

## Biomedical Publications Profile and Trends in Gulf Cooperation Council Countries

\*Almundher Al-Maawali,<sup>1</sup> Ahmed Al Busadi,<sup>2</sup> Samir Al-Adawi<sup>3</sup>

### شاكلة المنشورات الطبية الحيوية واتجاهاتها في دُول مجلس التّعاون الخليجي

المنذر المعولي، أحمد البوسعيدي، سمير العدوي

**المخلص:** الهدف: هناك ندرة في الدراسات التي تكشف العلاقة بين مخرجات البحوث وغيرها من المؤسّرات الديموغرافية والاجتماعية في دول مجلس التعاون الخليجي (عمان، البحرين، الكويت، قطر، المملكة العربية السعودية، الإمارات العربية المتحدة). كانت الأهداف الثلاثة المترابطة لهذه الدراسة كالاتي، أولاً التأكد: من عدد المنشورات الطبية الحيوية في دول مجلس التعاون الخليجي للفترة من سنة 1970 إلى سنة 2010. ثانياً: تحديد معدل إصدار المنشورات الطبية الحيوية مقارنة بحجم السكان خلال نفس الفترة. ثالثاً: قياس العلاقة بين عدد المنشورات الطبية وبعض المعالم الاجتماعية والاقتصادية. الطريقة: تم البحث في قاعدة البيانات ميدلاين في أكتوبر 2010 حسب نوع الانتماء، والسنة، ثم نوعية المنشورات للفترة من سنة 1970 حتى سنة 2010. تم تسوية النتائج مع المنشورات الطبية لكل مليون من السكان، وحسب الناتج المحلي الإجمالي، ثم عدد الأطباء في كل بلد. النتائج: كان عدد من المقالات التي نُشرت في دول مجلس التعاون الخليجي خلال فترة الـ 40 سنة هي 25,561. كانت المملكة العربية السعودية أكثر الدول من حيث عدد المنشورات الطبية تليها الكويت، ثم الإمارات العربية المتحدة، ثم عمان. سجلت الكويت أعلى عدد من المنشورات عند مقارنتها مع حجم السكان، تليها قطر، أما عمان فهي الأدنى في هذا الترتيب. وعموماً، أظهرت الدول الست اتجاهها متزايداً في أعداد المنشورات مع وجود زيادة أكبر في عُمان في الفترة من 1990 سنة إلى سنة 2005. هناك علاقة مُعتدّة بين عدد الأطباء وعدد المنشورات. الخلاصة: شهدت الإنتاجية البحثية في دول مجلس التعاون الخليجي نمواً معتدلاً ومتقلباً في السنوات الـ 40 الماضية. تم مناقشة الآفاق المستقبلية لزيادة معدل إنتاج البحوث مع إشارة خاصة إلى الوضع في عُمان.

مفتاح الكلمات: منشورات، عُمان، مجلس التعاون الخليجي، شبه الجزيرة العربية، بحوث طبية حيوية.

**ABSTRACT: Objectives** There is a dearth of studies examining the relationship between research output and other socio-demographic indicators in the Gulf Cooperation Council (GCC) countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates). The three interrelated aims of this study were, first, to ascertain the number of biomedical publications in the GCC from 1970 to 2010; second, to establish the rate of publication according population size during the same period and, third, to gauge the relationship between the number of publications and specific socio-economic parameters. **Methods:** The Medline database was searched in October 2010 by affiliation, year and publication type from 1970 to 2010. Data obtained were normalised to the number of publications per million of the population, gross domestic product, and the number of physicians in each country. **Results:** The number of articles from the GCC region published over this 40 year period was 25,561. Saudi Arabia had the highest number followed by Kuwait, UAE, and then Oman. Kuwait had the highest profile of publication when normalised to population size, followed by Qatar. Oman is the lowest in this ranking. Overall, the six countries showed a rising trend in publication numbers with Oman having a significant increase from 1990 to 2005. There was a significant relationship between the number of physicians and the number of publications. **Conclusion:** The research productivity from GGC has experienced complex and fluctuating growth in the past 40 years. Future prospects for increasing research productivity are discussed with particular reference to the situation in Oman.

