# Medical Research Productivity of Lebanon : A Bibliometric Study of Papers indexed in Medline, 1985-2004

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**RÉSUMÉ**

**Prérequis :** L'analyse des publications biomédicales d'un pays est utilisée pour suivre la tendance de la recherche conduisant à une meilleure planification et gestion de la politique de santé.

**But :** Décrire la productivité des publications médicales libanaises au cours d'une période de 20 ans de 1985 à 2004.

**Méthodes:** La base de données Medline a été interrogée à travers une requête combinant le nom du pays, ceux des facultés de médecine, des principaux hôpitaux universitaires et des principales villes au Liban en Français et en Anglais. Les articles ayant une affiliation médicale Libanaise ont été inclus et les articles de médecine dentaire, de médecine vétérinaire, des sciences infirmières et de pharmacie ont été exclus.

**Résultats:** Nous avons recensé 1 964 articles médicaux sur une période de deux décennies. La productivité a été de 2,9 articles/ 100 000 habitants / an et de 9,2 articles / milliards de US dollars PIB/ an. Le taux de croissance des articles indexés a décliné au cours des années passant de 202% (1990-1994) à 55,3% (2000-2004). Les quatre spécialités les plus productives (Anesthésiologie, Médecine Interne, Gynécologie, Pédiatrie) ont publié 611 articles (31,1%). La capitale Beyrouth, l'Université Américaine de Beyrouth et son Centre Hospitalo-Universitaire ont publié respectivement 1 926 (98%), 568 (28,9%), et 601 articles Libanais (30,6%).

**Conclusion:** La productivité médicale libanaise a été faible et instable en conséquence du manque de ressources financières et de l'instabilité de la région. L'accroîssement du financement de la recherche, la formation des médecins en méthodologie de recherche et en rédaction scientifique, sont nécessaires pour améliorer la production médicale Libanaise.

**Mots-clés**

Publication - bibliométrie - Medline – Liban



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**SUMMARY**

**Background:** Analysis of biomedical publications of a country is used to monitor research trends which leads to a better formulation of health policy planning and management.

**Aim :** We sought to describe the Lebanese medical publications productivity over a 20 years period from 1985 to 2004.

**Methods:** Medline's database was consulted and the query contained the name of the country, the medical universities, the main teaching hospitals, and cities, both in French and in English. The articles with a Lebanese health affiliation were included and the articles of dentistry, veterinary, nursing and pharmacy were excluded.

**Results:** We counted 1964 medical articles over a two-decade period. The productivity was 2,9 articles/100000 capita/year and 9,2 articles/billion US dollars GDP/year. The growth rate of publication drew a decline passing from 202% (1990-1994) to 55,3% (2000-2004). The four most productive specialties (Anesthesiology, Internal medicine, Gynecology, Pediatrics) published 611 articles (31,1%). The governorate of Beirut, the American University of Beirut and its teaching hospital published the most with respectively 1926 (98%), 568 (28,9%), and 601 articles (30,6%).

**Conclusion:** The Lebanese medical productivity was weak and unstable mainly due to the lack of financial resources and the instability of the region. Increasing research funding, improving the physicians' research methodology and writing capacities are likely needed to improve the Lebanese medical output.

**Key-words**

Publication – Bibliometrics – Medline – Lebanon

In the present knowledge-based economy, the rising costs of research and the tight restrictions in funding call for more efficient systems of resource allocation. To this end, many countries have begun to impose national exercises in research evaluation [1]. Hence, research is now evaluated via indicators concerning the input as well as the output where bibliometrics is the corner stone [2]. It is a means for situating a country in relation to the world, an institution in relation to a country, and even individual scientists in relation to their own communities [3,4]. By providing new information, bibliometrics can be an aid to decision-making and research management.

