

BEYOND EXTERNAL BRAIN DRAIN IN MEXICAN HEALTH SCIENCES COMMUNICATION

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ABSTRACT

Mexico is one of the largest Latin American countries, a fact which underlines its importance. However, the country's unbalanced development has widened dramatically the gap between the rich and the poor in the past twenty years. Research is seen as an option to alleviate the health conditions of the poor.

We understand that scientific communication can be hard work, hard work that does not have to be disconnected from the needs of the population. However, research evaluation relies on the number of published papers and citations attracted. Therefore, we attempted to determine the role that publications play in evaluating individual research, i.e. obtaining scientists' recognition, as well as to determine if published papers have contributed to the solution of health problems.

Papers in the list of "Hottest Journals of the Millennium (so Far)" authored by Mexicans or foreigners working in Mexico were retrieved from the *Web of Science*. Papers published in seven disciplines were matched against the main causes of death. Most productive authors in each field were also matched against the list of scientists recognized by Mexican government as national researchers.

We identified that a total of 415 unique papers that were cited at least once were published by Mexicans or by foreigners working in Mexico from 1995 to 2004 in 43 journal titles (excluding Nature, Science and PNAS). Papers were published by academic institutions (79%), three of them located in the country's capital (60% of the total output) in seven health sciences-related fields. Research was published by scientist working in the most prestigious academic institutions (67%). Papers were published mainly in two fields: Microbiology and Immunology.

Our results may under-estimate Mexican research effort since we looked at a small number of the most central journals within a limited number of fields. Large institutions and the country's capital concentrated most of the output, output that does not correlate with major causes of death.

Keywords: communicating science; bibliometrics; health sciences; Mexico; brain drain

INTRODUCTION

For many years Mexico has faced an epidemiologic transition (1) which reveals a mixed picture: a decline in the incidence of infectious diseases and a rapid increase in the incidence of chronic diseases and accidents. Many of the emerging ailments are a result of a defective process of industrialization that has placed more value on economic

growth than on human welfare. Mexico's development depends ultimately on the quality of life of its population, however, socio-economic imbalances have an effect on health patterns within the population: a small proportion of the population live in affluent neighborhoods but many millions live in poverty -- from patched farm plots to the cardboard slums that ring the cities. Cramped living conditions, a lack of basic amenities -- such as potable water, sewage disposal, biological contamination of food, a protein-deficient diet and lack of an effective health education -- seriously affect the health of the latter group. Poor people continue the suffering from the pathologies of poverty (cirrhosis, tuberculosis, amoebiasis). The better-off segments of the population have completed the epidemiologic transition.

Mexico also requires for its development a strong science capability. Research, therefore, is needed in order to reduce the imbalances.

Science policy research seeks to identify rational measures with which to optimize the allocation of financial and human resources. National plans for development have stressed the importance of an autonomous decision-making capacity, locally relevant research and the creation of an indigenous science base. An autonomous decision-making capacity is still far from being achieved; much knowledge has to be imported because of a weak connection between research and society's needs. Research in Mexico does not have to be oriented towards, influenced or determined by external agencies or agendas which are set outside the country and have little to do with its development requirements.

Mexican researchers have been accused of insularity, of failing to adopt a critical attitude towards their own creative endeavors and of neglecting external criteria (efficiency, applicability) in assessing scientific merit. However, several questions need to be asked: is research creating social benefits, contributing to the advancement of science and accelerating development? Are Mexican scientists contributing to the internal brain drain or has research become a self-serving exercise? Is there a case for holding in check the science-for-science's-sake ethos in Mexico?

Therefore, we attempted to analyse the performance of Mexican health sciences research through the communication of research results in the most visible journals, taking into consideration that publications play an important role in evaluating individual research, i.e. gaining scientists' recognition. We also considered that the communication of science has to be associated with the improvement of health of the Mexican population.

METHODS

The visibility of health sciences research in Mexico from 1999 to 2004 was measured via the *Web of Science*. Papers in the “Hottest Journals of the Millennium, (so Far)” (2) authored by Mexicans or foreigners working in Mexico were retrieved; papers were matched against the main causes of death (3) as an evidence of brain drain. Also, the esteem measure was obtained from Mexico’s National Researchers System (SNI) –the Mexican government recognition- data.

RESULTS AND DISCUSSION

A small number of papers were published in the journals listed in the Hottest Journals of the Millennium (so Far) (N=414). A previous study (4) based on 111 journal titles listed by Garfield in 1998 (5-6) showed that a total of 1,293 papers were published by Mexicans or foreigners working in Mexico from 1999-2004, i.e. 68% more than the papers that appeared in the hottest journals.