**Keywords:** Publications; Oman; Gulf Cooperation Council; Arabian peninsula; Biomedical research.

#### ADVANCES IN KNOWLEDGE

*This study sheds light on the biomedical research productivity profile of the Gulf Cooperation Council countries, its growth and fluctuations and its relations to specific socio-economic parameters.*

<sup>1</sup>Department of Genetics, Sultan Qaboos University Hospital, Muscat, Oman; <sup>2</sup>Department of Family & Community Medicine, Ministry of Health, Dhakhiliya Region, Oman; <sup>3</sup>Department of Behavioural Medicine, College of Medicine & Health Sciences, Sultan Qaboos University, Muscat, Oman

Corresponding Author e-mail: almaawali@squ.edu.om

**APPLICATION TO PATIENT CARE**

*Studying biomedical research profile and improving research productivity has a direct impact on improving patient care. Many research studies lay the groundwork for evidence-based medicine and the formulation of health policy, planning and management*

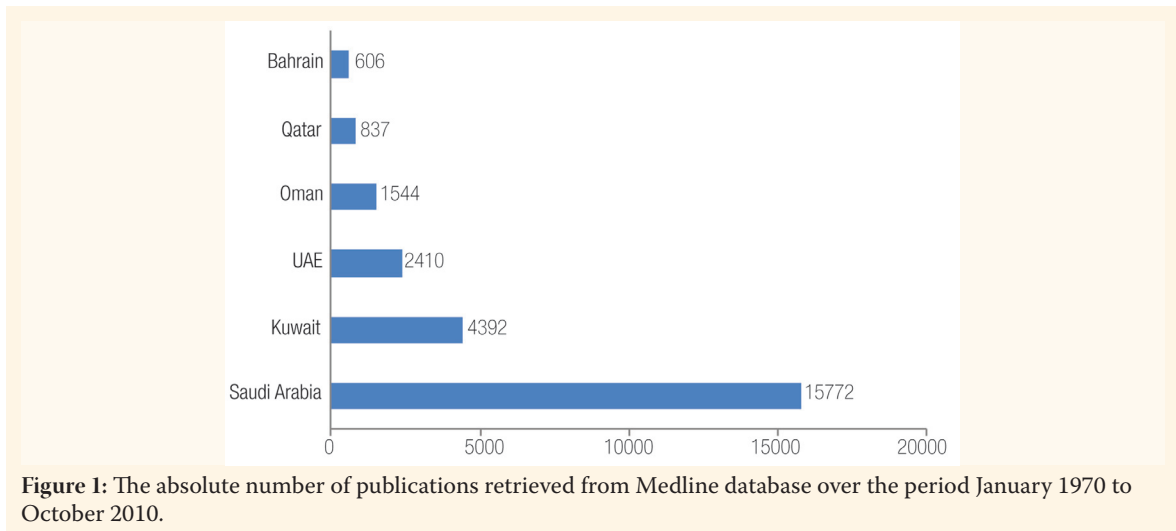
**H**EALTH RELATED RESEARCH DETERMINES the extent and burden of health problems, establishes the clinical and epidemiological profiles of different diseases, and determines the efficacy of therapies.<sup>1</sup> Such research leads to a better formulation of health policy planning and management, and has a direct impact on improving patient care.<sup>2</sup> Globally, there is a huge gap in research output between industrialised countries and emerging economies.<sup>3</sup> The USA, the UK, some Western European countries and Japan contribute the majority of papers published in high impact journals. Research papers produced in these geographical regions are likely to be highly cited.<sup>4,5</sup> This is a paradox since 80% of the global population lives outside the countries which contribute 98% of scientific output.<sup>6</sup> In general, compared to other countries, Arab countries do not fare well in international comparisons of biomedical research.<sup>7-9</sup> This has been attributed to the political instability that is besetting the region which does not create an environment conducive to progress in science and the development of a knowledge-based society.<sup>10</sup> According to Fergany, "The Arab region also has far fewer researchers and engineers, and produces fewer scientific publications, than any other world region, apart from sub-Saharan Africa" (p. 33).<sup>9</sup> However, to put all Arab countries into one category is erroneous, despite their common heritage and language, given that the multiplicity of factors contributing to growth in medical research will vary from country to country. Given this diversity among Arab countries, it would be better to compare those countries that may have some socio-economic characteristics in common.

