



Cardiovascular disease research output in WHO priority areas between 2002 and 2011

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Abstract Approximately 17.3 million people died from cardiovascular disease (CVD) in 2008, and approximately 80% came from low- and middle-income countries. However, previous studies document poor research productivity related to CVD prevention and treatment in these countries between 1991 and 1996. The World Health Organization (WHO) developed a prioritized research agenda emphasizing research on policy development, translation of knowledge and implementation. This study assessed whether research output in priority areas increased between 2002 and 2011. It was reported that only 3–4% of papers from each year related to a priority area, and most were conducted by corresponding authors from high-income countries. Low-income countries were highly underrepresented both in terms of productivity and as the study population. However, there was a significant rise in the productivity of middle-income countries and their representation as the study population. While 30% of priority-related papers addressed a cost-effective strategy, this represents 1% of papers overall. More cost-effectiveness research is encouraged to decrease the millions of deaths per year attributed to CVD in the developing world.

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1. Introduction

Cardiovascular diseases (CVDs) refer to coronary artery disease, cerebrovascular disease, peripheral vascular disease, rheumatic heart disease, congen-

ital heart disease, deep vein thrombosis and pulmonary vascular disease. Collectively, these seven diseases are the number one cause of death globally [1]. A report from the World Health Organization (WHO) estimates that 17.3 million people died from CVDs in 2008, and 80% of these cases occurred in low- and middle-income countries [2]. It is thought that people in resource-poor countries have less access to preventive services, less access to medications and procedures, and more exposure to risk factors such as tobacco exposure and

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fat-laden foods. Unfortunately, this means that countries with the fewest resources to conduct research on risk factors and cost-effective interventions carry the burden of disease.

While some treatments for these diseases are expensive (CABG, stenting, valve replacements, and pacemakers), many are affordable to all countries (aspirin, insulin, generic anti-hypertensives, generic statins, and nicotine replacement). A systematic review by Shroufi et al. [3] published in 2013 examined the number and type of cost-effective interventions for CVDs that were done in low- and middle-income countries in 2010. These included both behavioral and pharmacologic interventions where cost per disability-adjusted life-year was less than 1-3 times the gross national income per capita. Of the 9729 papers obtained in the original search, the list was narrowed to 16 papers that addressed the following four broad categories: medications to lower blood pressure and cholesterol [4–14]; tobacco control (through nicotine patch, bupropion, and price control of cigarettes) [15,16]; intervention through mass media (diet modification, reduced salt intake, and smoking cessation) [17,18]; and intervention through legislation (mandatory lowering of salt added to mass-produced food) [19]. If a country's limited resources were allocated to these cost-effective, data-proven strategies, one could imagine a significant reduction in the CVD morbidity and mortality in low- and middle-income countries.

However, these cost-effective strategies need to be adapted for and validated in specific populations prior to being implemented broadly. A paper by Mendis et al. [20] documented low CVD research output from low- and middle-income countries between 1991 and 1996. They report that 82 developing countries, which represent 11% of the global population, did not publish a single paper in their random sample [20]. This data indicates that the amount of meaningful research that contains outcomes-based data on cost-effective strategies in low- and middle-income countries must be increased.

This study sought to assess the progress of CVD research output in the last decade between 2002 and 2011. A sample of a large number of papers from each year was chosen and it was determined if they addressed one of the four broad categories published by the WHO as priority research areas (Table 1) [21]. The country of origin of the corresponding author and study population, the type of study, the presence of cost-effective strategies and the language of publication (Table 2) were analyzed to get a better sense of the features of the

priority-related papers published during this timeframe.

2. Materials and methods

Medline was searched using the MeSH term “Cardiovascular Diseases” and a year filter of 2002 and 2011; 3000 publications from each year in any language and from any country were examined by a physician, who read the abstracts and decided if the topic related at all to a WHO priority area. The original article was obtained if categorization was unclear. Each paper was assigned to one priority area that fit it best. The physician recorded the country of origin of the corresponding author and the study population. The World Bank list of economies from November 2011 was used to classify these countries by income level.

Fisher's Exact test was used to assess statistical significance in research output over time (Table 1). It was also used to assess statistical significance in research output over time with the corresponding authors from high vs. a combined group of low- and middle-income countries, and research output over time studying populations from high vs. a combined group of low- and middle-income countries. Papers were classified as being a north to north collaboration (corresponding author and study population from a high-income country), north to south collaboration (corresponding author from a high-income country and study population from a middle- or low-income country, respectively), or south to south collaboration (corresponding author and study population from low- or middle-income country). North to south and south to south collaborations were compared with north to north collaborations using Fisher's Exact test (Table 2).

Similarly, Fisher's Exact test was used to assess statistical significance in the type of publication over time (Table 2). For example, the number of clinical papers (that were not RCTs or survey-based) was compared with the combined group of all other types of publications published over time. Finally, Fisher's Exact test was used to assess statistical significance for the number of publications with cost-effective strategies over time and number published in a language other than English over time (Table 2).

3. Results and discussion

There were 47,897 cardiovascular disease publications indexed in 2002 and 54,488 in 2011, which increased overall from 35,000 in 1991 to 39,000 in

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