Is research related to a country's economic development? An analysis of biomedical publications from several GCC and ASEAN countries from 1994-2013

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ABSTRACT

Introduction: Biomedical research has traditionally been the domain of developed countries. We aim to study the effects of the increased focus on biomedical and medical research on level 1-4 publications in several industrialised and newly industrialised countries endowed with petroleum and gas resources.

Methods: We identified all level 1-4 publications from 01/01/1994 to 31/12/2013 via PubMed using advanced options. The population and GDP (current US$) data from 1994-2013 were obtained through data provided by the World Bank and the raw data was normalised based on these two indicators.

Results: From 1994-2013, Saudi Arabia and Malaysia were responsible for the highest absolute number of level 1 to 4 biomedical and medical research publications with 2551 and 1951 publications respectively. When normalised to population, Kuwait and Qatar had the highest publication rates, with 7.84 and 3.99 publications per 100,000 inhabitants respectively in a five yearly average. Kuwait produced the largest number of publications per billion (current US$) of GDP, at 2.92 publications, followed by Malaysia at 2.82 publications in a five yearly average.

Conclusion: The population size of a country as well as GDP can influence the number of level 1-4 publications in some countries. More importantly, effective government policy which stimulates research as well as a culture which actively promotes research as shown by Malaysia have proven to have a larger influence on the amount of level 1-4 biomedical and medical publications.

KEY WORDS:
Biomedical research, publications, PubMed, bibliometrics

INTRODUCTION

Many countries which have traditionally relied on petroleum and gas based resources have striven to diversify their economic portfolios in the pursuit of developing knowledge based economies to break free from the cyclical prices of these finite resources and to provide alternatives to these finite resources. Medical and bioscience research has been a beneficiary of this push as many of these countries have identified this as a niche key growth area.

We aim to look at several countries where such efforts have been underway. These countries include the Gulf Cooperation Council countries of Kuwait, Qatar, Saudi Arabia, Oman, the United Arab Emirates and countries in Southeast Asia such as Malaysia, Indonesia and Brunei. All of these countries share similar cultural and religious traits as well as significant petrochemical industries.

Several publications have quantitatively analysed biomedical publications from these countries whilst not differentiating between higher impact research output (level 1 to 4 evidence, as defined by the Centre for Evidence-Based Medicine in Oxford), such as randomised controlled trials, versus lower impact publications such as editorials and single case reports.[1,2,3,4,5] This article aims to analyse the impact of the efforts of these countries to advance in the field of biomedical science based on the number of level 1 to 4 research publications in the field of biomedical science and medicine. This can be bibliographically studied using PubMed, taking into account the country's population and the gross domestic product (GDP (current US$)).

MATERIALS AND METHODS

PubMed was searched for publications using advanced options. The builder option was first set to 'affiliation'. The name of the country was then entered as 'Oman[Affiliation]' for example to carry out a comprehensive search based on the country of the institution the author was affiliated to. Only the country of affiliation of the first author of each publication was taken into account in this search. The period of study was from 01/01/1994 to 31/12/2013, which was done by selecting the custom range option from a selection panel.

Additional filters were selected to select only level 1 to 4 research publications based on the article types from a selection panel. The types of articles selected were clinical trials, comparative studies, controlled clinical trials, meta-analysis studies, multicentre studies, observational studies, pragmatic clinical trials, randomised controlled trials, systematic reviews, twin studies and validation studies.[4,5] The absolute publication numbers were normalised to the average population and GDP of each time period. The population and GDP (current US$) data from 1994-2013 were obtained through data provided by the World Bank.[6,7] Microsoft Excel was then used to analyse the data.

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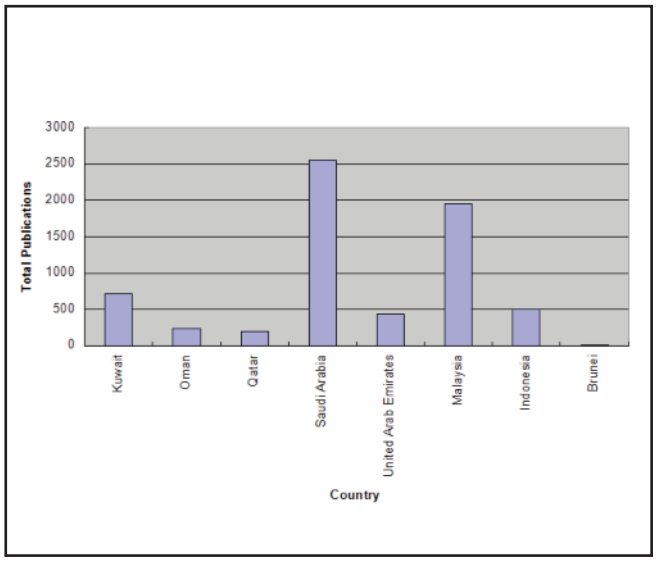

Fig. 1: Total number of publications by country from 1994-2013.