Health care facilities and research institutes in the Arabian Gulf countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates [UAE]), formally known as the Gulf Cooperation Council (GCC), have witnessed significant growth in the last 40 years. In the case of Oman, the World Health Organization has ranked it as the most "efficient" health care system in the world.<sup>11</sup> Postnatal care and coverage is the highest among the Arab nations<sup>12</sup> and the country has

generally triumphed over the traditional enemies of health such as communicable diseases,<sup>13</sup> even though it is now facing the emerging challenge of 'diseases of civilization.'<sup>14</sup> Such a trend has coincided both with an increased number of physicians in the country and an improved standard of living, a result of growth in gross domestic product (GDP).<sup>15</sup> However, to our knowledge, no study has been done in the GCC to document the relationship between current trends in biomedical publications output and socio-economic factors. Previous studies have either focused on an individual country<sup>16</sup> or have compared the GCC region with non-GCC countries.<sup>8</sup> Similarly, earlier attempts to quantify trends in publication output in the GCC were limited to descriptive analysis.<sup>16-18</sup> GCC countries represent a fertile ground for examining the relationship between economic indicators and research output. These countries share socio-political outlooks, but their stage of economic development varies. Therefore, studies are needed to evaluate medical research against demographic and economic indicators. In the past four decades, these countries, like other emerging economies, have witnessed unprecedented economic growth fueled by the exploitation of hydrocarbons. The interrelated aims of the present study are to ascertain the number of biomedical publications from the GCC in the period 1970 to 2010 in order to calculate the rate of publication per million of the population (PPMP) per year in this period, and to examine the relationship between the number of publications (PPMP) and the number of physicians per 1,000 and GDP per capita. Additionally, this study endeavours to extrapolate the trends in the GCC with some reflection on the situation in Oman.

## Methods

Electronic databases provide a good estimate of biomedical publication productivity. Medline is the most widely used international database for health research. The Medline database was searched during the last week of October 2010. The search strategy included search by affiliation, years and publication



type. Affiliation included the country names written in different forms (e.g. Saudi Arabia, KSA, or Saudi). The time period investigated was 1970 to 2010 as there were very few articles published before 1970. The trends in publication numbers for each five year period were extrapolated using the period interface limits in Medline. We limited the publication type to journal articles. Data obtained were normalised to the number of publications per million of the population (PPMP), GDP, and the number of physicians (per hundred of the population) in each of the countries. These demographic and economic indicators were retrieved from the World Bank.<sup>19</sup> The data were analysed using Microsoft Excel (Microsoft Office 2007).

## Results

The number of articles for the GCC published over the 40 year period 1970 to 2010 was 25,561. Saudi Arabia had the highest number of publications followed by Kuwait, the UAE, and then Oman. Figure 1 presents the absolute number of publications retrieved from the Medline database.

The average size of the population for each country from 1970 to 2010 was calculated and the normalisation to PPMP per year is presented in Figure 2. Kuwait had the highest number of publications when normalised to population size, followed by Qatar. Oman was the lowest in this ranking.

Overall, all the countries showed a positive trend. Medical research output has been blooming in Qatar, showing a strong positive trend for the

period 2000 to 2010. Oman had a significant increase in the number of publications in the period 1990 to 2005; however, the trend has plateaued in the last five years. A similar observation was noted in both Saudi Arabia and the United Arab Emirates for the last 10 years [Figure 3]. In Kuwait, there was a negative trend in the early and mid 1990s, probably due to the second Gulf war.

The third interrelated aim of this study was to gauge the research output (PPMP) against the number of physicians per 100 and GDP. The GDP per capita averages for every five year interval and the average number of physicians per 100 of the population for the same interval were calculated, and then the correlation between these parameters examined independently and the PPMP extrapolated. There was a significant positive correlation between the number of publications and number of physicians ( $r = 0.69$ ,  $P < 0.05$ ) and a similar positive correlation between PPMP and GDP per capita ( $r = 0.26$ ,  $P = 0.08$ ), but it was not statistically significant. Figure 4 shows the comparison in respect to the 40 year averages of these three parameters.

