A scientometric analysis of health and population research in South Asia: focus on two research organizations

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ABSTRACT

In this article we provide a scientometric comparison between two health and population research organizations, namely the International Centre for Diarrhoeal Disease Research in Bangladesh (ICDDR,B) and the National Institute of Cholera and Enteric Diseases (NICED) in India, during the period 1979-2008. We study these two institutes because they conduct similar research and because of their collaboration ties. Data are collected from the Web of Science (WoS) as well as from official records of these two organizations. The analysis presents the evolution of publication activities. Special attention is given to research impact through time series of the institutional h- and R-indices, as well as to the trend in yearly citations received. Types of publications, international collaboration with other countries, top scientists and most cited articles co-authored by scientists from these institutions are highlighted. It is observed that female scientists play a minor role in these two institutes.

Keywords: Scientometrics; Publication productivity; Research impact; Citation studies; h-index

INTRODUCTION

One of the big challenges for developing countries is to secure improvements in public health (Santana et al. 2004). When limited resources are used as effectively as possible, reductions in maternal and child morbidity as well as mortality in general can be obtained. Basic and applied research focusing on the local needs can contribute to solving these challenges. But how can a country with a low literacy rate and struggling against poverty, adverse weather conditions and a high disease burden compete in the international scientific fray? From this point of view we previously investigated scientific research in the following Indian sub-continent regions – Bangladesh, India, Pakistan and Sri Lanka (Mahbuba and Rousseau 2008; 2009). In this article we perform a scientometric study of two of the strongest institutes in this region that conduct research to save millions of lives by controlling childhood diarrhoea and other infectious diseases. The International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) and the National Institute of Cholera and Enteric Diseases (NICED) in Kolkata (formerly Calcutta), India, are the focus of this investigation. These two organizations share a similar historical background and are frequent research collaborators.

ICDDR,B and NICED were both established in the 1960s, with a general goal to lead in the study of epidemiology, i.e. the study of disease in population, and in particular treatment and prevention of cholera. These common origins can be seen from their former names: *Cholera Research Lab* for ICDDR,B and *Cholera Research Centre* for NICED. The *Cholera Research Lab* achieved an international position in 1978 when it became the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B). Similarly the *Cholera Research Centre* received national status in 1979 when it was renamed the National Institute of Cholera and Enteric Diseases (NICED). ICDDR,B is one of the world's leading research institutes in the field of diarrhoeal diseases. It became famous by the development and convincing field tests of the oral rehydration solution (ORS), a simple solution that has saved millions of lives. In recent times the centre has expanded its priority areas to the areas of children's health, reproductive health, nutrition, infectious diseases and vaccines, family planning and population sciences. NICED conducts research on acute diarrhoeal diseases of diverse aetiologies as well as typhoid fever, infective hepatitis and HIV/AIDS related epidemiological research and screening.

ICDDR,B is the leading organization in health and population research in Bangladesh, a country in which scientific investigations are dominated by health research (Mahbuba and Rousseau 2008). This study compares the scientific output of ICDDR,B with that of its collaborating organization, NICED in India. The paper presents the evolution of publication activities, citations received and the institutional h-index of these two institutes. It covers the publication period 1979-2008.

Researchers in several disciplines have been interested in publication productivity as a means of assessing scholarly excellence of individual researchers within a field. Publication productivity as measured by the number of papers, has also been regarded as one of the main indicators of reputation of institutions in general and academic institutions in particular. In an earlier study, Wickremasinghe (2008) focused on research activities of two rice research institutes in India and Sri Lanka: the Central Rice Research Institute (CRRI) in India and the Rice Research and Development Institute (RRDI). Research collaboration between Indian institutes and institutes in the ASEAN (Association of South East Asian Nations) countries is described in Gupta et al. (2002), based on the data obtained from the Science Citation Index (SCI). It was shown that collaboration took mainly place in the field of chemistry and less in medicine. This article contains in essence an enumeration of numbers of collaborative articles between India and each of the ASEAN countries. It was shown that the impact of multilateral collaborations was higher than that of bilateral collaborations. As the *h*-index (Hirsch 2005) was not invented at that time, the article does not report on *h*-index related results. In the present study however, the *h*-index will play an important role.