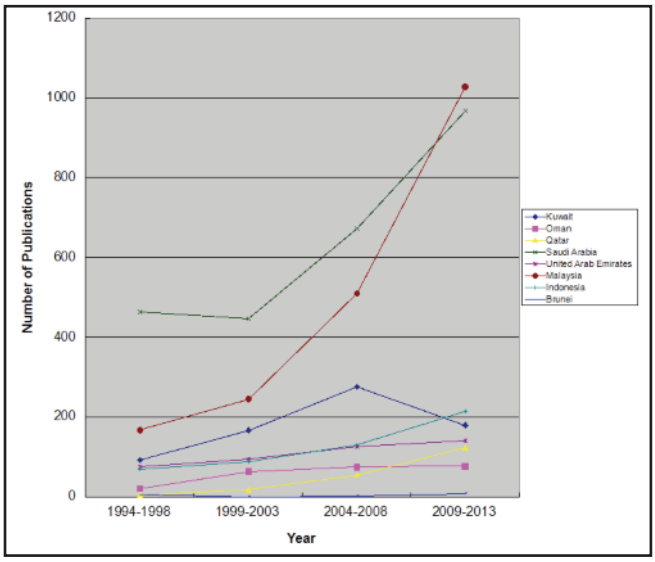

Fig. 2: Number of publications by year and country.

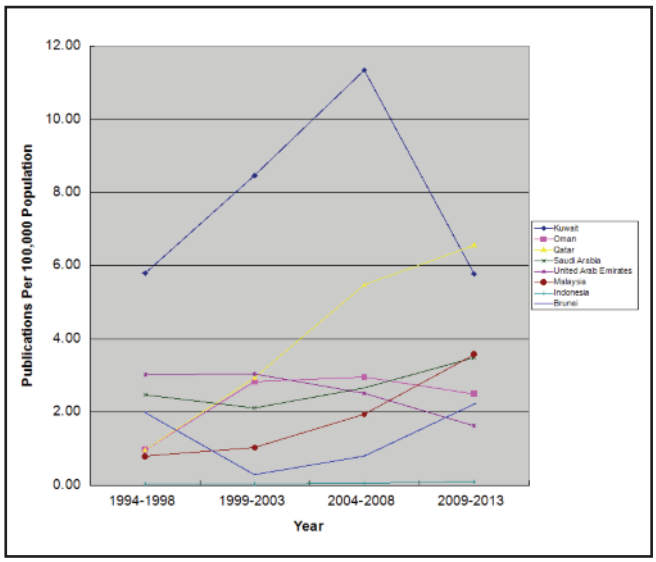

Fig. 3: Number of publications per 100,000 population by year and country.

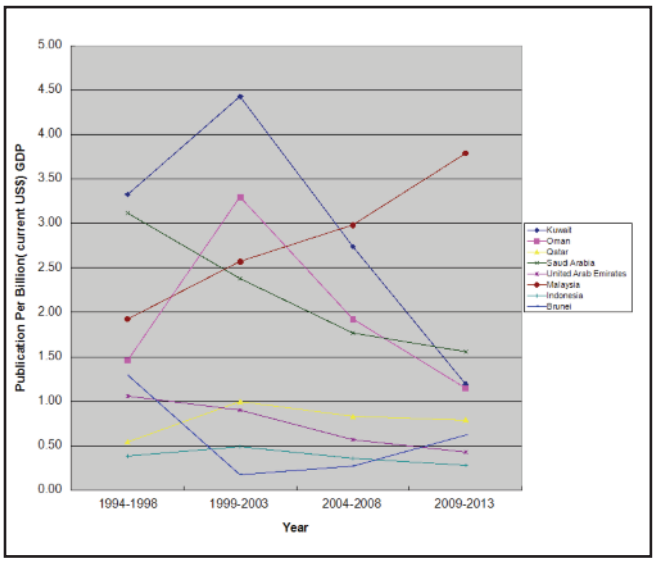

Fig. 4: Number of publications per billion (current US$) GDP by year and country.

RESULTS

Between 1994 and 2013, Saudi Arabia was the leader with 2551 level 1 to 4 research publications in the Gulf Cooperation Council region as compared to the next highest at 716 publications from Kuwait (Figure 1). This trend was evident over the years with Saudi Arabia consistently producing the largest number of publications throughout the study period. It increased from 464 publications in the 1994-1998 period to 968 publications in the 2009-2013 period. Malaysia led the three nations studied from Southeast Asia with 1951 publications and Indonesia coming in next with 504 publications. Malaysia has shown a consistently increasing number of publications throughout the period of study. The total number of level 1 to 4 publications increased from a mere 168 publications in the 1994-1998 period to 1028 publications in the 2009-2013 period.