## Discussion

This study is, to our knowledge, the first detailed analysis of publication productivity in the GCC which traces the research trend over the last 40 years. There are several factors that determine the medical bibliometric productivity in any country, which include, but are not limited to, population size, the number of physicians, and economic status.

**Table 1: SCImago Journal & Country Rank: citations of all articles published 1996–2000 in Gulf Cooperation Council countries**

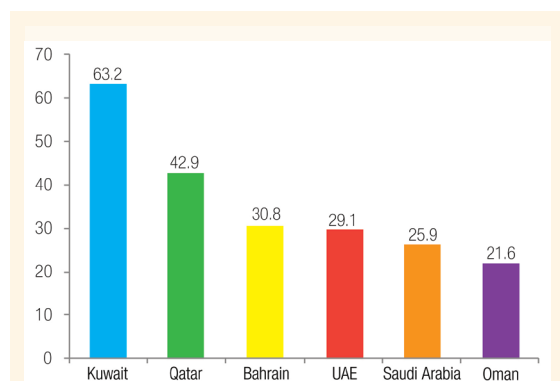
Country	Articles	Citations	Self-Citations	Percentage of self citations	Citations per articles	Hirsch index
Saudi Arabia	12,303	71,843	8,813	12%	6.31	80
Kuwait	3,101	19,835	2,254	11%	7.13	48
United Arab Emirates	2,776	16,754	1,498	9%	7.05	45
Oman	1,518	6,710	610	9%	5.15	29
Qatar	1,179	3,841	416	11%	4.49	24
Bahrain	1,075	3,184	431	14%	3.65	22

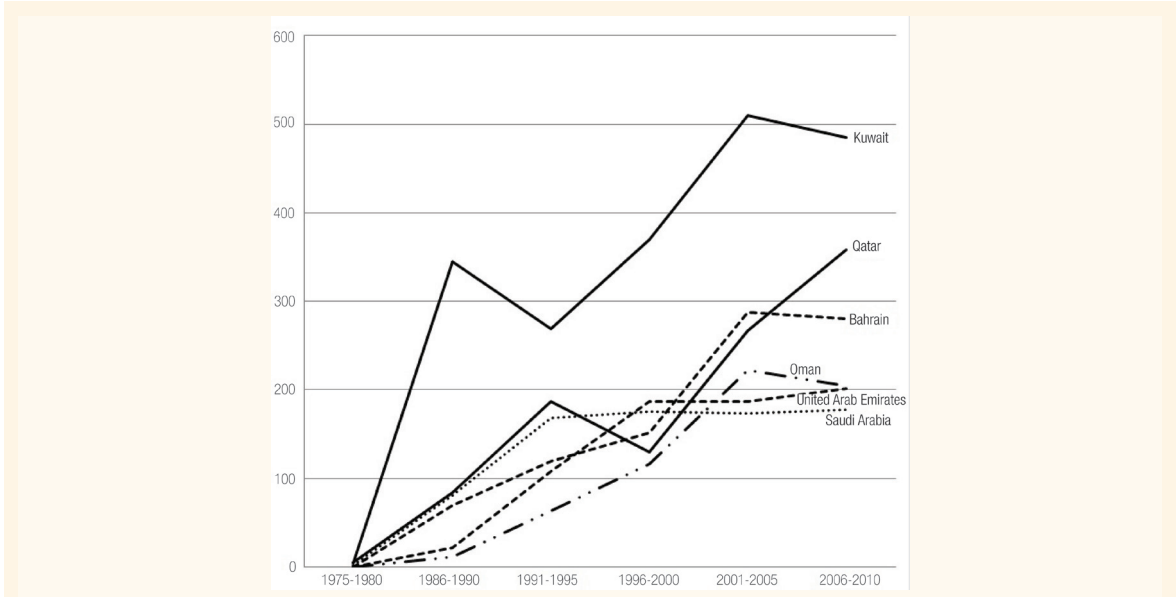
We corrected the total number of publications with some of these parameters in order to elicit national differences. These parameters have been used by several studies in order to normalise bibliometric productivity.<sup>20</sup> Saudi Arabia had the highest overall publication rate followed by Kuwait, the UAE and then Oman. In order to audit the present findings, we used the SCImago Journal & Country Rank, to retrieve the citations of all documents published in the period 1996–2010 from GCC countries.<sup>21</sup> Table 1 shows the rank of each of these countries according to the citations. It is observed that the citation ranking is similar to our initial approach as depicted in Figure 1. The percentage of self-citations of these countries is lower than 14%. The H index (Hirsch index) measures both the productivity and impact of the work published, integrates the number of publications and the number of citations per publication and serves as a very good tool for examining the quality of research. Saudi Arabia has had the highest H index while Bahrain has had the lowest H index.