Basu and Aggarwal (2001) studied the effect of international collaboration on the impact of Indian institutions. It has observed that some scientific institutes, such as private hospitals, gained strongly from international collaboration. Sypsa and Hatzakis (2009) who studied on the research performance of biomedical research propose a modified *h*-index (Hirsch 2005) to account for the size of the institute under investigation. This approach can be considered a variation on the Molinari-Molinari approach used in Mahbuba and Rousseau (2009; 2010).

Thijs and Glänzel (2009) propose a benchmarking framework for classifying research institutes based on their research profile. Their approach has been tested for European institutes, but it would be highly interesting to include South-west Asian countries and institutes, in particular as their approach leads to a validation of national research performance measurements. A similar approach has been applied to Israeli institutes (Thijs et al. 2009). In a similar vein Ball et al. (2009) introduce a new indicator, called the *J*-factor, which measures the relative perception of the performance of an institution accounting for its publication and citation habits. It is claimed that this new indicator makes transdisciplinary comparisons possible.

METHOD

This study compares the scientific output between two research organizations in the area of health and population research which covers the publication period 1979-2008. The paper presents the evolution of publication activities, citations received and the institutional h-index of these two institutes (ICDDR,B and NICED). Scientometric data presented in this article were extracted form Thomson Reuter's Web of Science (WoS) in June 2009. We took great care to find as many publications as possible. This was no easy task, especially for ICDDR,B, as we identified more than fifty variant names for the institute, some of which are mentioned in Mahbuba and Rousseau (2008).

Over the period 1979-2008 ICDDR,B has published 2,252 articles included in the WoS. During that period these articles received more than 36,000 citations, an average of 16 citations per article. During this same period NICED published 734 articles in the WoS, which were cited 7,490 times, or an average of 10.2 times per articles. The two institutes' yearly numbers of publications included in the WoS are shown in Figure 1.

The two graphs in Figure 1 show an increasing trend. Yet ICDDR,B has a dip during the period 1997-2004. The Pearson correlation between yearly NICED publications and yearly ICDDR,B publications is 0.85, indicating a somewhat similar evolution between the two institutes. The two institutes provide a list of publications on the institutional websites. ICDDR,B makes a distinction between internal publications, such as working papers and scientific reports, and external publications, including journal articles, abstracts, book chapters, conference proceedings and monographs. This leads to a total of 4075 external publications during the period 1979-2008. Of these 4075 publications, 2252 or 55% could be traced in the WoS. Note though that the list of external publications contains documents, such as monographs, that are by definition not included in the WoS. NICED only publishes a list of journal articles. According to this list NICED published 949 journal articles during the period 1979-2008. Of these 949 articles 734 or 77% could be found in the WoS. Table 1 shows the division of types of published documents (in the WoS) for the two institutes. Compared to ICDDR,B, NICED has fewer meeting abstracts and hence more regular articles and letters. This reflects NICED's research policy which is, indeed, more directed to publishing full-text articles.

