Scientific research on diseases: the distinct profile of developed and developing countries

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INTRODUCTION

In most of the countries across the globe, health is seen as a priority. The European Commission (2013), for example, considers health as a precondition for economic prosperity given that people's health influences economic outcomes in terms of productivity, labor supply, human capital and public spending. Accordingly, the Commission places health in one of the big Societal Challenges ('health, demographic change and wellbeing') in Horizon 2020.

Part of the investment on research and development is devoted to specific diseases. In order to assess whether scientific research is targeting the most pressing diseases, some studies have tried to analyze the degree of alignment between the funding allocated to specific diseases and the burden of disease (e.g. Gillum et al, 2011; Kingel et al, 2014). Others, like Evans et al (2014), focus on the relationship between research outputs dealing with specific diseases and the burden of disease.

In the later study, Evans et al (2014) found that there was no relationship between the burden of disease and the total health research at the world level. Only when the relationship between research outputs and burden of disease was analyzed at the level of individual countries, a significant association was found between the two. Another finding of this study is the striking disparity among countries in the capacity to produce health research: developed countries publish much more biomedical research than less developed countries. While this is not a surprising finding, the authors consider that this fact combined with the tendency of focusing on national health needs, results in the overrepresentation diseases more prevalent in

developed countries and the underrepresentation of diseases affecting less developed countries.

An interesting remark by the authors of this study is that those diseases that affect most developing countries only slightly affect the developed countries (e.g. neglected tropical diseases or NTD [1]), while diseases that most afflict rich populations also affect substantially less developed countries (e.g. cancer).

Building on the study by Evans et al (2014) we put forward the following hypothesis:

> *H1: Developed countries concentrate most of their publications in diseases that most affect these countries while only a minor share of publications is devoted to NTD*
> *H2: Developing countries present a more balanced publication profile, covering both NTD and also diseases that most affect developed countries*

While both developed and developing countries might publish scientific articles on NTD as well as on diseases that primarily affect developed countries, we do not expect only differences in terms of the amount of publications developed and developing countries published on each type of disease, but also regarding the status of the journal in which the research was published as well as in terms of citation impact achieved, given the unequal scientific impact observed across countries (e.g. King, 2004).

> *H3 Regardless the type of disease, developed countries publish research in high impact journals, while developing countries publish in journals with lower impact*
> *H4 Citation impact achieved by developed countries is higher compared to developing countries, regardless the type of research*

Scientific basic research is just the first step in the development of new drugs, additional stages are needed before patients can benefit of such a drug. Preclinical research, clinical research and post-marketing are also part of the costly process of generation of new drugs. As highlighted by Wilder and Solovy (2005), probably the most important gap is that existing between basic research and pre-clinical research, as this generally requires the investment by private companies to continue the process where the public sectors left off. However, companies are more likely to invest in the development of new drugs if they can ensure a return for that investment, by introducing the new drugs in the market. Evans et al (2014) found a significant positive relationship between the market size and publication of research. The market size is not determined by the amount of people suffering from a specific disease but is related to the purchasing power of the population. Although scientific publications can be considered to be far away from final marketable drugs, we put forward the following hypothesis:

> *H5: Private companies are more likely to engage in public upstream research on diseases that affect primarily developed countries, both in terms of conducting and funding research*
> *H6: Universities and Public Research Organizations lead the research on NTD, while funding to conduct this research flows mainly from Governments and NGOs*

[1] http://www.who.int/neglected_diseases/diseases/en/

In the next section we describe the data and methods used in the study. Finally, we present some preliminary findings

METHODS

In order to conduct the study, we limit ourselves to a short list of diseases and countries, which will allow us to develop a more detailed analysis. Also, it is necessary to have a classification of the countries in terms of degree of development as well as a classification of diseases, especially to determine those that are prevalent both in developed and developing countries.

Selected countries

Six specific countries were selected to develop this study. The main criteria in the selection of these countries was to obtain a balanced representation of countries according to their degree of development. We used the 2015 edition of the Human Development Index (HDI)[2], created by the United Nations Development Programme, in order to determine the degree of development of the countries. The HDI is a composite indicator which takes into account several dimensions such as life expectancy, education, and income per capita to estimate the degree of development.

