cancer	3
	Financial Burden	Direct costs	Mean, $[a]	2,311	3,830	(−5,196; 9,819)	Breast cancer	
	Financial Burden	Total costs, per year	Mean, $[a]	3,730	5,591	(−7,729; 14,690)	Breast cancer	
	Hardship	Reported any type of economic loss	Percent	92.0	NA	NA	Breast cancer	
Gordon et al. [51]	OOP	Net costs (e.g. drugs, transport, consultation)	Mean, $	5,938	NA	(4,930;6,946	Breast cancer	5
Grunfeld et al. [76]	Financial Burden	Caregiver burden in start of palliative period, per week	Mean score[c]	19	13	NA	Breast cancer	3
	Financial Burden	Caregiver burden in start of terminal period, per week	Mean score[c]	26	12	NA	Breast cancer	

Table 4 continued

Study	Type of outcome	Outcome specified as	Assessment type	Point ESTIMATE	SD for mean	95 % CI	Reported NCD	Quality score
Jagsi et al. [77]	Coping strategy	Used income and/or savings to pay for health	Percent	80.0	NA	NA	Breast cancer	5
	Coping strategy	Borrowed from family or friends to pay for health	Percent	7.0	NA	NA	Breast cancer	
	Coping strategy	Left some medical bills unpaid Left some credit card debt to pay for health	Percent	5.0	NA	NA	Breast cancer	
	Coping strategy	Increased credit card debt to pay for health	Percent	10.0	NA	NA	Breast cancer	
Lauzier et al. [40]	Income loss	Wage losses for both absences and reduced hours of work, per year	Mean, $	10,101	20,672	(−28,039; 46,661)	Breast cancer	6
	Hardship	Reported hardship after diagnosis	Percent	14.7	NA	NA	Breast cancer	
Lauzier et al. [42]	OOP	Total net cost (considering financial assistance received	Mean, $	330	301	NA	Breast cancer	6
Lauzier et al. [41]	OOP	Absolute net OOP costs (costs minus financial assistance)	Mean, $[a]	1,333	1,209	(−1,036; 3,703)	Breast cancer	7
	OOP	% OOP of family income, per year	Percent	2.3	NA	NA	Breast cancer	
	Hardship	Change for the worse in family financial situation 1 year after diagnosis[d]	Percent	1.0	NA	NA	Breast cancer	
	Hardship	Low OOP costs and high wage losses	Percent	2.5	NA	(1.9; 3.3)	Breast cancer	
	Hardship	High OOP costs and low wage losses	Percent	1.3	NA	(0.9; 2.0)	Breast cancer	
	Hardship	High OOP costs and high wage losses	Percent	2.2	NA	(1.6; 3.1)	Breast cancer	
Longo and Bereza [39]	OOP	Total OOP costs for lung, colon and prostate cancer, per year	Mean, $[a]	1,856	3,302	(−4,615; 8,328)	Cancer	5
	OOP	Total OOP costs, per year	Mean, $[a]	4,876	10,311	(−15,334; 25,088)	Breast cancer	
Markman and Luce [38]	OOP	Total OOP costs <5000$	Percent	60	NA	NA	Breast cancer	4
	OOP	Total OOP costs, >5,000$	Percent	41	NA	NA	Breast cancer	
	OOP	Total OOP costs, <5,000$	Percent	52	NA	NA	Colon cancer	
	OOP	Total OOP costs, >5,000$	Percent	46	NA	NA	Colon cancer	
	OOP	Total OOP costs, <5,000$	Percent	56	NA	NA	Lung cancer	
	OOP	Total OOP costs, >5,000$	Percent	44	NA	NA	Lung cancer	
	Hardship	Reported large financial stress caused by cost	Percent	19	NA	NA	Breast cancer	
	Hardship	Reported large financial stress caused by cost	Percent	25	NA	NA	Colon cancer	
	Hardship	Reported large financial stress caused by cost	Percent	27	NA	NA	Lung cancer	
Moore [36]	OOP	Total costs (e.g. assistance, drugs, households improvements)	Mean, $	503	484	NA	Breast cancer	1
Obi and Ozumba [34]	Financial burden	Early expenditures by patients (e.g. initial visit, preliminary investigations and treatment)	Mean, $	240	NA	NA	Cervical cancer	3