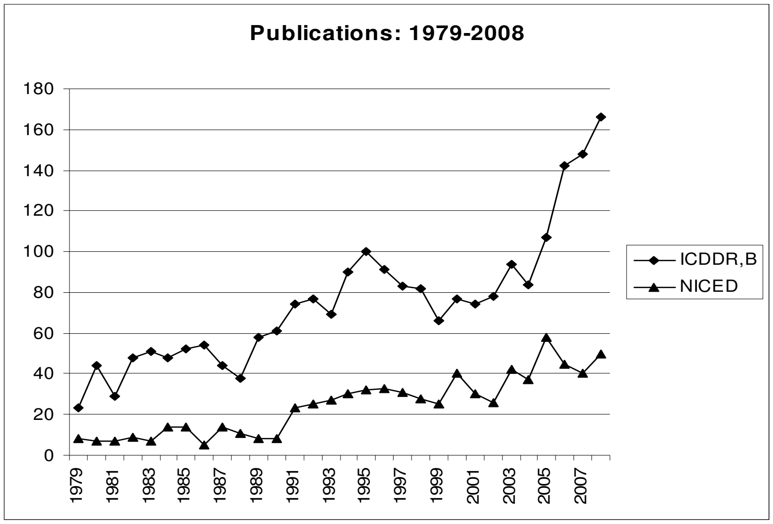

Figure 1: Number of Publications in WoS: Period 1979-2008

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Table 1: Types of Documents (in percentages) in the WoS

Type	ICDDR,B (in %)	NICED (in %)
Article	73.6	81.6
Meeting abstract	9.4	1.8
Letter	5.3	8.0
Note	4.0	3.8
Editorial material	2.5	0.9
Proceedings paper	2.4	1.2
Reviews	1.7	2.5
Other	1.1	0.1

RESULTS

Citations Received

We collected the number of citations received each year. These numbers are expected to increase as the number of articles that can be cited increases each year. Results are shown in Figure 2. By and large our expectations are fulfilled. ICDDR,B's citation curve can be described by a fourth order polynomial (Figure 2). Its equation is: $y = 0.031\ t^4 - 1.532\ t^3 + 23.04\ t^2 - 33.13\ t + 75.35$, where y denotes the number of citations received in year t, and t = 1 in the year 1979; $R^2 = 0.985$. NICED's citation history can be described by a second order polynomial (also shown in Figure 2). Its equation is $y = 1.361\ t^2 - 15t + 53.27$; $R^2 = 0.949$. We also collected the number of citations received over the whole citation window (the period: year of publication – June 2009) per publication year. Theoretically, these numbers may or may not increase depending on the number of yearly publications. One expects though that the number of citations per publication decreases because the older articles have a longer citation window. Of course quality and visibility of the published articles may interfere with our expectations. As shown in Figure 3a and 3b our expectations are met for ICDDR,B but not at all for NICED. Clearly the articles published by NICED in the middle of the period of investigation attracted more citations than those published in the beginning of the period.

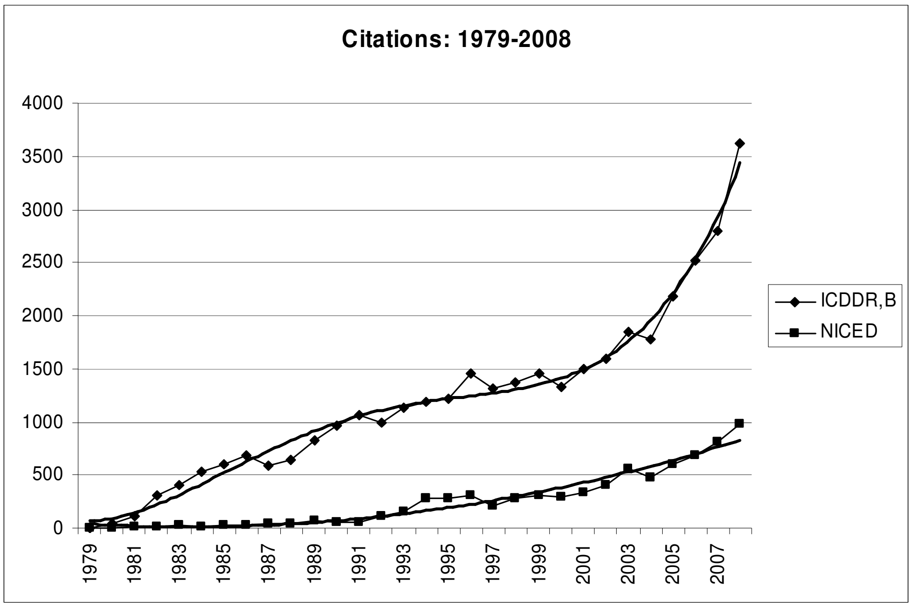
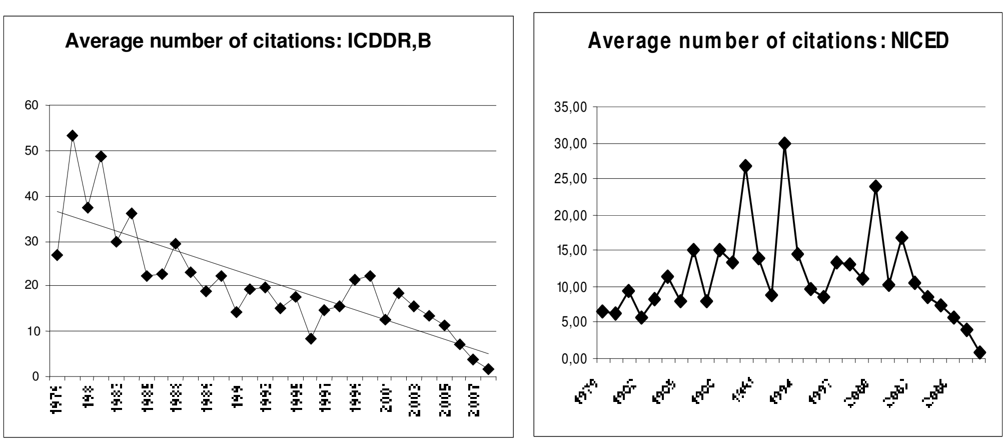