Distribution of papers by year of publication increased and then decreased (Table 1).

Table 1. Distribution of papers by year of publication

Year	No. papers
1999	65
2000	76
2001	80
2002	87
2003	74
2004	32
Total	414

“Hottest research” output is, however, highly skewed, since more than 60% of the papers were concentrated in Mexico City. Fourteen states published less than five articles, without counting the zero producers (Table 2).

Table 2. Geographic distribution of papers

State	No. papers
Mexico City (Federal District)	250
Morelos	95
Guanajuato	15
Nuevo León	15
Puebla	15
Colima	4
Baja California Sur	3
Yucatán	3
México	2
Querétaro	2
San Luis Potosí	2
Chiapas	1
Durango	1
Jalisco	1
Michoacán	1
Oaxaca	1
Sinaloa	1
Sonora	1
Tamaulipas	1

From Table 3 it is clear that the majority of research is being carried out by academic institutions (80%), followed by the public health sector (18%). Private institutions, academic or health, were absent.

Table 3. Author's institutional affiliation

Type	No. papers	%
Academia	329	79
Government	73	17
Research, public	4	0.9
Health, private	3	0.7
Academic, private	0	
International organisations	3	0.7
Other	2	0.4

Five institutions, three academic and two tertiary and research government centres accumulated the greatest number of published papers (Table 4).

Table 4. Top publishing institutions (ranked by total number of papers)

Rank	Institution	No. papers	% of total
1	National University	190	46
2	Centre of Research and Adv Studies	62	15
3	National Polytechnic	25	6
4	Inst of Nutrition	18	4
5	Social Security Inst	16	3

The scatter across journals is striking: in 43 hottest journals, 58% of the journals carried five or more papers. Journals such as J Biol Chem, J Bacteriol, Infect Immun and Molec Microbiol accumulated 43% of the published papers. Mexican scientists published 414 papers in hottest journals distributed across seven categories where disciplines such as Microbiology, Immunology and Biology & Biochemistry were the most active (Table 5-11). Cites per paper were higher in Clinical Medicine, Molecular Biology & Genetics and Immunology.

When we compared our results with those of Frame (7) we noted that the author identified that the most active health related fields in Latin American countries were: Hygiene and Public Health, Fertility, Tropical Medicine, Parasitology, Obstetrics and Gynaecology, and Nutrition and Dietetics, areas of enquiry relevant to the quality of life of the population. Licea et al. (8) found that basic disciplines such as Biochemistry & Molecular Biology, Neurosciences, Microbiology, Pharmacology & Pharmacy and Physiology were the most active.

Table 5. Published papers on Molecular Biology & Genetics

Rank	Journal	No. papers	Cites per paper
1	Cell	1	87
2	Genes & Develop	2	51
3	Nature Genetics	5	41
4	Am J Hum Genet	5	11
5	J Cell Biol	2	8

Table 6. Papers on Biology & Biochemistry

Rank	Journal	No. papers	Cites per paper
1	Structure	2	35
2	Nature Biotechnol	5	29
3	J Biol Chem	52	14
4	Molecular Endocri	3	5
5	BBA Mol Cell Bio	3	3

Table 7. Published papers on Pharmacology & Toxicology

Rank	Journal	No. papers	Cites per paper
1	Pharmacogenetics	1	37
2	Chem Res Toxicol	7	25
3	Brit J Pharmacol	19	10
4	Mol Pharmacol	4	8
5	Drugs	1	6
6	J Pharm Exp Ther	5	5
7	Drug Metanol&Dep	1	1

Table 8. Papers on Neuroscience & Behaviour

Rank	Journal	No. Papers	Cites per paper
1	J Neurosci	13	19
2	Nature Neurosci	1	17
3	Biol Psychiat	1	16
3	Neuron	5	16
4	Cerebral Cortex	4	11
5	Annals Neurol	2	9

Table 9. Published papers on Clinical Medicine

Rank	Journal	No. Papers	Cites per paper
1	New Eng J Med	5	126
2	J Clin Invest	1	25
3	Lancet	19	21
4	JAMA	6	18
5	J Nat Cancer Inst	2	17
6	J Exp Med	2	7

Table 10. Papers on Microbiology

Rank	Journal	No. Papers	Cites per paper
1	J Virol	13	18
2	Appl Env Microb	21	15
3	Molec Microbiol	29	14
4	J Gen Virol	5	11
5	Antim Agents Chem	10	9
6	J Bacterial	52	8
6	Virology	14	8

Table 11. Published papers on Immunology

Rank	Journal	No. Papers	Cites per paper
1	Immunity	1	47
2	J Immunol	13	17
3	J Infec Dis	12	14
4	Infec Immun	44	12
5	J Leukocyte Biol	8	10
6	Eur J Immunol	7	5
7	AIDS	6	4