Table 4 continued

Study	Type of outcome	Outcome specified as	Assessment type	Point ESTIMATE	SD for mean	95 % CI	Reported NCD	Quality score
	Financial burden	Late expenditures by patients (e.g. transportation, hospital admission, treatment))	Mean, $	558	NA	NA	Cervical cancer	
Pisu et al. [32]	OOP	Direct OOP cost, per year	Mean, $[a]	4,105	5,344	(−6,369; 14,579)	Breast cancer	4
	OOP	Family income spent on total OOP costs, per year	Percent	9.7	NA	NA	Breast cancer	
Shankaran et al. [27]	Income loss	>20 % income decline	Percent	23.9	NA	NA	Colon cancer	5
	Coping strategy	Borrowed money from family/friends	Percent	16	NA	NA	Colon cancer	
	Coping strategy	Withdrew money from saving accounts	Percent	30	NA	NA	Colon cancer	
	Coping strategy	Withdrew money from retirement account	Percent	15	NA	NA	Colon cancer	
Shugarman et al. [25]	Financial burden	Total payment for beneficiaries with cancer, in the last year of life	Mean, $	37708	NA	NA	Colon cancer	3
Syse and Tonnessen [22]	Income loss	Percent wise income deviation from reference category, for men[e]	Percent	−7.2	1.7	(−10.6; −3.6)	Colon cancer	9
	Income loss	Percent wise income deviation from reference category, for women[e]	Percent	−6.1	1.8	(−9.7; −2.3)	Colon cancer	
	Income loss	Percent wise income deviation from reference category, for men[e]	Percent	−21.1	3.6	(−27.3; −12,2)	Lung cancer	
	Income loss	Percent wise income deviation from reference category, for women[e]	Percent	−20.0	3.4	(−27.8; −13.7)	Lung cancer	
	Income loss	Percent wise income deviation from reference category, for women[e]	Percent	−5.7	0.8	(−7.2; −4.2)	Breast cancer	
	Income loss	Percent wise income deviation from reference category[e]	Percent	−3.8	1.5	(−6.7; −0.9)	Cervical cancer	
Van Houtven et al. [20]	Financial burden	Total economic burden for informal caregivers, in any disease phase	Mean, $	16,778	NA	NA	Lung and colorectal cancer	5
	Financial burden	Total time costs for informal caregivers, in any disease phase	Mean, $	15,057	NA	NA	Lung and colorectal cancer	
	OOP	Total OOP costs for informal caregivers, in any disease phase	Mean, $	1,483	NA	NA	Lung and colorectal cancer	
Yabroff et al. [19]	OOP	Net costs of care, in the first 12 months, for men	Mean, $	32,044	NA	(31,330;32,758)	Colorectal cancer	6
	OOP	Net costs of care, in the last 12 months of life, for men	Mean, $	39,484	NA	(38,682;40,286)	Colorectal cancer	
	OOP	Net costs of care, in the first 12 months, for men	Mean, $	38,606	NA	(37,339;39,873)	Lung cancer	
	OOP	Net costs of care, in the last 12 months of life, for men	Mean, $	56,013	NA	(55,076;56,950)	Lung cancer	
	OOP	Net costs of care, in the first 12 months, for women	Mean, $	32,392	NA	(31,798;32,987)	Colorectal cancer	
	OOP	Net costs of care, in the last 12 months of life, for women	Mean, $	36,374	NA	(35,659;37,090)	Colorectal cancer	

Table 4 continued

Study	Type of outcome	Outcome specified as	Assessment type	Point ESTIMATE	SD for mean	95 % CI	Reported NCD	Quality score
	OOP	Net costs of care, in the first 12 months, for women	Mean, $	37,693	NA	(36,681;38,705)	Lung cancer	
	OOP	Net costs of care, in the last 12 months of life, for women	Mean, $	55,004	NA	(54,039;55,971)	Lung cancer	
	OOP	Net costs of care, in the first 12 months, for women	Mean, $	12,693	NA	(12,460;12,925)	Breast cancer	
	OOP	Net costs of care, in the last 12 months of life, for women	Mean, $	31,601	NA	(31,133;32,068)	Breast cancer	
Zaidi et al. [18]	Hardship	Cost more than anticipated	Percent	70.0	NA	NA	Breast cancer	4
	Hardship	Perceived level of burden unmanageable	Percent	70.0	NA	NA	Breast cancer	
Zhou et al. [17]	OOP	Total drug costs, patients with social health insurance	Median, $	1028	NA	NA	Breast cancer	6
	OOP	Total drug costs, patients without social health insurance	Median, $	231	NA	NA	Breast cancer	
	OOP	Total drug costs, patients with social health insurance	Median, $	1,829	NA	NA	Lung cancer	
	OOP	Total drug costs, patients without social health insurance	Median, $	1,289	NA	NA	Lung cancer	
	OOP	Total drug costs, patients with social health insurance	Median, $	1,730	NA	NA	Colorectal cancer	
	OOP	Total drug costs, patients without social health insurance	Median, $	1,301	NA	NA	Colorectal cancer	

CD Communicable diseases, *CI* confidence interval, *NCD* non-communicable diseases, *NA* not applicable, *OOP* out-of-pocket, *OR* odds ratio, *SD* standard deviation

[a] Per month or per quarter means and SD were recalculated to annual values to make the eligible studies better comparable. Per month mean and SD: times 12; per quarter mean and SD: times 4

[b] Costs were adjusted for income

[c] Family caregiver burden was measured by the Zarit Burden Inventory

[d] Reference low OOP costs and low wage losses

[e] The modeled income for the reference categories are $36,100 for women and $39,200 for men, respectively

Table 5 Results of the included studies on the impact of chronic obstructive pulmonary disease on households and impoverishment