Unfortunately, great inequities are revealed as the United Nations Educational, Scientific and Cultural Organization (UNESCO) estimates show that the developing countries, with 78% of the world's inhabitants, only contributed to some 16% of the global Research and Development (R&D) expenditures. As scientific knowledge has become a crucial factor in the production of wealth, so has its distribution become more inequitable [5]. Although they count 315 million inhabitants in 23 countries with a near 1 100 billion US dollars of Gross Domestic Product (GDP), the Arab countries fared poorly in many aspects of development [6]. Many reasons were found to cause this, of which, the conflicts of the region and the scarce investments in R&D were the main features [7]. In fact, the Arab countries have some of the lowest levels of research funding in the world where R&D expenditure as a percentage of GDP was a mere 0,3%, compared to 3,8% for Sweden, 3,2% for Japan and 2,7% for United States of America [8]. With less than 1% of the biomedical citations in the world the biomedical research in the Arab world is not doing well either [9]. Realising the need for research evaluation, many bibliometric studies were conducted from Algeria [10], Morocco [11] and Tunisia [12-15] to the countries of the Middle East [9].

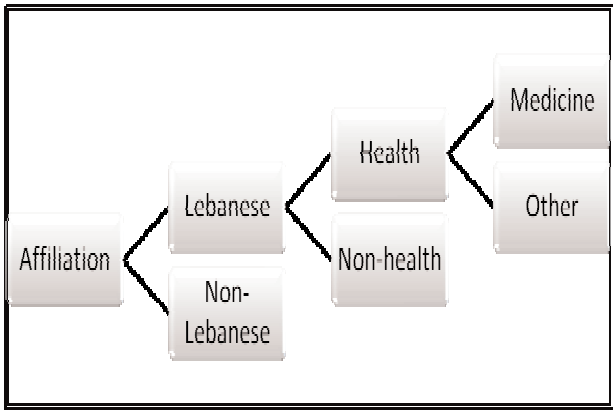
Lebanon, suffering from a long history of conflicts and limited financial resources, reflects the difficulties of research in many Arab countries. A bibliometric study of the Lebanese medical research productivity would help the decision makers to elaborate a development strategy regarding the national research based on a valid statistical data. And so, we aimed to assess the quantitative aspect of the biomedical research of Lebanon during a period of 20 years from 1985 to 2004 by determining the productivity and the key producers.

## MATERIAL AND METHODS

It's a desciptive bibliometric study of the Lebanese medical literature indexed in Medline during a period of 20 years from january 1st 1985 to Decembre 31st 2004. Its aim is to analyse the Lebanese scientific output based on the productivity. The articles that had a Lebanese health facility or medical education institutions affiliation were included. Meanwhile, articles that had a foreign or non-medical affiliation (science, biology, veterinary, dentistry and nursing) were exluded (box n°1).

The study was almost exclusively conducted on the Internet. Medline (www.pubmed.gov) was used to collect and retrieve data relative to the articles. The demographic and economic indicators were retrieved from the World Group Bank (www.worldbank.org). To create the most accurate but exhaustive query, we entered in Medline's affiliation tag, both in English and in French, the country's name, the medical schools, the main cities and hospitals, and, since the name Lebanon represent a town in the United Stated and there also exists Beirut in Italy, those two adresses were excluded using the Boolean operator "NOT". Finally the date was limited from 01/01/1985 to 31/12/2004. After obtaining the results of the query, we used the option "Medline" in the DISPLAY tag which allowed us to extract the informlations relative to the articles (pulication date, affiliation and specialty). Finally, the data were manually extracted and processed with the SPSS software version 16.0 for windows. Brief informations relative to Lebanon can be found in the Box n°2.

**Box n°1: Inclusion creteria algorithm of the Lebanese medical articles.**




**Box n°2: Context study.**

As for Lebanon, it is a country of the Middle East region with a total land area of 10 452 kmÇ and a total population of 4 350 000 (2005). It witnessed a civil war in the region from 1975 to 1990 followed by multiple armed conflicts. This persistent instability has been felt in all aspects of development in this country especially the health sector. Overall, the health situation is first characterized by a discrepancy between the geographical regions and between the population strata in terms of access to health services (availability, affordability and quality). Secondly, there is a focus on the curative rather than on the preventive aspect of health care.