When the publication rates were scrutinised against socio-economic indicators, the productivity changed. Kuwait had the highest rate and Oman the lowest. All the countries showed a positive trend in general over the past 40 years. The trend changed in the period 2001–2005 in Oman when it increased to become equal to that of the UAE. The trend has remained the same for the last ten years in both Saudi Arabia and the UAE.<sup>22</sup> It is very interesting to note that the rate became linear for all countries after 2005 with the exception of Qatar. This was period when Qatar instituted massive investment in research and development (R&D).<sup>23</sup> However, the relatively small absolute number of publications

from Qatar, together with a surprisingly large number of physicians in that country, compared to the rest of the GCC, may make this a spurious result. Future studies need to provide mechanisms to counter such inherent limitations. Nonetheless, it is possible that this significant change may have stemmed from the fact that, in Qatar, R&D has been given preference over tourism and real estate development.<sup>24,25</sup> In addition to PPMP, there is an indication that many social and economic factors play a pivotal role in research output. These include GNP, the number of physicians, public expenditure in the health sector, health expenditure per capita, expenditure on R&D, the number of personnel (scientists and engineers) in the R&D sector, and the number of indexed journals published.

Rahman and Fukui surveyed global research productivity in 166 countries right across the economic divide and showed that there is a critical relationship between GNP, resources allocated to R&D, and the quality and quantity of biomedical publications.<sup>1</sup> Such a link was indirectly explored in

**Figure 2: The average number of publications per million population (PPMP) per year over a 40 year period from 1970 to 2010.**



**Figure 3:** The trend in numbers of publications corrected to publication per million of the population over interval periods between 1970 and 2010.

the present study. Qatar had the highest GDP per capita compared to other GCC countries, while Oman had the lowest. However, the paradox here is that despite the fact that these countries are ‘high income’ according to global standards, the number of publications they produce leaves much to be desired, with the exception of some medical research subspecialties.<sup>26</sup> Within the GCC, the differences could be a result of resource allocation. In 2010, for those countries where information is available, Qatar spent 2.8% of GDP on R&D, while

Saudi Arabia and Kuwait spent 0.05 and 0.09%, respectively. An additional reason for Qatar’s success may be that the country has the highest number of physicians per 100 of the population. This, in turn, may also explain the presently noted linear growth in Qatar’s publication numbers.

There are some obvious limitations to the present study that need to be acknowledged. First, while Medline is a premier database for biomedical sciences, there are a number of medical publications that are not featured in it. With a few exceptions,



**Figure 4:** Comparison across countries for the period 1970 to 2010 giving the average number of publications per million population (PPMP), gross domestic product (GDP) and physicians.