Study	Type of outcome	Outcome specified as	Assessment type	Point estimate	SD for mean	95 % CI	Quality score
Baanders and Heijmans [70]	Financial burden	Economic consequences perceived by the partners	B coefficient[b]	0.01	NA	NA	3
Essue et al. [58]	Hardship	Participants that experienced economic hardship after disease	Percent	78.0	NA	NA	4
	Catastrophic expenditure	>10 % family income, in previous 3 months	Percent	46.0	NA	NA	
	OOP	OOP spending per year	Mean[a]	2048	2,767	(−3,376; −7,473)	
	OOP	Reported used financial coping strategy	Percent	65.0	NA	NA	
Jeon et al. [46]	Hardship	Affordability of treatment (e.g. capacity to pay for medications, consultations)	Percent	36	NA	NA	6
	Hardship	Affordability of other things (e.g. capacity to pay for basic living expenses, transport, food)	Percent	38	NA	NA	

CI Confidence interval, *NA* not applicable, *OOP* out-of-pocket, *SD* standard deviation

[a] Per month or per quarter means and SD were recalculated to annual values to make the eligible studies better comparable. Per month mean and SD: times 12; per quarter mean and SD: times 4

[b] Model includes disease characteristics

Table 6 Results of the included studies on the impact of chronic kidney disease on households and impoverishment

Study	Type of outcome	Outcome specified as	Assessment type	Point estimate	SD for Mean	95 % CI	Quality score
Banthin and Bernard [69]	Catastrophic expenditure	>10 % of family income, per year	Percent	19.7	NA	NA	8
	Catastrophic expenditure	>20 % of family income, per year	Percent	9.8	NA	NA	
Campbell et al. [67]	OOP	Increase in OOP spending from 2002 to 2005	Percent	60.0	NA	NA	5
Essue et al. [56]	Hardship	Participants that experienced economic hardship after disease	Percent	57.0	NA	NA	3
	Catastrophic expenditure	>10 % of family income, per 3 months	Percent	71.0	NA	NA	
	OOP	OOP spending for all participants, per year	Mean, $[a]	3,755	4,430	(−4,928; 12,439)	
Higashiyama et al. [48]	Financial burden	Total medical expenditure/person	Mean, $	7755	NA	NA	7
Kelley et al. [79]	OOP	OOP spending in the last 5 years of life	Mean, $	33,083	NA	NA	3

CI Confidence interval, *NA* not applicable, *OOP* out-of-pocket, *SD* standard deviation

[a] Per month or per quarter means and SD were recalculated to annual values to make the eligible studies better comparable. Per month mean and SD: times 12; per quarter mean and SD: times 4

cervical cancer in Nigeria, the costs rose from 240 to 558 USD [34]. Among Norwegian women, income loss for cervical, breast, colon and lung cancer was experienced by 3.8, 5.7, 6.2 and 21.1 %, respectively. A loss in income due to cervical cancer was reported by 39 % of Argentinean women [71]. When comparing cancer to communicable diseases in India, the risk of catastrophic spending, defined as OOP costs exceeding 40 % of household income, and the risk of impoverishment was 2.7 times (95 % CI 2.1–3.1) and 2.3 times (95 % CI 1.9–2.9) higher [59].

Of the five studies focusing on coping strategies, all except one did so for the assessment of the impact of cancer [27, 64, 68, 77]. The results of a study by Chirikos and colleagues suggested that losses incurred by breast cancer patients were compensated by other individuals in the household [64]. Income and savings were used to pay for

Table 7 Results of the included studies on the impact of Type 2 diabetes mellitus on households and impoverishment