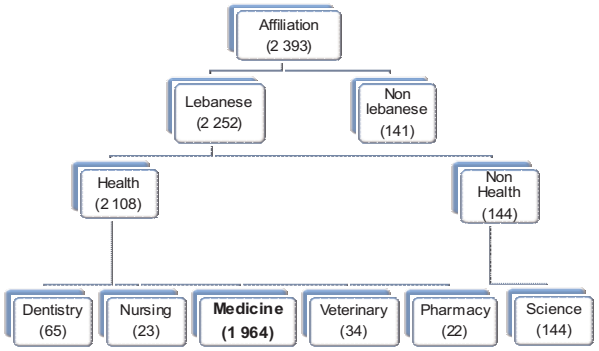
Also, Lebanon is witnessing an epidemiological transition over the past two decades where the infectious and communicable diseases remain endemic with an increase in the prevalence of non-communicable and degenerative diseases. The total health expenditure as percent of GDP reached 11,5% by 2002 while more than 90% of health service delivery is provided by the private sector. The health information system is fragmented and data are not collected in a systematic manner [16].

With five medical schools, the sole public one being the Lebanese University, and the other four private (the American University of Beirut, Saint-Jospeh University, Beirut Arab University and Balamand University) there is an oversupply of doctors reaching 10 327 at the end of 2004. Finally, nine national journals are indexed in the Index medicus for the Eastern Mediterranean region, and two of them are indexed in Medline (Le Journal Médical Libanais and Middle East Journal of Anesthesia) [16,17].

## RESULTS

The query captured 2 393 articles from the Medline database published over a 20 years period from 1st of january 1985 to 31st of december 2004. After the first inclusion criterion, 141 articles were eliminated leaving 2 252 with Lebanese affiliation. The second inclusion criterion eliminated 144 non health related articles. Of the 2 108 remaining papers,only 1 964 were considered as medical articles. Thus, 429 articles were exluded from this study (figure n°1).

**Figure 1 :** Selection process of the 1 964 Lebanese medical articles indexed in Medline from 1985 to 2004.




Although many fluctuations were noticed, the production marked a progressive increase going from 103 articles in the 1985-1989 period to 943 articles in 2000-2004 which was the most productive period (table I).

**Table 1 :** Repartition by year of the 1 964 Lebanese medical articles indexed in Medline from 1985 to 2004.

| Years | Frequency | Relative percent | Cumulative percent | Growth rate (%) |
|---|---|---|---|---|
| 1985 | 1 | 0,1 | 0,1 | - |
| 1986 | 0 | 0,0 | 0,1 | - |
| 1987 | 23 | 1,2 | 1,3 | - |
| 1988 | 44 | 2,2 | 3.5 | - |
| 1989 | 35 | 1,8 | 5,3 | - |
| 1985-1989 | 103 | 5,3 | 5,3 | - |
| 1990 | 27 | 1,4 | 6,7 | - |
| 1991 | 47 | 2,4 | 9,1 | - |
| 1992 | 81 | 4,1 | 13,2 | - |
| 1993 | 80 | 4,1 | 17,3 | - |
| 1994 | 76 | 3,9 | 21,1 | - |
| 1990-1994 | 311 | 15,8 | 21,1 | 202,0 |
| 1995 | 65 | 3,3 | 24,4 | - |
| 1996 | 88 | 4,5 | 28,9 | - |
| 1997 | 112 | 5,7 | 34,6 | - |
| 1998 | 163 | 8,3 | 42,9 | - |
| 1999 | 179 | 9,1 | 52,0 | - |
| 1995-1999 | 607 | 30,9 | 52,0 | 95,2 |
| 2000 | 164 | 8,3 | 60,4 | - |
| 2001 | 211 | 10,7 | 71,1 | - |
| 2002 | 182 | 9,3 | 80,4 | - |
| 2003 | 231 | 11,8 | 92,1 | - |
| 2004 | 155 | 7,9 | 100,0 | - |
| 2000-2004 | 943 | 47,9 | 100,0 | 55,3 |
| Total | 1 964 | 100,0 | - | - |

The Lebanese scientific output was able to follow up with the regular population growth over the years passing from 0,7 article/ 100 000 capita/year to 4,9 articles /100000 capita/year (table II). The increase was most significant between the 1985-1989 and 1990-1994 period. The mean of the productivity was 2,9 articles/ 100 000 capita/year. On the other hand, the Lebanese medical publications as well as the GDP marked an unstable growth over the years. The mean of the productivity was 9,2 articles/billion US dollars GDP/year (table II).

**Table 2 :** Lebanese medical articles indexed in Medline from 1985 to 2004 compared to population and Gross domestic Product (GDP).