Table 12. Disciplines of authors that published two or more papers and have been distinguished by Mexican government as national researchers

Discipline	Most productive authors	No. published papers	SNI members
Molecular Biol & Genetics	3	2	1
Biology & Biochemistry	2	4	2
Pharmacol & Toxicology	6	4>9	3
Neuroscience & Behaviour	4	4>8	3
Clinical Medicine	6	2	2
Microbiology	16	5>14	12
Immunology	9	4>7	3

Nowadays, communicating science gives rise to new forms of competition. Therefore, it is necessary to monitor Mexico's scientific performance despite opinions that say that there is an elite of scientists of excellence but, in general terms, there are no discoveries, i.e. knowledge is not being generated. Our results show that Mexican authors have the ability to publish in the most visible journals, that they have challenged publication and citation issues. Also, that they represent a real picture of Mexican research.

Mexican authors of the 414 papers published in the hottest journals were not tempted by foreign institutions to sell their expertise therefore contributing to the brain drain -- a pejorative expression, suggestive of loss of a vital resource, without compensation, or the depletion of the intellectual or professional resources of a country through immigration (9). Similar expressions include: "brain circulation" -- a cycle of study and work abroad may be followed by a return to the home country to take advantage of high-level opportunities -- (10); "cerveau en fuite"; "cerveaux en voyage" (11); "migration of talent" (12); "intellectual exodus" (13); "mobility of qualified manpower"

(14); and “fuga de cerebros”. All of these terms have been applied to qualified Mexicans going to well-paying jobs abroad, within or outside academia, i.e. external brain drain. But what about those scientists who return to their country and publish abroad?

Table 13 Published papers by main causes of death, 2003 (including their ranking)

Rank	Cause of death	No. papers
2	Heart diseases	1
3	Cerebrovascular diseases	4
5	Pulmonary diseases	11
8	Hypertensive diseases	1
14	Intestinal infectious diseases	55

The internal brain drain, identified by the ‘Sussex Group’ (15), refers to the orientation of science and technology. The Group notes that “the weight and orientation of world scientific effort has preponderant influence in the developing countries. Moreover, it is clear that, even in the advanced countries is strongly influenced by the major national objectives to which the scientific efforts of the advanced countries are intimately linked...”

The Group adds: “by implication, the orientation of science is often influenced and determined by objectives which are external to the countries themselves and which have little enough to do with the requirements of development. Sometimes the aid activities of the advanced countries in relation to science in the less developed countries have reinforced these contradictory tendencies. The result is a phenomenon which we shall refer to as the “internal brain drain”, whereby a substantial part of the scientific work going on in the developing countries, in addition to being underfinanced and poorly organized, is irrelevant to the environment in which it is being done”.

Therefore, we agree with the Group’s statements that Mexican researchers orient themselves towards the international scientific community choosing research topics alien to Mexico’s needs, seeking to contribute to the advancement of science as an international undertaking, and disregarding Mexico’s specific requirements. As long as these needs are ignored by the national community, researchers can retain their identity

only by orienting themselves outwards, thus delaying the solution of societal problems (16). Researchers, if they want to remain visible, have to choose research topics sanctioned by the international scientific community, for which resources have been often more freely available. Also, that they have chosen English as Diderot chose Latin to communicate their research output. Will they look back and publish in Spanish such as Diderot published in French? Will the Mexican government continue to support and distinguish those that publish in prestigious journals or will it favour indigenous publications? (Table 12).

Our results suggest that Mexican scientists have succeeded in placing their articles in prestigious journals, however, only a small number of papers dealt with pathologies of “poverty” and “development. Most papers on a cause of death were on intestinal infectious diseases that ranked 14 in main causes of death in Mexico in 2003 despite the fact that population tend to concentrate in urban areas and deaths possibly occurred because of the MRD (Microbial Resistance Diseases) (Table 13), results that were similar to those published elsewhere (17).

CONCLUSIONS

This study provides information pertinent to this complex and controversial issue: drain or gain. The data revealed facts that might stimulate rethinking of the national science policy regarding support for health sciences research.

If we take into account that the number of papers published in the hottest journals of the millennium is low as well as their incidence in terms of citations we need an explanation on what factors influence the communication of research results. Therefore, it can be interpreted that the small number of papers could be largely a function of tradition as well as the influence of various social and personal factors.

As only 72 papers were associated with a cause of death research seems to be isolated from the needs of society. Regarding those that have been recognised by the SNI as national researchers we concluded that policy makers in Mexico have to analyse the high cost paid by the country to support research.

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