Study	Type of outcome	Outcome Specified as	Assessment type	Point estimate	SD for mean	95 % CI	Quality score
Baanders and Heijmans [70]	Financial burden	Economic consequences perceived by the partners	B coefficient[f]	0.03	NA	NA	3
Banthin and Bernard [69]	Catastrophic expenditure	>20 % of family income, per year	Percent	13.0	NA	NA	8
Bernard et al. [73]	Financial burden	>10 % of disposable income, in nonelderly adults	Percent	45.0	NA	NA	4
	Financial burden	>10 % of disposable income, in elderly adults	Percent	70.0	NA	NA	
Campbell et al. [67]	OOP	Increase in OOP spending from 2002 to 2005	Percent	23.0	NA	NA	5
Chang [66]	OOP	Inpatient costs	Mean, $[a]	133	583	(1,010; 1,276)	5
	OOP	Outpatient costs	Mean, $[a]	10	11	(−11; 32)	
Chatterjee et al. [65]	Financial burden	Monetary value of informal care, by opportunity cost method	Mean, $	34	NA	NA	5
	Financial burden	Monetary value of informal care, by proxy good method	Mean, $	35	NA	NA	
Engelgau et al. [59]	OOP	Per hospital stay, private + public (1995–1996)	Mean, $	134	NA	NA	7
	OOP	Per hospital stay, private + public (2004)	Mean, $	211	NA	NA	
Falconer et al. [55]	OOP	Prescription medication, per year	Mean, $	31	NA	NA	2
	OOP	Over-the-counter medications	Mean, $	64	NA	NA	
Goldhaber-Fiebert et al. [53]	OOP	OOP (uninsured) as a % of total health expenditure, in India	Percent	75	NA	NA	4
	OOP	OOP (uninsured) as a % of total health expenditure, in China	Percent	51	NA	NA	
	OOP	OOP (uninsured) as a % of total health expenditure, in Thailand	Percent	19	NA	NA	
	OOP	OOP (uninsured) as a % of total health expenditure, in Malaysia	Percent	38	NA	NA	
Grover et al. [50]	OOP	Direct costs, per year (e.g. drugs, transport, consultations)	Mean, $	280	239	NA	4
	OOP	Indirect costs, per year (e.g. loss of income, days lost because of illness for patient and caregivers)	Mean, $	113	273	NA	
Jeon et al. [46]	Hardship	Affordability of treatment (e.g. capacity to pay for medications, consultations)	Percent	50	NA	NA	6
	Hardship	Affordability of other things (e.g. capacity to pay for basic living expenses, transport, food)	Percent	48	NA	NA	
Joshi et al. [45]	OOP	Cost every doctor visit for DM	Mean, $[a]	4	2	(0; 8)	2
Kelley et al. [79]	OOP	OOP spending in the last 5 years of life	Mean, $	43,008	NA	NA	3
Khowaja et al. [43]	OOP	Total direct costs (e.g. drugs, travel, investigations)	Mean, $	221	NA	NA	4
	OOP	Total indirect costs (e.g. loss of time and productivity)	Mean, $	22	NA	NA	
Niens et al. [35]	Impoverishment	Absolute impoverishment in chronic patient population, due to purchase of LPG glibenclamide, 16 countries	Count	2000000	NA	NA	NA
	Impoverishment	Relative impoverishment in chronic patient population, due to purchase of LPG glibenclamide, 16 countries[b]	Percent	5.0	NA	NA	

Table 7 continued

Study	Type of outcome	Outcome Specified as	Assessment type	Point estimate	SD for mean	95 % CI	Quality score
	Impoverishment in Kyrgyzstan	Population that will fall below poverty line after purchasing LPG glibenclamide[b]	Percent	2.0	NA	NA	
	Impoverishment in Mali	Idem above	Percent	53.0	NA	NA	
	Impoverishment in Nigeria	Idem above	Percent	71.0	NA	NA	
	Impoverishment in Pakistan	Idem above	Percent	0	NA	NA	
	Impoverishment in Tajikistan	Idem above	Percent	11.0	NA	NA	
	Impoverishment in Tanzania	Idem above	Percent	58.0	NA	NA	
	Impoverishment in Uganda	Idem above	Percent	53.0	NA	NA	
	Impoverishment in Uzbekistan	Idem above	Percent	22.0	NA	NA	
	Impoverishment in Yemen	Idem above	Percent	10.0	NA	NA	
	Impoverishment in El Salvador	Idem above	Percent	11.0	NA	NA	
	Impoverishment in Indonesia	Idem above	Percent	0	NA	NA	
	Impoverishment in Jordan	Idem above	Percent	0	NA	NA	
	Impoverishment in Mongolia	Idem above	Percent	6.0	NA	NA	
	Impoverishment in Peru	Idem above	Percent	5.0	NA	NA	
	Impoverishment in Philippines	Idem above	Percent	13.0	NA	NA	
	Impoverishment in Tunisia	Idem above	Percent	0	NA	NA	
Okumura and Ito [33]	OOP	Average OOP burden for diabetes + SPD	Percent	11.3	NA	NA	5
	OOP	Average OOP burden for diabetes + MPD	Percent	4.8	NA	NA	
	OOP	Average OOP burden for diabetes + noncase	Percent	6.4	NA	NA	
Ramachandran et al. [31]	Income	Family income in urban area, per year	Median, $	58	NA	NA	5
	Income	Family income in rural area, per year	Median, $	21	NA	NA	
	Financial burden	Total expenditure on health in urban area (e.g. medication, consultations)	Median, $	6	NA	NA	
	Financial burden	Total expenditure on health in rural area (e.g. medication, consultations)	Median, $	3	NA	NA	
Rayappa et al. [29]	OOP	Total direct costs for non -hospitalized patients	Mean, $	262	NA	NA	7
Rao et al. [30]	OOP	OOP household consumption expenditure, per year[c]	Percent	17.0	NA	NA	1
	OOP	OOP per hospitalization	Mean, $	137	NA	NA	
Rodbard et al. [28]	OOP	Health care OOP expenses, per year[d]	B coefficient	247.9	NA	(129.4; 335.7)	6
	OOP	Health care OOP expenses, per year[e]	Mean, $	1237	NA	NA	