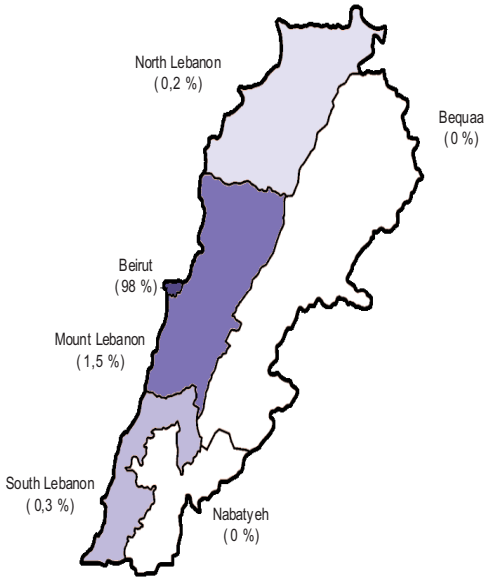
| Years | Article frequency | Inhabitants* | GDP (billions of dollars)* | Articles /100 000 capita /year | Articles/billion US dollars GDP/year |
|---|---|---|---|---|---|
| 1985-1989 | 103 | 2 899 270 | 3,3 | 0,7 | 6,2 |
| 1990-1994 | 311 | 3 158 390 | 5,5 | 2,0 | 11,3 |
| 1995-1999 | 607 | 3 631 100 | 15,5 | 3,3 | 7,8 |
| 2000-2004 | 943 | 3 869 220 | 18,7 | 4,9 | 10,1 |
| Total | 1 964 | 3 441 315 | 10,7 | 2,9 | 9,2 |

** The median of the variable for the specific period.*

Forty one specialties published the 1 964 Lebanese medical articles indexed in Medline from 1985 to 2004. Anesthesiology was the most prolific of them all (10,4%). Almost the third of the ouput (31,1%) came from four specialties (Anesthesiology, Internal medicine, Gynecology, Pediatrics) (table III).

The analysis of the articles' distribution by governorate showed an enormous domination of Beirut with 98% of the total publishing ouput. What was left for the other regions fell way behind in terms of numbers scoring all together 2% (figure n°2).

**Figure 2 :** Map of Lebanon showing the articles'share of the six governorates

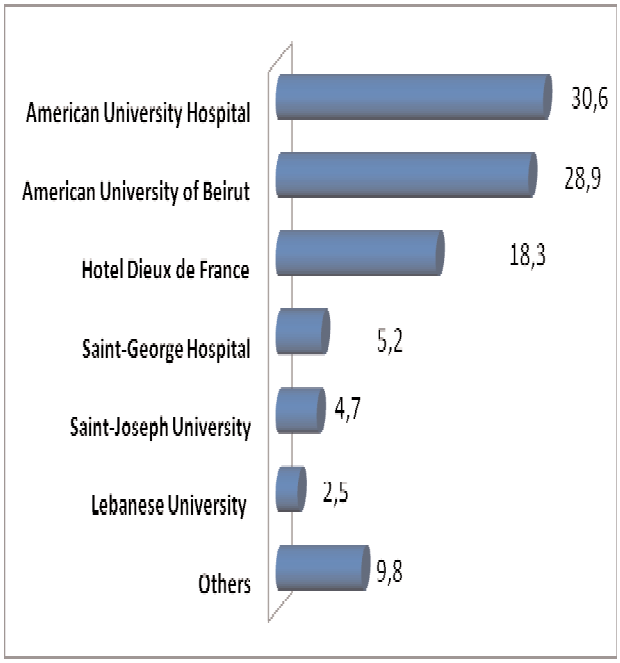


The American University of Beirut and its teaching hospital the American University Hospital where the institutions that published the most with respectively 28,9% and 30,6% followed by "Hotel Dieux de France" with 18,3% of the total articles (figure n°3).