Kuwait and Qatar led the group with the largest number of level 1 to 4 publications per 100,000 population at 7.84 publications and 3.99 publications per 100,000 population respectively in a five yearly average from 1994-2013. This was followed by the Saudi Arabia with 2.68 publications per 100,000 population and the United Arab Emirates with 2.55 publications per 100,000 population, and Oman with 2.31 publications per 100,000 population. Overall, the other countries such as Malaysia, Indonesia and Brunei produced less than two publications per 100,000 population. Nevertheless, in the last five years Malaysia, with 3.57 publications per 100,000 population actually overtook Saudi Arabia with only 3.48 publications per 100,000 population.

In a five yearly average from 1994-2013, Kuwait produced the largest number of publications at 2.92 publications per billion of GDP. This was followed by Malaysia at 2.82

publications per billion of GDP and then Saudi Arabia at 2.21 publications per billion of GDP. Oman produced 1.96 publications per billion of GDP, while the rest of the countries produced less than one publication per billion of GDP. In Southeast Asia, Malaysia showed consistent strong growth in terms of the number of level 1 to 4 publications per billion of GDP. The number of level 1 to 4 publications per billion of GDP grew from 1.92 per billion of GDP in the 1994-1998 period to 3.79 per billion of GDP in the 2004-2008 period.

DISCUSSION

Several quantitative studies have been published on the biomedical publications in the countries involved in this study.[1-3] This paper aims to determine the number of papers that are graded at least level 4 evidence based on the Centre for Evidence-Based Medicine classification. This includes clinical trials, comparative studies, controlled clinical trials, meta-analysis studies, multicentre studies, observational studies, pragmatic clinical trials, randomised controlled trials, systematic reviews, twin studies and validation studies.[4] These types of studies were selected as they have a larger influence on clinical practice as compared to publications such as editorials and single case reports.[4,5] We hypothesise that the population size of a country as well as gross domestic product are only among a few factors that can determine a country's success in the field of medical and biomedical research. Other factors may influence biomedical research. These include government policy and culture. Government policy provides incentives and a suitable environment for research, as well as a culture which promotes research. These factors remain the cornerstones of success in the world of biomedical and medical research.[8]

This study has a number of limitations. First, there are non-English articles in journals not indexed in PubMed which were not included in this study. Nevertheless English remains the *lingua franca* of medicine. As only PubMed was used in this study, journals not indexed by PubMed may not have been accurately captured in this study. However, PubMed is one of the foremost bibliographic database of bioscience and medical information and is an optimal tool in biomedical electronic research.[9] This study also did not include the impact factors of the journals that the research articles were published in as part of the analysis. However, all the included articles were graded at least level 4 evidence. In addition, only the country the first author of each publication was affiliated to was taken into account in our search, where the co-authors of the papers were not taken into account. This was a limitation for all papers before 2014 which were listed on PubMed. This approach while simple to apply in identifying publications affiliated from each country, does not guarantee that the affiliated country is responsible wholly or in part for funding the published research. In addition, this study aimed to look at publications based on their type of publication rather than the citation index. By searching based on country rather than the individual universities of the countries in the study, universities without clearly stated affiliation may not have been included. For example, in the case of the University of Malaya, based on a search done on 14/1/15 for articles from our study period from 1/1/1994 to 31/12/13, when searching for the university of malaya[ad] NOT malaysia[ad] there was a discrepancy of 47 publications. Malaysia produced a total of 1951 of such studies during the period from 1/1/1994 to 31/12/13, where the 47 publications represents a total of less than 2.5% of the total number of publications. While we tried to capture the number of publications as accurately as possible this is one of the limitations of our study.

Given that productivity and economic performance vary between countries and are not necessarily governed by population, the publication rate of each country was normalised to GDP (current US$). It is important to normalise these results versus the population size to give a clearer comparison between the countries due to their diverse population sizes. This could give a biased view of a country's actual research efficiency and efforts towards building up their biomedical and medical research capabilities.[3,10] This is in view of the sheer advantage in terms of numbers that larger countries have over their smaller counterparts.[3,10] Looking closely at the data in the last 10 years, it is clear that Malaysia, a developing country has managed to surpass all its developed counterparts from the Gulf Cooperation Countries in terms of number of publications per billion of GDP. Countries such as Malaysia and Saudi Arabia produced more than 3 times the amount of level 1 to 4 research publications as compared to their other counterparts such as Qatar and the United Arab Emirates if the number of level 1 to 4 publications were normalised to the GDP.

