A quantitative analysis of medical publications from Arab countries

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ABSTRACT

Objectives: To perform geographical analysis of the number of biomedical publications produced in 20 Arab countries over a 15-year period from 1987 to 2001 and to compare publication rates normalized by country population, school enrolment, adult illiteracy, and gross domestic product (GDP).

Methods: This study was carried out at the Faculty of Medicine and Health Sciences, UAE University, Al-Ain, United Arab Emirates. A search of the Medline database for publications in which the first author of original articles is affiliated with an institution located in the Arab World was performed. Data collection, extraction, and validation was performed.

Results: The Kingdom of Saudi Arabia and Egypt had the highest number of publications together accounting for 58.4% of the Arab World's publications. Kuwait and the United Arab Emirates (UAE) had the highest number when normalizing by population with 6.57/100,000 for Kuwait and 2.62/100,000 for UAE. Normalizing by the GDP indicator, Jordan had the highest number of publications with 11.2 per one billion average yearly GDP followed by Lebanon with 10.3 per one billion average yearly GDP.

Conclusion: Normalizing publications by different indicators is important as results may vary when using different normalizing indicators or no normalization at all.

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The Arab World consists of countries at varying stages of development. There is great variation in the standard of annual income, education, and health care between these countries.[1] Biomedical research is important for health care, higher education, needs training and financial support. Biomedical publications are the final outcome of medical research and can be considered as a marker of medical research activity.[2,3] The purpose of this study was to perform geographical analysis of the number of biomedical publications produced in 20 Arab countries over a 15-year period normalized by country population, school enrolment, adult illiteracy and gross domestic product (GDP).

Methods. A search of Medline was performed through the PubMed web site.[4] This study was carried out at the Faculty of Medicine and Health Sciences, UAE University, Al-Ain, United Arab Emirates. The total publications for each Arab country were collected and validated over the considered time period from 1987 to 2001. First, the country name is entered into the "for" field. Then, the "Limits" link is clicked and "Affiliation" is chosen in the "Limited to:" field so that the affiliation field in the Medline database is searched for the entered country name. Then, the "Go" button is pressed and a list of results is displayed in "summary" form which is not an easy form to use for automated extraction of wanted data. It also does not contain the affiliation information needed in the validation phase. Rather, the "Medline" form is ideal for automated extraction because it contains all needed fields and is formatted in a way where automated searching can be

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performed. It is chosen rather than the "Summary" form by clicking on the "Summary" pick list and then choosing "Medline".

In the same fashion, the sort order "Pub Date" is chosen so that articles are sorted by publication date. Then, the "Save" button is clicked so that the data is downloaded and saved in a text file. This text file is then used in the extraction phase. Collection of data for each country is carried out in this way completing the collection phase, then the extraction phase begins. The extraction phase involved writing a visual basic program that reads each country's text file and creates one text file in tabular form. The 3 main fields of this created table are country, date of publication, and full affiliation name. This text file is read into an excel spreadsheet where it is carefully looked over for errors. When affiliation names were originally entered into the Medline search, we aimed to be as general as possible so as to ensure that we catch all articles from that country. For some countries, several country names where entered (namely, Saudi, Saudia, and KSA). Hence, in the validation phase it is necessary to tediously check for duplications and false positives. All entries were manually reviewed and duplicates and false positives were eliminated. The most common error was false positives for Lebanon and Jordan, since there are several cities in the United States of America (USA) called "Lebanon", and many USA universities have "Jordan Halls". Most entries where "USA" was in the full affiliation name were manually deleted among others. This way, accurate publication counts were produced per country per year using an access database.

Raw publication counts, however, may not serve as a fair comparison of research publications unless normalized. Therefore, we decided to normalize these publication counts using several country indicators. The first indicator normalized by is the average of the country's 1990, 1995, and 2000 population which was obtained from the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects.[5] Then, 2 other indicators were used, the 1995 male adult illiteracy rate and the 1990-1996 male school enrolment ratio (primary and secondary) which were obtained from the United Nations publication "Charting the Progress of Populations" provided by The UN Department of Economic and Social Affairs, Population Division.[1] The 4th and last indicator used was the country's average gross domestic product (GDP) from 1988 to 1998 which was obtained from the United Nations Department of Economics and Social Affairs, Statistics Division, Statistical Yearbook.[6]

Results. We found only 39 publications before 1987 for all Arab countries combined. Therefore, this study focused on the 15-year period from 1987-2001. **Figure 1** shows the average annual publication per country with percentages. The Kingdom of Saudi Arabia (KSA) and Egypt had the highest number of publications together accounting for 58.4% of the Arab World's publications. Normalizing by the population indicator, Kuwait had the highest research publications with 6.57 publications per 100,000 of the population as shown in **Figure 2**. The United Arab Emirates is second with 2.62 publications per 100,000 of the population. The next 2 indicators used are adult illiteracy rate and male school enrolment ratio. The results were similar to the population-normalized results. The 4th and last indicator used was the country's GDP in US$ at current values. Normalizing by the GDP indicator, Jordan had the highest research publications with 11.2 publications per one billion average yearly US$ GDP at current values as shown in **Figure 3**. Lebanon is second with 10.3 publications per one billion average yearly US$ GDP at current values.