This HDI group all the countries in four categories, ranging from 'very high human development' to 'low human development'. We selected countries in the three top categories of development, as countries in the lower category ('low human development') hardly contribute to the international scientific literature, somehow reflecting their low activity on scientific research. Table 1 shows the countries selected, representing distinct stages of development.

Table 1. Countries included in the study according to their HDI (position in the ranking)

Very high	High	Medium
Netherlands (5)	Russia (50)	Colombia (97)
Spain (26)	Brazil (75)	India (130)

Selected diseases

We will consider two main group of diseases in the study, based on their prevalence in developed and developing countries. To this effect, we rely on the *Types* of diseases defined by the Consultative Expert Working Group on Research and Development: Financing and Coordination (CEWG) of the World Health Organisation. Three types of diseases are defined[3]:

- Type I: incident in both rich and poor countries, with large numbers of vulnerable populations in each
- Type II: incident in both rich and poor countries, but with a substantial proportion of cases in poor countries
- Type III: are those that are overwhelmingly or exclusively incident in developing countries

[2] http://hdr.undp.org/en/2015-report

[3] WHO Secretariat. Defining disease types I, II, and III. (http://www.who.int/phi/3-background_cewg_agenda_item5_disease_types_final.pdf)

For our study, we will focus on a selection of diseases of Type I and Type III, given that the former affect more or less equally developed and developing countries, and the later affect specially developing countries. Type III diseases basically correspond to the NTD.

Table 2. Selected diseases by type

Type I	Type III
Ischaemic heart disease	Chagas disease
Diabetes mellitus	Leishmaniasis
Cerebrovascular disease	Schistosomiasis
Liver cancer	Onchocerciasis
Alzheimer	Trypanosomiasis

Identifying research on diseases

The identification of scientific research on specific diseases builds upon a previous study conducted at CWTS aimed at quantifying research outputs by disease. This was done coupling of publications to International Classification of Disease (ICD)-10 Diagnose Groups via keywords (manuscript in progress).

The Web of Science (WoS) was used to identify scientific research on different diseases, focussing only on biomedical research fields.

There were selected 84 out of the 250 WoS categories that are most medically oriented. The selection was validated looking at the research output of the eight Dutch university medical centers. The outcome of this validation exercise indicated that over 95% the publications was in one of the selected web of science categories. The dataset originally built included all articles and reviews in the 84 WoS categories, published between 2000 and June 2014. This original dataset contained 6.5 million publications in total.

In our study, we will select publications in the period 2009-2014, covering the most recent period. In this period we will be also able to analyse the origin of the funding used in research on specific diseases as acknowledged by authors in their publications

Scientific impact of journals and publications

The level of citation impact of journals and publications will be determined using CWTS' standard indicators. In the case of journals, we will divide each WoS subject category in four quartiles based on the Mean Normalized Journal Score (MNJS), which will allow us to distinguish between journals with a higher impact (1st and 2nd quartiles) and journals with lower impact (3rd and 4th quartiles).

Citation impact of publications will be determined mainly using the Mean Normalized Citation Score (MNCS).

PRELIMINARY FINDINGS

Table 3 shows the total number of publications produced by each country in the period 2009-2014 and the amount of publications dealing with specific diseases. In this table can be observed how very high developed countries devote a higher amount of publications to specific diseases, also Brazil, reaching comparable figures.

Table 3. Publications by country in the period 2009-2014

Country	All publications	Publications on diseases (%)
Netherlands	210,813	36,271 (17.2)
Spain	310,285	35,204 (11.3)

Russia	174,596	5,923 (3.4)
Brazil	220,803	31,583 (14.3)
Colombia	18,781	1,847 (9.8)
India	291,877	23,301 (8)

In table 4 we present an example of the amount of publications each country devoted to a disease of Type I (Diabetes) and a disease of Type III (Chagas disease). This table reveals that very high developed countries devoted much more research to Diabetes while the relative effort of countries like Colombia is much more concentrated on Chagas disease. Brazil, a country suffering both diseases and with a relatively good position to conduct research, presents a quite balanced profile.

Table 4. Publications devoted to Chagas disease and Diabetes

Country	Diabetes (%)	Chagas disease (%)
Netherlands	517 (1.4)	8 (0)
Spain	542 (1.5)	114(0.3)
Russia	125 (2.1)	5 (0.1)
Brazil	774 (2.5)	664 (2.1)
Colombia	17 (0.9)	82 (4.4)
India	689 (3)	4 (0)

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