Table 7 continued

Study	Type of outcome	Outcome Specified as	Assessment type	Point estimate	SD for mean	95 % CI	Quality score
Shobhana et al. [26]	Income	Family income in private hospital, per year	Mean, $	1546	NA	NA	3
	Income	Family income in public hospital, per year	Mean, $	309	NA	NA	
	OOP	Income spent on DM, by inpatient care	Percent	17.5	NA	NA	
	OOP	Income spent on DM, by outpatient care	Percent	7.7	NA	NA	

CI Confidence interval, *DM* diabetes mellitus, *LPG* lowest price generic, *MPD* mild psychological distress, *NA* not applicable, *OOP* out-of-pocket, *SD* standard deviation, *SPD* serious psychological distress

[a] Per month or per quarter means and SD were recalculated to annual values to make the eligible studies better comparable. Per month mean and SD: times 12; per quarter mean and SD: times 4

[b] Poverty line defined as US$ 1,25 USD/day

[c] Value adjusted for insurance reimbursement

[d] No diabetes as reference group

[e] No diabetes as reference group and value adjusted for annual health care

[f] Model includes disease characteristics

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 [77].

Impact of chronic obstructive pulmonary disorder

In Australia, financial hardship (e.g. worries about, or change for the worse in, financial situation) was felt by 36–78 % of COPD patients (Table 5) [46, 58]. 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 [58].

Impact of chronic kidney disease

57 % of Australian CKD patients reported financial hardship (Table 6). Using the same income threshold of 10 %, financial catastrophe was experienced by 71 % of CKD patients, which is equivalent in absolute terms to annual OOP expenditure of 3,755 USD [56]. In Japan, mean annual OOP expenditure was 2,604 USD [48]. OOP expenses due to CKD increased by 60 % between 2002 and 2005, and 32.6 % of CKD patients spent more than 10 % on income OOP [67, 69].

Impact of Type 2 diabetes mellitus

From the 21 studies focusing on DM, eight originated from India and showed a consistent impact on households (Table 7). Mean OOP expenditure per in-patient hospital stay for DM increased from 134 USD to 211 USD between 1995 and 2004 and direct total OOP spending per year was estimated at 262–280 USD [29, 50, 59]. The percent wise household consumption spent OOP ranged between 7.7 and 17.5 % [26, 30]. In Japan, the average OOP burden for DM, as a percentage of household income, ranged from 4.8 to 11.3 % [33].

In the USA, the mean annual OOP diabetes care cost was 1,237 USD and increased by 23 % from 2002 to 2005 [28, 67]. Nearly 40 % of DM cases in the USA experienced catastrophic spending (using the >10 % threshold); 13 % experienced catastrophic spending even above the 20 % threshold [69]. A cross-country analysis, performed by Niens et al., 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, these percentages ranged between 0 and 58 % [35].

Table 8 Results of the included studies investigating the impact of non-communicable diseases on households and impoverishment

Study	Type of outcome	Outcome specified as	Assessment type	Point estimate	SD for mean	95 % CI	Quality score
Engelgau et al. [59]	OOP	Per capita household income spent on OOP expenses for healthcare, poorest (2004)	Percent	3.8	NA	NA	7
	OOP	Per capita household income spent on OOP expenses for healthcare, richest (2004)	Percent	6.6	NA	NA	
	OOP	% of OOP expenses spent on NCD (1995–1996)	Percent	31.6	NA	NA	
	OOP	% of OOP expenses spent on NCD (2004)	Percent	47.3	NA	NA	
Okumura and Ito [33]	OOP	Average OOP burden	Percent	2.1	6.2	NA	5
Su et al. [24]	Catastrophic expenditure	Prevalence of catastrophic (> 20 % of monthly non-food expenditure)	Percent	10.6	NA	NA	1
	Catastrophic expenditure	Prevalence of catastrophic (> 40 % of monthly non-food expenditure)	Percent	6.1	NA	NA	
	OOP	Household health expenditure, per year (>20 % of non-food expenditure)	Mean, $[a]	79	130	(−177; 335)	
	OOP	Household health expenditure, per year (>40 % of non-food expenditure)	Mean, $[a]	96	150	(−198; 391)	
Sun et al. [23]	Financial burden	Chronic disease expense per capita/annual non-food expenditure, Shandong, insured members	Percent	27.0	NA	NA	2
	Financial burden	Chronic disease expense per capita/annual non-food expenditure, Shandong, uninsured members	Percent	47.0	NA	NA	
Sun et al. [23]	Financial burden	Average chronic disease expense per capita/annual nonfood expenditure, Ningxia, insured members	Percent	35.0	NA	NA	
	Financial burden	Average chronic disease expense per capita/annual nonfood expenditure, Ningxia, uninsured members	Percent	42.0	NA	NA	
	Catastrophic expenditure	>40 %, Shandong, insured members, per year	Percent	15.0	NA	NA	
	Catastrophic expenditure	>40 %, Shandong, uninsured members, per year	Percent	21.0	NA	NA	
	Catastrophic expenditure	>40 %, Ningxia, insured members, per year	Percent	14.0	NA	NA	
	Catastrophic expenditure	>40 %, Ningxia, uninsured members, per year	Percent	18.0	NA	NA	
Thuan et al. [21]	Financial burden	Health expenditure spend on NCDs	Percent	27.7	NA	NA	1
	Catastrophic expenditure	Total household health expenditures to household capacity to pay between 20–30 %	Ratio	23.4	NA	NA	
	Catastrophic expenditure	Percentage of health expenditure spent on NCDs	Ratio	27.7	NA	NA	