**Table 3 :** Distribution by specialty of the 1 964 Lebanese medical articles indexed in Medline from 1985 to 2004.

| Specialties | n | % | Cumulative percent |
|---|---|---|---|
| 1.Anesthesiology | 205 | 10,4 | 10,4 |
| 2.Internal Medicine/infectious Diseases | 160 | 8,2 | 18,6 |
| 3.Gynecology | 124 | 6,3 | 24,9 |
| 4.Pediatrics | 122 | 6,2 | 31,1 |
| 5.Epidemiology | 122 | 6,2 | 37,3 |
| 6.General Surgey | 97 | 5,0 | 42,3 |
| 7.Radiology | 88 | 4,5 | 46.8 |
| 8.Physiology | 79 | 4,0 | 50,8 |
| 9.Genetics | 72 | 3,6 | 54,4 |
| 10.Ophtalmology | 66 | 3,4 | 57,8 |
| 11.Cardiology | 61 | 3,1 | 60,9 |
| 12.Family Medicine | 60 | 3,0 | 63,9 |
| 13.Cardio-Thoracic Surgery | 53 | 2,7 | 66,6 |
| 14.Dermatology | 52 | 2,6 | 69,2 |
| 15.Orthopedics | 52 | 2,6 | 71,8 |
| 16.Urology | 49 | 2,5 | 74,3 |
| 17.Otolaryngology | 45 | 2,3 | 76,6 |
| 18.Microbiology | 42 | 2,1 | 78,7 |
| 19.Endocrinology | 39 | 2,0 | 80,7 |
| 20.Plastic Surgery | 37 | 1,9 | 82,6 |
| 21.Neurosurgery | 33 | 1,7 | 84,3 |
| 22.Gastroenterology | 32 | 1,6 | 85,9 |
| 23.Hematology | 31 | 1,6 | 87,5 |
| 24.Nephrology | 29 | 1,5 | 89,0 |
| 25.Immunology | 29 | 1,5 | 90,5 |
| 26.Pathology | 26 | 1,3 | 91,8 |
| 27.Biochemestry | 20 | 1,0 | 92,8 |
| 28.Oncology | 19 | 1,0 | 93,8 |
| 29.Psychiatry | 17 | 0,9 | 94,7 |
| 30.Neurology | 16 | 0,8 | 95,5 |
| 31.Laboratory | 16 | 0,8 | 96,3 |
| 32.Pneumology | 12 | 0,6 | 96,9 |
| 33.Pediatric Surgery | 12 | 0,6 | 97,5 |
| 34.Rheumathology | 10 | 0,5 | 98,0 |
| 35.Geriatrics | 8 | 0,4 | 98,4 |
| 36.Maxillofacial Surgery | 8 | 0,4 | 98,8 |
| 37.Anatomy | 8 | 0,4 | 99,2 |
| 38.Pharmacology | 7 | 0,4 | 99,6 |
| 39.Physiotherapy | 4 | 0,2 | 99,8 |
| 40.Emergency Medicine | 2 | 0,1 | 99,9 |
| 41.Intensive Care | 1 | 0,1 | 100,0 |
| Total | 1 964 | 100,0 | - |

**Figure 3 :** List of the most prolific Lebanese intitutions that published Lebanese medical articles indexed in Medline from 1985 to 2004 (%).




## DISCUSSION

The main purpose of the biomedical research is vital to the development of the nation especially in keeping the current and future generation in a good shape and identifying prioritized sectors. Consequently, national health, social and economic goals are attained [18]. This new knowledge, updated by researchers has to be transformed into information made available to the scientific community [19] where publishing is the best mean. According to Price, a scientist is "any person who has ever published a scientific paper" [20]. Aware of the importance of publications, and with the era of digitilazed science, the number of articles have been increasing exponentially. Due to this situation, and with the need to control the quality of scientific activity, bibliometrics was born [13].

Bibliometrics can be defined as a field of research that examines bodies of knowledge both within and across disciplines, it is for publications what demography is for populations [21]. Hence, institutions and nations have been conducting bibliometric studies all over the world from the United States of America [22] to Japan [23], to the Arab world [24;25] like Algeria [10], Morocco [11], Tunisia [12-15] and Saudia Arabia [26] etc. To our knwoledge, there are few Lebanese bibliometric studies and taking into consideration the particularity of the Middle East region and Lebanon exactly (instability issues on one hand and a link between the East and the West on the other), we found it interesting to analyze the bibliometric characteristics of the medical research productivity of Lebanon, over a period of 20 years from 1985 to 2004, hence, placing it on the international geographic chart.