It was clear that there was an obvious slowdown in the average percentage growth between 2004-2008 and 2009-2013 when compared with the growth seen between 1999-2003 and 2004-2008 for all the countries involved in this study. We postulate that this drop was due to the global financial crisis in the late 2008 with government finances of the countries involved in this study affected by the decline in oil prices and demand despite normalising for GDP.[11] This drop shows that external factors still have an impact on the ability of these countries to develop their biomedical and medical research sectors beyond economic influences. This also suggests that the global economic recession had far reaching effects with ripples felt beyond the economic environment into the biomedical sphere. Keeping in mind the limitations produced by these external factors, future efforts by these countries should focus on performing efficiently and pragmatically with the available resources.[12] The Kingdom of Saudi Arabia, has given much emphasis to scientific research in the main policies of its development plans to promote scientific innovation, as well as developing universities and other research & development centers.[13] Notable academic efforts include the funding of the King Abdullah University of Science and Technology with a US$10 billion endowment in Saudi Arabia.[14] While the absolute number of publications have been increasing, the number of publications when normalised to GDP has been on a downtrend which shows that increased wealth in the form of increased GDP, does not necessarily translate into more efficient research output. Countries such as Qatar and Kuwait actually take the lead when the publication figures are normalised to their populations and have had encouraging average growth in the last two decades in terms of the total number of higher quality publications.

Qatar has devoted massive resources toward establishing centres of excellence in biomedical research. Among such efforts include the establishment of the Qatar Foundation which aims to make Qatar a leader in innovative education and research. Several key efforts under this establishment include the Education City in Doha, home to six American university branch campuses, the Qatar National Research Fund, and the Qatar Science and Technology Park.[15] Through this, they have attempted to rapidly develop a biomedical research industry through collaborations with foreign universities and researchers. However, the absolute number of publications remains small compared to countries such as Saudi Arabia and Malaysia. The Gulf cooperation countries as evident in the case of Saudi Arabia and Qatar have provided an enormous amount of funding for medical and biomedical research in recent years. Malaysia on the other hand has had a history of medical research, starting in the 1900s with the setting up of the Institute Of Medical Research in Kuala Lumpur, which started off as the Pathological Institute.[16]

Clearly, newly industrialised countries such as Malaysia are fast closing the gap and can hold their own when compared to more developed and wealthier countries such as countries in the Gulf Cooperation Council especially when data in the last 10 years was examined. Malaysia which did well in this study spent 1.06% of their GDP in 2011 on research and development. Countries like Qatar and the United Arab Emirates spent 0.33% and 0.47% of their GDP in 2006 and 2011 respectively on research and development.[17-19] The other countries in this study spent less than 0.1% of their GDP on research and development.[17-19] Studies have shown that the quality of published medical research is associated with study funding, hence this finding supports the notion that government policy that encourages spending on research and development remains important in the effort to promote quality biomedical research.[20-22] However the percentage of GDP spent on research and development in the studied countries remains low compared to countries like the United states which spent 2.7% of their GDP in 2011 on research and development, 3.25% for Japan, 2.2% for Singapore.[19]

Malaysia, has been able to translate its development plans into tangible research output in the form of level 1 to 4 medical and biomedical publications over the past two decades. Malaysia has invested a considerable deal in research and development including the setting up of a National Clinical Research Centre and a National Medical Research Register to streamline research applications for clinical trials.[23] A culture of research has been actively promoted at Malaysian universities whereby research has been positioned as an important component for academic career advancement.[24] In Indonesia, before the year 2000, the majority of clinical trials were conducted with little mechanism to control the quality of these trials. In an effort to improve the quality of clinical trials in Indonesia, the Clinical Trial Working Group (CTWG) was established.[25] The Kingdom of Brunei, although still largely dependent on petroleum based resources, had moved to develop its research capabilities through several initiatives. Among these initiatives include the Brunei Research Incentives Scheme which offers incentives for biomedical companies to establish research facilities in Brunei with health sciences as one of the major cluster.[26] Surprisingly, Brunei's efforts have not been shown to translate into an increase in level 1 to 4 medical publications as it lags behind considerably when compared to similarly developed countries in the Gulf Cooperation Council. With the exception of Malaysia, the other Southeast Asian countries have shown considerable growth but still lag behind the Gulf Cooperation Countries in terms of the total number of level 1 to 4 publications. This is even when the raw data was normalised to their GDP (current US$) and their population size.

CONCLUSION

The population size of a country as well as gross domestic product have been shown to have an influence on the number level 1-4 biomedical and medical publications in some countries. Nevertheless, the foundation of success still lies in the form of an effective government policy which stimulates research as well as a culture which actively promotes research as shown by Malaysia. Malaysia can serve as a model for other resource dependent, newly industrialised countries to work on in a bid to develop their own biomedical and medical research industries.

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