many of the medical publications in the GCC region are not indexed in Medline. There is also a concern that research from developing countries, including those in this study, do not get favourable editorial consideration in the major journals featured in Medline.<sup>6</sup> If this is really the case, then it could be extrapolated that the visibility of articles from the GCC would be inevitably be affected. This would also mean that the number of publications and their impact on scientometrics is likely underestimated.<sup>27</sup> However, even if such misgivings are accepted, the present quest has heuristic value since the aim was to compare the biomedical research trends among GCC countries. Secondly, in order to compare adequately the trend in GCC countries, it would be essential to include local journals; however, many of the local journals are not yet indexed. This is a paradoxical situation for biomedical research in this region. On one hand, the local journals are finding it extremely difficult to get indexed while, on the other hand, research from this part of the world does not get international exposure. Despite such caveats, some GCC countries have benefitted from having their local medical journals indexed by Medline, thus adding to the total number of publications. In the period under review, Saudi Arabia published 4,197 articles in indexed GCC journals, Kuwait published 411 articles, Qatar published 69 articles, the UAE 32, Bahrain 88 and Oman 138 articles. The third limitation worth considering is that, although the present study has examined trends in publications against certain socio-economic indicators, in the parlance of scientometrics, the citation index or impact factor is the *sine qua non* of good research. The present study has not taken on board either the citation index or the impact factors of the articles in the Medline from the GCC region. It would also have been helpful to consider the relationship between the number and history of medical schools in the region and their relationship to the number of publications. Common sense teaches us that more research centres or, in the present parlance, a greater number of medical schools, would translate into more research activity and hence, an increased number of publications. It is also possible, however, that most of the academic centres in the region are more interested in teaching than pursuing academic research.<sup>6</sup> However, since such a line of thought was not central to the present study, it would need to be addressed in a future study. Last

but not least, it is possible that generalisation of the present study could be hampered by the fact that the search for the publications was partly based on the affiliations of the authors. In some journals, an affiliation is only provided for the corresponding author. Therefore, the possibility remains that there are more publications that originated from GCC countries than were reported in this study.

Despite the aforementioned caveats, it is right to acknowledge the achievements so far and delineate the hurdles still to be overcome in the GCC region. There is an urgent need to increase institutional support for R&D following the model of Qatar.<sup>28</sup> In the context of Oman, allocating more research funding would be essential, if not paramount. Such an undertaking should be enshrined in the policies for R&D development. There are already some good examples in this regard, for example, Oman established a Research Council in 2005.<sup>29</sup> Despite its infancy, this body has funded some strategic research projects that have a direct bearing on biomedical sciences.<sup>30</sup> The expected outcome of these projects is an increase in the number of publications which should further help to put Oman on the world map of biomedical publications. In tandem with the Oman Research Council, the Oman Medical Specialty Board and the College of Medicine & Health Sciences at Sultan Qaboos University encourage research in all phases of medical education. The explicit goal here is to equip the future cadre of Oman health professionals with research skills. Conversely, and relevant to Oman, there are some issues to be contemplated. First, it should be acknowledged that there are a number of biomedical journals in Oman and, as in other GCC countries, concerted efforts should be made to feature these journals in various indexes, especially Medline, so that GCC publications are accessible to the global audience. Second, it is essential to improve the existing research culture in the region. Health professionals and those in allied fields should be given incentives to pursue research as a career option, and the path towards tenure should be based on merit rather than on the existing form of 'academic nepotism.' Another constraint on the development of biomedical research is the idea that health care should focus on dispensing services. Notwithstanding such a view, research could contribute to the betterment of just those services. The establishment of a knowledge-

based health care system would have many positive implications. For example, a medical curriculum could be developed to reflect the prevailing socio-demographic and epidemiological trends in the country. This would likely result in evidence-based allocation of resources and the establishment of an enlightened health care system in the country.

#### CONFLICT OF INTEREST

The authors declared no conflict of interest and stated that no funding was received for this work.