Figure 2: Number of Citations in WoS and Trend Curves: Period 1979-2008



3 (a) 3 (b)

Figure 3a, 3b : Average Numbers of Citations for ICDDR,B and NICED

H-Indices

Combining publication and citation data leads to *h*-indices. A set of articles' *h*-index (in a given timeframe) is *h* if *h* is the largest natural number such that *h* of this set's articles have received at least *h* citations (Hirsch 2005). These h articles form the *h*-core. The *h*-index has a number of practical advantages: it is not necessary to know the exact number of publications; once it is known that an article belongs to the *h*-core, or does certainly not belong to it, one must not determine the exact number of citations, and it avoids undue focus on the number of publications alone. The WoS h-index for all ICDDR,B publications is 82, while it is 39 for NICED. A timeline of how the *h*-index changes over time is probably more interesting. As in Liu et al. (2009) we use a type 1 time series (for a description of all types of time series we refer to Liu and Rousseau (2008)). This means that we fix the publication year and determine the *h*-index using all citations received over the period [publication year – June 2009]. The time series for ICDDR,B is always higher than that of NICED (Figure 4). Yet, ICDDR,B's *h*-values are more or less constant over a long period (except for the most recent one), while, even more surprisingly, NICED's show an increasing trend over a long period. Note that, in case the number of publications and the number of citations received are the same each year, these curves must decrease. For this reason we also consider a time series of normalized *h*-indices (Rousseau 2006), i.e. *h*-values divided by the number of publications. In Figure 5, ICDDR,B 's normalized values show the expected trend (Pearson R = 0.92), but NICED's values become even more irregular. Note though, that most of the years, NICED's normalized values are higher than ICDDR,B's.