CI Confidence interval, *NCD* non-communicable diseases, *NA* not applicable, *OOP* out-of-pocket, *SD* standard deviation

[a] Per month or per quarter means and SD were recalculated to annual values to make the eligible studies better comparable. Per month mean and SD: times 12; per quarter mean and SD: times 4

Impact of NCDs in general terms

The proportion spent OOP on NCDs increased from 31.6 to 47.3 % between 1995 and 2004 in India (Table 8) [59]. In Japan, the average OOP burden was 2.1 % of available income [33]. The threshold for what is considered 'catastrophic spending' has a large impact on the proportion of households who experience it. For example, in Burkina Faso, the proportion of households experiencing catastrophic spending gradually increased from 4.5 to 10.6 % (and in absolute numbers from 79 to 108 USD annually) as the catastrophic threshold lowered, stepwise, from >60 to >40 %, >30, and >20 % [24]. The mean NCD expenditure as a proportion of household capacity to pay in Vietnam was 27.7 %. When using different catastrophic spending thresholds, nearly 60 % of the participants spent between 20 and 30 % of their income on NCDs [21].

Discussion

This systematic review summarizes 64 studies published worldwide of the impact of the major NCDs (CHD, stroke, COPD, major cancers, DM and CKD) at the micro-economic level on households and impoverishment. The studies show a steady global increase in household expenditure on NCDs between 1999 and 2014. The importance of these trends in global health is further underlined by the 'WHO Global Action Plan for the Prevention of non-communicable diseases 2013–2020', which highlights the need for further research into NCDs and their impact at the micro-economic level [81].

There is evidence that a substantial number of people experience financial hardship due to NCDs, as income losses affect patients and their caregivers and OOP medical expenditure for NCDs drive households into financial catastrophe and impoverishment. This rising burden is directly related to the global rise of NCDs, particularly in LMIC, many of which have under-resourced healthcare systems that impose OOP payments on individuals and households as a means to supplement other sources of revenue [1]. As healthcare systems in LMIC often experience a dual burden of infectious and chronic disease, they are less able to allocate resources towards primary prevention of NCDs. Most eligible studies used OOP expenditure to quantify the magnitude of the economic impact of NCDs on households and for mapping the extent of financial catastrophe, in particular. OOP expenditure was self-reported in most of the studies, with some exceptions where studies used health insurance claim data. Relative to different income proxies, OOP expenditure ranged widely between 2 and 158 % across different NCDs and countries.

The threshold for what is considered 'catastrophic spending' has a large impact on the proportion of households who experience it; depending on the income threshold taken by the study, the global proportion of households suffering from financial catastrophe ranged from 6 to 84 %. Heterogeneity in the use of an income threshold in combination with differences in study samples (among others, related to insurance coverage levels) undermine comparability across the studies, although evidence does suggest that financial catastrophe due to NCDs is an important issue for all countries and across all income strata. This observation is in accordance with other reports that took a broader (chronic) illness perspective [8, 10, 14, 82]. Variations in OOP spending and financial catastrophe across and within countries depend a great deal on the triad of factors, described by Xu and colleagues, as poverty levels, healthcare service access and use, and the presence or absence of financial risk pooling mechanisms such as health insurance or taxed-based systems [9]. Although it was outside the scope of this study to review the impact of this triad on catastrophic spending, these factors are very likely to be key components of the (varying) relation between OOP spending and catastrophic spending. Therefore, although OOP spending and financial catastrophe are valuable methodological approaches to provide insights into the impact on households, these measures cannot be interpreted without being placed within the specific health system perspective from which the sample is drawn. Standardized definitions and thresholds would facilitate unbiased and cross-country comparisons.

A minority of the studies addressed the absolute impoverishing effects of NCDs. A large study by Niens et al., in 16 LMICs, showed that the purchase of lowest price generic medication rather than originator brand DM (and other) medication could reduce absolute impoverishment, at the 1.25 USD/day poverty line, from 11 to 6 % of the total population. This finding reinforces the need to improve availability of low-priced generics, which for NCDs receives comparatively little attention compared to infectious disease treatment [83, 84].