## References

- Rahman M, Fukui T. Biomedical publication - global profile and trend. *Public Health*. 2003; 117:274–80.
- Hyder AA, Corluka A, Winch PJ, El-Shinnawy A, Ghassany H, Malekafzali H, et al. National policy-makers speak out: Are researchers giving them what they need? *Health Policy Plan* 2011; 26:73–82.
- Patel V, Kim YR. Contribution of low and middle-income countries to research published in leading general psychiatry journals 2002-2004. *Br J Psychiatry* 2007; 190:777.
- Garg KC. An overview of cross-national, national, and institutional assessment as reflected in the international journal *Scientometrics*. *Scientometrics* 2003; 56:169–99.
- Karageorgopoulos DE, Lamnatou V, Sardi TA, Gkegkes ID, Falagas ME. Temporal trends in the impact factor of European versus USA biomedical journals. *PLoS One* 2011; 6:e16300.
- AlAdawi SH, Ali BH. West is West, East is East. The divide in science. *Saudi Med J*. 2010; 31:1093–4.
- Benamer HT, Bakoush O. Arab nations lagging behind other Middle Eastern countries in biomedical research: A comparative study. *BMC Med Res Methodol* 2009; 9:26.
- Tadmouri GO, Bissar-Tadmouri N. Biomedical publications in an unstable region: The Arab world, 1988-2002. *Lancet* 2003; 362:1766.
- Fergany N. Islam and Science: Steps towards reform. *Nature* 2006; 444:33–4.
- Arab Human Development Report 2009: Challenges to Human Security in the Arab Countries. From: <http://www.arab-hdr.org/contents/index.aspx?rid=5>. Accessed: Oct 2010.
- Lauer JA, Knox Lovell CA, Murray CJ, Evans DB. World health system performance revisited: The impact of varying the relative importance of health system goals. *BMC Health Serv Res* 2004; 4:19.
- UNICEF. *The State of the World's Children 2010*. Oxford: Oxford University Press, 2010.
- Ganguly SS, Al-Lawati A, AlShafae MA, Duttagupta KK. Epidemiological transition of some diseases in Oman: A situational analysis. *World Hosp Health Serv* 2009; 45:2631.
- AlAdawi S. Emergence of diseases of affluence in Oman: Where do they feature in the health research agenda? *Sultan Qaboos Univ Med J* 2006; 6:3–9.
- Ghosh B. Health workforce development planning in the Sultanate of Oman: A case study. *Hum Resour Health* 2009; 7:47.
- AlKhader AA, AlJondeby MS, Shaheen FA. Impact of nephrology publications from Saudi Arabia in the last decade. *Saudi Med J* 2002; 23:1177–80.
- Deleu D, Northway MG, Hanssens Y. Geographical distribution of biomedical publications from the Gulf Corporation Council countries. *Saudi Med J* 2001; 22:10–2.
- Shaban SF, Abu-Zidan FM. A quantitative analysis of medical publications from Arab countries. *Saudi Med J* 2003; 24:294–6.
- The World Bank. Oman Report. From: <http://data.worldbank.org/country/oman>. Accessed: January 2012.
- King DA. The scientific impact of nations. *Nature* 2004; 430:311–16.
- SCImago. SCImago Journal & Country Rank 2007. From: <http://www.scimagojr.com>. Accessed: Oct 2011.
- Neves K, Lammers WJ. Growth in biomedical publications and scientific institutions in the Emirates (1998-2004): An Arabian renaissance? *Health Info Libr J* 2007; 24:41–9.
- Chouchane L, Mamtani R, Al-Thani MH, Al-Thani AA, Ameduri M, Sheikh JI. Medical education and research environment in Qatar: A new epoch for translational research in the Middle East. *J Transl Med* 2011; 9:16.
- El Amrousi M, John Biln. Muscat emerging: Tourism and cultural space. *J Tourism Cult Change* 2010; 8:254–66.
- Steiner C. Political instability, transnational tourist companies and destination recovery in the Middle East after 9/11. *Tourism Plan & Develop* 2007; 4:169–90.
- Lammers WJ, Karam SM. Emerging excellence in neurogastroenterology and motility research in the Arabian Peninsula. *Neurogastroenterol Motil* 2010; 22:946–9.
- Fava GA, Ottolini F. Impact factors versus actual citations. *Psychother Psychosom* 2000; 69:285–6.
- Chouchane L, Mamtani R, AlThani MH, AlThani AA, Ameduri M, Sheikh JI. Medical education and research environment in Qatar: A new epoch for translational research in the Middle East. *J Transl Med* 2011; 27:9–16.
- Oman Research Council. From: <http://www.trc.gov.om/TRCWebsite/decreed.htm> Accessed: Apr 2011.
- Oman Daily Observer. SQU College of Medicine contemplates research. 9 May 2010. From: <http://main.omanobserver.om/node/8968>. Accessed: Apr 2010.