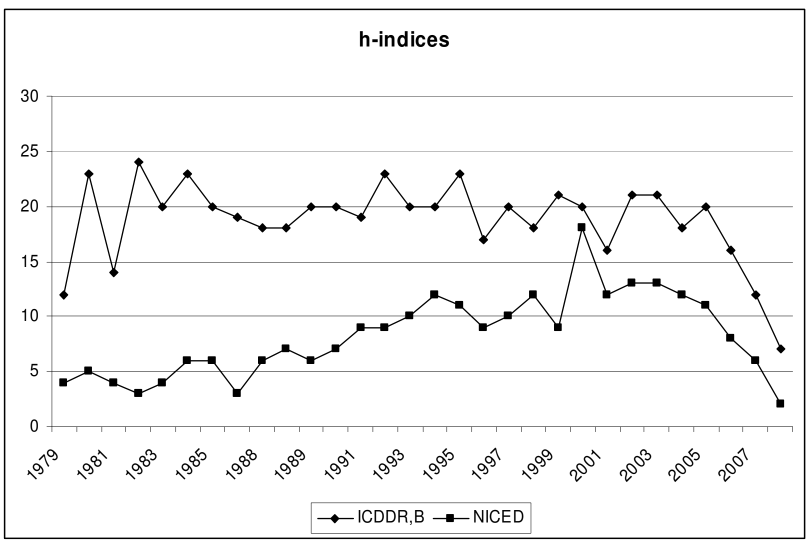


Figure 4: Type 1 Time Series of *h*-indices

We also consider type 2 time series of *h*-indices. Type 2 series are constructed by considering cumulative publication time periods. This means that the first *h*-value refers to publications in the year 1979, the second one to publications during the period 1979-1980, the third one during the period 1979-1981, and so on. Citations are always considered over the period [publication year – June 2009]. By definition such time series never decrease. Results are shown in Figure 6. ICDDR,B shows the typical concave shape, while NICED's type 2 time series of h-indices increases linearly over a long period. Based on the same data we also calculated a type 2 *R*-index time series for the two institutes (Figure 7). The *R*-index of a set of articles is equal to the square root of the sum of the citations received by the articles in the corresponding *h*-core (Jin et al. 2007). Remarkably the Pearson correlation coefficient between the type 2 *h*-index time series and the type 2 *R*-index time series are very high: 0.988 for ICDDR,B and 0.994 for NICED. This is a new observation that should be confirmed in other investigations. Indeed, although the different *h*-type indices are related, they can usually be subdivided into two groups: a group, including the original *h*-index, describing the quantity of the most-cited articles, and a group, including the *R*-index, describing the actual impact, as measured by citations, of these most-cited articles (Bornmann et al. 2009).