The extent to which NCDs drive households into relative poverty were more difficult to estimate from the eligible studies, partly due to the fact that relative poverty is more difficult to measure and the definitions are less clear. We observed that some eligible studies used income losses to estimate the relative impoverishing influence of NCDs. For instance, for Norwegian women suffering from cervical, breast or lung cancer, the percent-wise income deviation compared to healthy women was 3.8, 5.7 and 20 % respectively [22]. Household income losses after CVD diagnosis were 67.5, 14.3, 26.3 and 63.5 % in high-income groups in Argentina, China, India and Tanzania respectively, and were even higher in the lower income groups [47]. These findings are consistent with similar studies, which showed that poor households are less able to cope with healthcare costs compared to more affluent households [9, 85, 86]. Solely five eligible studies provided insights in the coping strategies adopted by households to cope with a family member suffering from NCDs. The paucity of evidence regarding coping strategies, together with the significant role that illness perceiving and absence of health care seeking due to financial reasons play, are likely to reflect a considerable underestimation of the true extent to which NCDs impact households.

Findings of this systematic review generally concur with and further extend previous reviews on this topic. Previous work was focused on specific types of NCDs, was focused in specific regions of the world or provided methodological commentaries [10, 87–100]. A recent narrative review emphasized the importance of standardized definitions for OOP spending, the use of larger sample sizes and prospective study designs and a better collecting of data on economic consequences of NCDs (e.g. direct and indirect

costs) [89]. Kankeu and colleagues assessed financial burden of four domains of NCDs (cancers, CVD, COPD, and diabetes) but did not include CKD in their review. In addition and interestingly, they included only studies conducted in LMICs [91]. Mahal and colleagues summarized the economic impact of NCDs for India [94]. A second study, conducted by Engelgau et al. [10], non-systematically reviewed studies mostly conducted in India. Costs involved in cancer care, without stratifying for cancer type, were reviewed in three domains in a systematic review by Pearce and colleagues. The domains included cost-effectiveness and cancer treatment, the indirect cancer costs and human costs of cancer. Definite conclusions were missing due to conceptual and methodological limitations of the included studies. Nevertheless, the complexity of the costs attached to cancer care was observed [95]. Pisu et al. [96] reviewed OOP expenses in breast cancer patients only. Tong and colleagues thematically synthesized patient and caregiver perspectives in CKD. Out of 26 included studies in this review, one study from Thailand focused on economic consequences, and found a large economic strain due to forced early retirement [97]. Coping with OOP health payments was assessed in 15 African countries and showed that borrowing and selling assets was an important coping mechanism, its prevalence ranging from 23 to 68 %. Unfortunately a specification of the included diseases was not provided [93].

The strength and limitations of our work merit careful consideration. An important strength of this review is the exhaustive search for relevant articles. We used extensive, precise search terms and applied stringent inclusion criteria, specifically the exclusion of studies focusing solely on 'chronic diseases' or 'illness'. We feel that this specific approach gave rise to a comprehensive undiluted perspective of the micro-economic impact of NCDs, since all available evidence was gathered via the initial search and was supplemented by an extensive screening of reference lists for possibly missed eligible studies. However, we do emphasize that precisely defining included chronic illnesses would greatly benefit future research and the disease specific policy implications this research could give rise to.

The methods used by the eligible studies to measure household impact and impoverishment were remarkably heterogeneous which, along with a broader disease burden perspective than NCDs, is a recurrent challenge in similar reviews and did not allow us to pool the reported estimates in a meta-analysis [14, 91]. Furthermore, in many studies convenience sampling was used to assemble study samples, and the overall quality of the included studies was moderate to low. Therefore, country-wide and disease-specific implications of the results must be interpreted with caution. Given the already wide scope of our systematic evaluation, we were unable to explore wider impacts associated with NCDs such as non-economic and indirect impacts including educational dropout among children, healthcare utilization and costs of premature death. Estimation of the number and experiences of marginalized and vulnerable people who do not seek care for NCDs for financial reasons is currently neglected and their inclusion could give a more comprehensive overview of the impact of NCDs on households and impoverishment.

Conclusions

NCDs impose a large and growing global impact on households and impoverishment, in all continents and levels of income. The true extent, however, remains difficult to determine due to heterogeneity across existing studies in terms of populations evaluated, outcomes reported and measures employed. The impact that NCDs exert on households and impoverishment is likely to be underestimated since 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 literature. Given the scarcity of information on specific regions, further research is required to estimate impact of NCDs on households and impoverishment in LMIC, especially the Middle Eastern, African and Latin American regions.

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Conflict of interest With regard to potential conflicts of interest, there is nothing to disclose. Drs. Jaspers, Colpani and Franco had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Appendix 1: Search strategy 6 November 2014