The last objective of this study was to perform trend analysis on the 15-year data of all 20 Arab countries. **Figure 4** shows a graph of the 3 countries with the highest raw publication rates. These countries are KSA, Egypt, and Kuwait in order of highest raw publication rate. The trend line for KSA shows that on average around 22.4 additional medical publications are produced each year. This number is known as the slope of the trend line. Egypt also shows a similar slope. Kuwait, however, shows a trend line slope around 1.6, which is low because of the Gulf War. If we study the trend line from the year 1992 to 2001, we see that the trend is positive and has a slope of 17. We then calculated the slope or yearly increase in publication rates for all Arab countries during the 15-year period. **Figure 5** shows the results of each country's slope. By comparing **Figure 1** and **Figure 5** we can see that the higher the rate of publication, the higher the slope for that country. The correlation between the rate of publication and increase in rate of publication was high (r=0.9).

Discussion. A number of studies discussing medical publications from Arab countries have been previously performed. They were limited, however, to the Arabian Gulf countries. Deleu et al[2] studied biomedical publications from the Gulf Cooperation Council (GCC) countries for the period of 1990 to 1999 using Medline database. Another recent study searched Medline and Science Citation Index databases concentrated on publications from KSA.[3] They obtained publication total counts as provided by the search index for 23 Arab countries from 1966 to 2000. Both studies did not normalize their data.[2,3] The publication percentages found in these studies were similar to **Figure 1**. Lammers et al[7-11] reported the publication counts from the UAE and the GCC for different periods of 1989-1998. Their results for the UAE and the GCC were similar to our non-normalized results. In some cases, such as KSA, our average publication percentages were slightly lower than previous studies due to the fact that our averages include the years 1987-1989 in which a significantly smaller number of articles were published.

Figure 1 - Average Arab country medical publications per year with percentages.

Figure 2 - Arab country medical publications normalized by average population (publications per 100,000 average population in 1990, 1995, and 2000).

Figure 3 - Arab country medical publications normalized by country's gross domestic product (GDP) (publications per one billion average yearly US$ GDP at current values from 1988 to 1998).

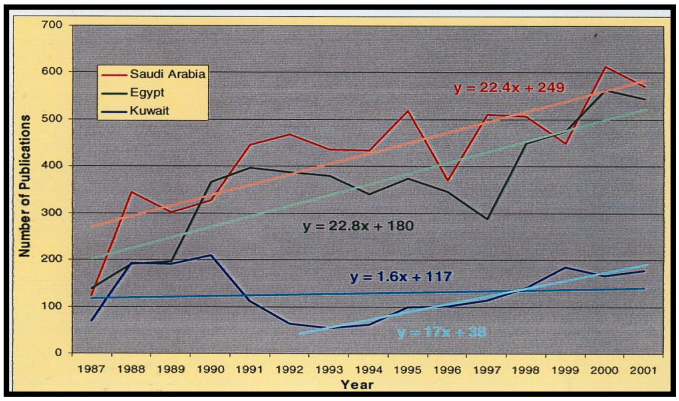

Figure 4 - Publication trends for the top 3 Arab countries.

Figure 5 - Publication trends (slope) for all Arab countries.

This brought our 15-year average down as compared to previous studies which do not include this early period in their averages.

Normalization is essential to understand outcomes as the results may differ after normalization.[12,13] Raw publication counts may not serve as a fair comparison of research activity unless normalized. We have chosen country population and GDP as normalizing indicators because they affect research activity. When comparing the 3 results of raw counts, counts normalized by population, and counts normalized by GDP (**Figures 1, 2, & 3**) it is interesting to observe that the countries with a smaller population rise up in the list (**Figure 2**) and that countries with lower GDP's also rise up in the list (**Figure 3**) as compared to their positions when using raw publication counts (**Figure 1**).

Another significant difference in methodology between our study and previous studies is the way data was collected. Previous studies, as well as ours, used the advanced search feature in Medline to search for each country's publications using the affiliation field. Medline returns a count of publications that previous studies use. We, however, saved the complete set of results in "Medline" form into a text file. Then, we executed a visual basic program, which we developed to extract the wanted fields. Obtaining publication counts in this way rather than relying on Medline's search count results is an innovative method that is more flexible and allows for better validation and higher control of the search. The validation of each country's publication counts was carried out by carefully and tediously checking each publication's affiliation to make sure that it really was affiliated with that country and that it was not a false positive.

We acknowledge that there are certain limitations to our present study. 1. Our study provides only a quantitative analysis of the number of publications and does not discuss the qualitative aspect of these publications nor their value or impact on medical practice and benefits to the community. They are only intended to give an idea of the level of research activity in Arab countries in the medical field. 2. We searched only Medline database. Nevertheless, it is the most commonly used database in medicine. Journals that are indexed in Medline have a high standard. Journals of local nature may not be indexed but their value should not be downgraded. 3. We have to appreciate that sometimes ratios can give a false impression when the denominator is too small. For example, Djibouti had a high GDP ratio simply because its GDP is too small (**Figure 3**). It had only published an annual average of 2 publications per year (**Figure 1**). 4. Further analyses of institution and discipline breakdowns were not performed. As found in a previous study,[3] there is no uniformity in the Medline database when it comes to institution names and it was therefore extremely difficult to correct and unify institution names for the purpose of these analyses. 5. The affiliation field was searched for the first author only. There are of course many publications with coauthors from Arab countries. These were not counted because the Medline database stores only the first author's affiliation information. Solutions for these shortages in databases have to be addressed if we want to efficiently progress in the use of medical informatics in research.

In summary, KSA has the highest number of publications over the last 15 years followed by Egypt. When normalizing by population, Kuwait has the highest rate for publication followed by United Arab Emirates. Whereas, normalizing by GDP, Jordan has the highest publication rate followed by Lebanon. Normalizing publications by different indicators is important because results may vary when using different normalizing indicators or no normalization at all.

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