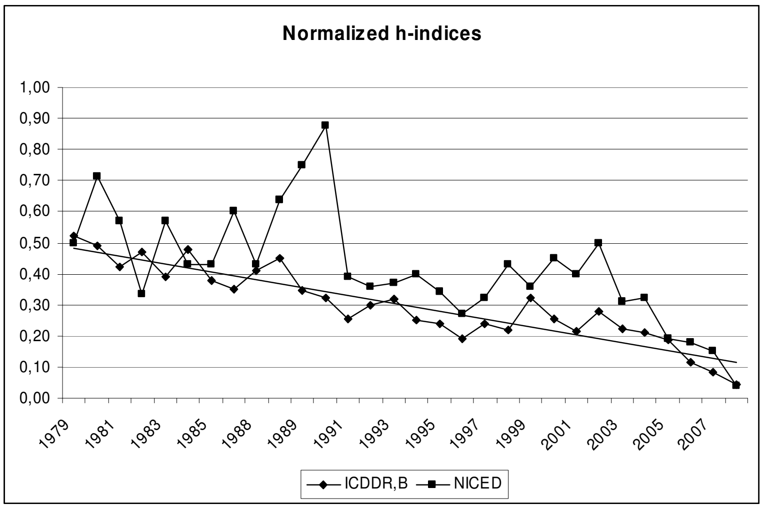


Figure 5: Normalized Type 1 Time Series of *h*-indices

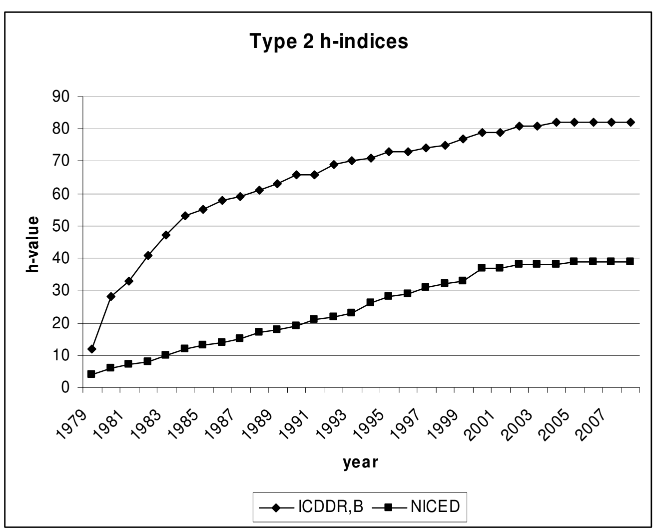


Figure 6: Type 2 Time Series of *h*-indices

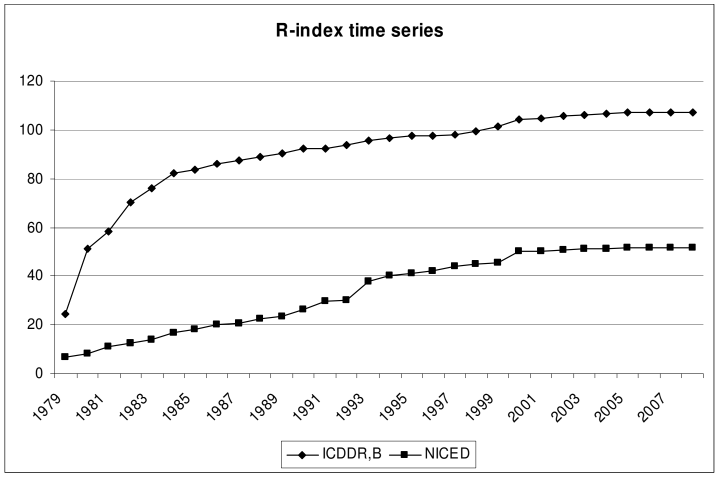


Figure 7: Type 2 Time Series of *R*-indices

Collaboration Aspects

Over the period under study, the two institutes collaborated on 79 articles. For NICED this means more than ten percent of the total output in the WoS. ICDDR,B collaborated most with Johns Hopkins University (on 10.8% of all publications), followed by the University of Maryland and NICED in that order. Using the ’analyze’ feature provided by the WoS software we investigated with which foreign countries the two institutes collaborate most. Results are shown in Table 2. For ICDDR,B we present the countries with at least 50 collaborations, for NICED the countries with at least 10 collaborations. Clearly, ICDDR,B is more internationally oriented than NICED. This observation is reflected in the names of these two institutes, with the words ‘international’ and ‘national’ in their respective names. ICDDR,B collaborates most with the USA, followed by Sweden and England; India is fourth. NICED collaborates most with Japan, while Bangladesh is second, followed by the USA.

Table 2: Collaborating Countries

ICDDR,B		NICED	
USA	942	Japan	174
Sweden	231	Bangladesh	88
England	161	USA	78
India	155	South Korea	23
Japan	133	England	19
Switzerland	82	Peoples R China	18
Australia	59	Thailand	12
Netherlands	54		
Belgium	51		

Top Scientists and Most-Cited Articles

We further investigated which scientists were the most productive over the period under study. Table 3 shows the 10 most productive scientists in ICDDR,B (according to PubMed and WoS) and their WoS career h-indices. These lists overlap to a large extend (8 scientists occur in the two lists). It is remarkable that the number of ICDDR,B or NICED publications in the WoS is higher than that in Pubmed. Two ICDDR,B scientists that do not occur in any of the two lists have a high h-index: Yunus M and Black RE, each with an h-index of 26. However, they do occur among the top 20 of the institute.

Similarly, Table 4 shows the results for NICED. For practical reasons this list starts in 1973. Some clarifications are in order regarding this list. First, Nair GB occurs in ICDDR,B's list and in NICED's list. The reason is that this scientist, who is now NICED's director, started his career at NICED, then moved to ICDDR,B and now again works at NICED. This also explains the close collaborating ties between the two institutes. Second, one may notice two Japanese names in NICED's list, namely Takeda Y and Yamasaki S. Since 1988 these Japanese scientists not only collaborated often with researchers from NICED, but also visited the institute for prolonged periods, which explains their occurrence is these lists.