('non communicable disease'/de OR 'ischemic heart disease'/exp OR 'cerebrovascular accident'/exp OR 'chronic obstructive lung disease'/de OR 'lung cancer'/exp OR 'colon cancer'/exp OR 'breast cancer'/exp OR 'chronic kidney disease'/de OR 'non insulin dependent diabetes mellitus'/de OR 'uterine cervix cancer'/exp OR ('non

communicable' OR noncommunicable OR ((heart OR cardiac OR cardial OR cardiopath* OR cardiomyopath* OR coronar* OR myocard*) NEAR/3 (ischem* OR ischaem* OR anoxia OR hypoxia)) OR (coronary NEAR/3 (insufficien* OR occlus* OR disease* OR acute OR atherosclero* OR arteriosclero* OR sclero* OR cardiosclero* OR constrict* OR vasoconstrict* OR obstruct* OR stenosis* OR thrombo*)) OR angina* OR ((heart OR myocard* OR cardiac OR cardial) NEAR/3 infarct*) OR ((cerebrovascul* OR brain OR 'cerebral vascular' OR 'cerebro vascular') NEAR/3 (accident* OR lesion* OR attack OR ischem* OR ischaem* OR insult* OR insuffucien* OR arrest* OR apoplex*)) OR cva OR stroke OR (chronic AND (obstruct* NEAR/3 (lung* OR pulmonar* OR airway* OR bronch* OR respirat*))) OR ((lung* OR pulmonar* OR colon* OR colorect* OR breast* OR mamma*) NEAR/3 (neoplas* OR cancer* OR carcino* OR adenocarcino* OR metasta* OR sarcom*)) OR (chronic NEAR/3 (kidney* OR nephropathy* OR renal)) OR (('adult onset' OR 'type 2' OR 'type ii' OR 'non-insulin dependent' OR 'noninsulin dependent' OR 'insulin independent') NEAR/3 diabet*) OR ((cervix OR cervical) NEAR/3 (cancer* OR neoplas* OR tumo* OR carcinom* OR malign*))):ab,ti) AND (adult/exp) AND ('randomized controlled trial'/exp OR 'cohort analysis'/de OR 'case control study'/exp OR 'cross-sectional study'/de OR 'systematic review'/de OR 'meta analysis'/de OR ecology/exp OR 'ecosystem health'/exp OR 'ecosystem monitoring'/exp OR model/exp OR ((random* NEAR/3 (trial* OR control*)) OR rct* OR cohort* OR 'case control' OR 'cross-sectional' OR (systematic* NEAR/3 review*) OR metaanaly* OR (meta NEXT/1 analy*) OR ecolog* OR ecosystem* OR model*):ab,ti) NOT ([animals]/lim NOT [humans]/lim) NOT ([Conference Abstract]/lim OR [Conference Paper]/lim OR [Letter]/lim OR [Note]/lim OR [Conference Review]/lim OR [Editorial]/lim OR [Erratum]/lim).

AND ((('cost of living'/de OR budget/de OR 'financial deficit'/exp OR income/de OR 'health care cost'/de OR 'hospitalization cost'/de OR insurance/exp OR 'cost of illness'/de OR socioeconomics/exp OR (((cost* OR econom* OR expen*) NEAR/6 (living OR individu* OR famil* OR personal* OR patient* OR illness* OR direct* OR indirect*)) OR budget* OR deficit* OR debt* OR income OR insurance* OR socioeconom* OR pover* OR impover* OR poor OR wealth):ab,ti) AND (family/exp OR home/de OR household/de OR (famil* OR home OR household* OR personal):ab,ti)) OR 'caregiver burden'/de OR (microeconom* OR (micro NEXT/1 econom*) OR 'Out of pocket' OR 'Willingness to pay' OR (catastroph* NEAR/3 (spend* OR expend*)) OR 'Poverty line' OR (Value* NEXT/2 'statistical life')):ab,ti).

Appendix 2: Newcastle Ottawa Quality Assessment Scale, cross-sectional and descriptive studies

Note: A study can be awarded a maximum of one star for each numbered item within the Selection and Exposure categories. A maximum of two stars can be given for Comparability.

Selection

1. Is definition of NCDs adequate?
   (a) Yes, according to a clear and widely used definition*
   (b) Yes, e.g. record linkage or based on self-reports
   (c) No description
2. Representativeness of the cases
   (a) Consecutive or obviously representative series of cases*
   (b) Excluded cases are random*
   (c) No description of the excluded cases or potential for selection biases or not stated
3. Comparison with a reference group
   (a) The results are compared with a reference from community or with the status of the cases prior to the disease*
   (b) The results are compared with the results from other patients
   (c) No description/no comparison available
4. Definition of reference
   (a) Individuals with no NCD or sample from general population or the same individuals before NCD suffering*
   (b) Non community comparator is described
   (c) No description of source

Comparability

1. Comparability of the results on the basis of the design or analysis
   (a) The results are described in age and sex sub groups (sex is not applicable for female diseases)*
   (b) The results are additionally adjusted for/ described in different socioeconomic factors or disease related confounders*

Exposure (costs, productivity, households)

1. Ascertainment of exposure

(a) Secure record (e.g. surgical records, hospital records, and administrative records, national…)*
(b) Structured interview where blind to case/control status*
(c) Interview not blinded to case/control status
(d) Written self-report or medical record only
(e) No description

2. Same method of ascertainment for NCDs and comparators

(a) Yes*
(b) No
(c) No comparator group exist

3. Non-Response rate

(a) All participants included or same rate for both groups or respondents and non-respondents have the same characteristics*
(b) Non respondents described
(c) Rate different and no designation
(d) Response rate not described

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