Table 3: Top Scientists at ICDDR,B

Scientist	# publications in Pubmed	Scientist	# publications in WoS	*h*-index
Albert MJ	126	Albert MJ	183	34
Sack DA	110	Sack DA	154	30
Mahalanabis D	85	Mahalanabis D	142	21
Faruque ASG	80	Nair GB	141	22
Nair GB	72	Rahman M	130	21
Sack RB	72	Qadri F	110	19
Faruque SM	71	Sack RB	107	27
Salam MA	70	Fuchs GJ	105	19
Qadri F	68	Faruque ASG	104	21
Rahman M	66	Wahed MA	97	19

Table 4: Top Scientists at NICED

Scientist	# publications in Pubmed	Scientist	# publications in WoS	*h*-index (May, 2009)
Bhattacharya SK	186	Bhattacharya SK	239	26
Nair GB	130	Nair GB	234	35
Ramamurthy T	71	Ramamurthy T	103	20
Dutta P	69	akeda Y	91	27
Takeda Y	65	Pal SC	69	18
Bhattacharya MK	60	Mukhopadhyay AK	57	18
Pal SC	53	Bhattacharya MK	54	13
Niyogi SK	44	Das P	53	11
Mitra U	42	Yamasaki S	49	17
Ghosh S	41	Dutta P	48	14

Besides the most active scientists we also collected the most-cited articles of the two institutes (data collected on June 4, 2010). These are shown in Tables 5 and 6. Generally, ICDDR,B's most-cited articles are more highly cited than NICED's. It is also remarkable that NICED's most-cited articles are often written in collaboration with relatively large international groups.

Table 5: Five Most-Cited Articles Co-Authored by Scientists from ICDDR,B

Times cited: 357
Authors: Smith, A.H., Lingas, E.O. and Rahman, M.
Title: Contamination of drinking-water by arsenic in Bangladesh: a public health emergence
Journal: Bulletin of the World Health Organization
PY: 2000; Vol. 78, no. 7: 1093-1103
Field: Public, environmental & occupational health

Times cited: 338
Authors: Moseley, S.L., Huq, I., Alim, A.R.M.A., So, M., Samadpourmotalebi, M. and Falkow, S.
Title: Detection of entero-toxigenic Escherichia-coli by DNA colony hybridization
Journal: Journal of Infectious Diseases
PY:1980; Vol. 142, no. 6: 892-898
Fields: Immunology; Infectious diseases; Microbiology

Times cited: 327
Authors: Chen, L.C., Chowdhurt, A.K.M.A., and Huffman, S.L.
Title: Anthropometric assessment of energy-protein malnutrition and subsequent risk of mortality among preschool aged children
Journal: American Journal of Clinical Nutrition
PY: 1980; Vol. 33, no. 8: 1836-1845
Field: Nutrition and dietetics

Times cited: 306
Authors: Black, R.E., Merson, M.H., Rahman, A.S.M., Yunus, M., Alim, A.S.M., Huq, I., Yolken, R.H. and Curlin, G.T.
Title: A 2-year study of bacterial, viral, and parasitic agents associated with diarrhea in rural Bangladesh
Journal: Journal of Infectious Diseases
PY: 1980; Vol. 142, no. 5: 660-664
Fields: Immunology; Infectious diseases; Microbiology

Times cited: 293
Authors: Koster, F., Levin, J., Walker, L., Tung, K.S.K., Gilman, R.H., Rahaman, M.M., Islam, S. and Williams, R.C.
Title: Hemolytic-uremic syndrome after shigellosis – relation to endotoxemia and circulating immune-complexes
Journal: New England Journal of Medicine
PY: 1978; Vol. 298, no. 17: 927-933
Fields: Medicine, general and internal

Table 6: Five Most-Cited Articles Co-Authored by Scientists from NICED

Times cited: 342
Authors: Ramamurthy, T., Garg, S., Sharma, R., Bhatacharya, S.K., Nair, G.B., Shimada, T., Karasawa, T., Kurazano, H., Pal, A. and Takeda, Y.
Title: Emergence of novel strain of vibrio-cholerae with epidemic potential in Southern and Eastern India
Journal: Lancet
PY: 1993; Vol. 341, no. 8846: 703-704
Fields: Medicine, general and internal

Times cited: 122
Authors: Matsumoto, C., Okuda, J., Ishibashi, M., Garg, P., Rammamurthy, T., Wong, H.C., Depaola, A., Kim, Y.B., Albert, M.J. and Nishibuchi, M.
Title: Pandemic spread of an O3-K6 clone of Vibrio Parahaemolyticus and strains evidenced by arbitrarily primed PCR emergence of related and toxRs sequence analyses
Journal: Journal of Clinical Microbiology
PY: 2000; Vol. 38, no. 2: 578-785
Fields: Microbiology

Times cited: 121
Authors: Okuda, N., Ishibashi, M., Hayakawa, E., Nishino, T., Takeda, Y., Mukhopadhyay, A.K., Garg, S., Bhattacharya, S.K., Nair, G.B. and Nishibuchi, M.
Title: Emergence of a unique O3-K6 clone of Vibrio Parahaemolyticus in Calcutta, India, and isolation of strains from the same clonal group from Southeast Asian travellers arriving in Japan
Journal: Journal of Clinical Microbiology
PY: 1997; Vol. 35, no. 12: 3150-3155
Fields: Microbiology

Times cited: 116
Authors: Shimada, T., Nair, G.B., Deb, B.C., Albert, M.J., Sack, R.B. and Takeda, Y.
Title: Outbreak of Vibrio-cholerae non-01 in India and Bangladesh
Journal: Lancet
PY: 1993; Vol. 341, no. 8856: 1347-1347
Fields: Medicine, general and internal

Times cited: 109
Authors: Kersulyte, D., Mukhopadhyay, A.K., Velapatino, B., Su, W.W., Pan, Z.J., Garcia, C., Hernandez, V., Valdez, Y., Mistry, R.S., Gilman, R.H. , Yuan, Y., Gao, H., Alarcon, T., Lopez-Brea, M., Nair, G.B., Chowdhury, A., Datta, S., Shirai, M., Nakazawa, T., Ally, R., Segal, I., Wong, B.C.Y., Lam, S.K., Olfat, F.O., Boren, T., Engstrand, L., Torres, O., Schneider, R., Thomas, J.E., Czinn, S. and Berg, D.E.
Title: Differences in genotypes of Heliobacter pylori from different human populations
Journal: Journal of Bacteriology
PY: 2000; Vol. 182, no. 11: 3210-3218
Fields: Microbiology

Contribution of Female Scientists

We found only 6% of female scientists in the list of ICDDR,B contributors; only one (Firdausi Qadri) of them occurring among the top scientists. A similar low number of woman scientists is active at NICED, none belonging to the top researchers. Is here a Matilda effect at work (Rossiter 1993) or is this low number just the reflection of the fact that although Bangladesh and India are democratic countries and women have in theory access to all public positions, in reality they have still a lot of catching up to do? The term "Matilda effect" is a term introduced by Margaret Rossiter, pointing to the systematic underestimation of women's academic merit. It has been noted that in Belgium about 50% of all doctoral students and lower level academic personnel are women, but among the full professors this share is only 10% (Dambre 2009).

When it comes to outreach to the local population female scientists working at specialized institutes focusing on the local needs, such as ICDDR,B and NICED, can make a huge difference for the population of the region where they are active. This is especially true for women in rural regions.

CONCLUSION

In general the performance in the health sciences of Asian countries lags behind that of Western countries (Hu and Rousseau 2009). It seems that India and Bangladesh follow this pattern (Mahbuba and Rousseau 2010). Yet, the term *lagging behind* refers to averages and general circumstances. In this note we have shown that, even with limited financial means these two related institutes are visible on an international scale, and are determined to make a difference for the population in the region.

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