Despite the efforts made to conduct the study with the best methods, we can not deny some selection and information biases. Choosing to restrain the search to Medline's database made us pass over some articles but we believe that this selection bias would not risk the validity of our results because of the fact that the articles in local journals are not systematically peer-reviewed and some of which are not edited on a regular base which lowers their quality. The other international databases index more journals of scientific nature than medical one. Moreover, most of the bibliometric studies were conducted via Medline's database and that would make it easier for us to compare our study with others [27]. On the other hand, biases of information are due to indexation errors within the database of Medline like affiliation, author's name and in some cases there was missing information. Adequate measures were taken to preserve the validity of the results.

And so, this work concludes that the Lebanese medical productivity is weak and unstable with a domination of the capital and some specialties. The raw production is the simplest indicator of the productiviy, it is used to compare the evolution of the country's number of publications and can not be used to compare different countries. For that, we have to normalize this number using demographic and economic indicators like population, GDP, physicians count and the gross domestic expenditure on research and development [28]. We found in this study that Lebanon, from 1985 to 2004, has published a total of 1 964 articles indexed in Medline. The productivity was 2,9 articles/ 100 000 captia/ year and 9,2 articles/ US billion dollars GDP/ year. Both the production and the productivity drew a general increase over the years. To shed some light on these numbers, we compared them with findings from similar studies starting with the Arab countries (table IV).

**Table 4 :** Exposition of different national Arab bibliometric studies with their different methods.

| Country | Database | Period | Raw production | Articles/ 100 000 captia/year | Articles/US billion dollars GDP/ year |
|---|---|---|---|---|---|
| **Saudi** | Medline | 1982-2000 | 5 962 | ND''' | ND |
| **Arabia*** | Medline | 1985-2004 | 1 964 | 2,90 | 9,20 |
| **Lebanon** | Medline | 2000-2003 | 1 248 | 3,20 | 10,60 |
| **Tunisia**** | Ovid | 1993-1998 | 720 | 0,53 | 4,39 |
| **Morocco***** | Medline/ | 1979-2006 | 386 | ND | ND |
| **Syria****** | Embase | 1988-2007 | 348 | ND | ND |
| **Lybia'** | Medline | 1993-1998 | 111 | 0,04 | 0,32 |
| **Algeria''** | Ovid | | | | |

* Source: Tadmouri G. Saud Med J 2002

' Source: Benamer H. Educ Health 2009
** Source: Ben Abdelaziz A. Tunis Med 2006

'' Source: Selamnia M. Tunis Med 2003
*** Source: Badrane H. Tunis Med 2003

''' ND: Not Determined

**** Source: Matar H. East Medit Health J 2009

Meanwhile, In an international comparison of the productivity, Lebanon was ranked 9th with 17,42 publications/ million population/ year among the Asian countries and 4th among Arabs after Kuwait, Saudia Arabia and Emirates respectively (table V) [29].

**Table 5 :** Publications per million population per year in different countries of four continents*.

| Africa | | Asia | | Europe | | America | |
|---|---|---|---|---|---|---|---|
| Gambia | 23,9 | Israel | 602,9 | Sweden | 675,5 | USA | 451,2 |
| South Africa | 19,6 | Japan | 204,9 | Finland | 525,0 | Canada | 360,1 |
| Gabon | 18,6 | Singapore | 172,0 | Denmark | 518,5 | Dom Rep*** | 57,1 |
| Zimbabwe | 9,2 | Hong Kong | 134,1 | Switzerland | 490,3 | Greenland | 51,5 |
| Senegal | 6,5 | Kuwait | 62,3 | Netherlands | 448,1 | Chile | 34,3 |
| Egypt | 6,4 | Korea | 30,0 | Norway | 330,4 | Puerto Rico | 30,1 |
| Kenya | 5,8 | Saudi Arabia | 23,0 | Belgium | 299,3 | Trinidad T.' | 27,2 |
| Botswana | 4,7 | Emirates | 22,9 | UK** | 272,7 | Argentina | 25,8 |
| Libya | 3,4 | Lebanon | 17,4 | Iceland | 240,9 | Jamaica | 23,2 |
| Nigeria | 3,1 | Jordan | 16,8 | Austria | 218,7 | Guam | 22,4 |
| Tunisia | 3,0 | Georgia | 15,1 | France | 210,7 | Uruguay | 20,5 |

*Source: Rahman M. Public Health 2003

***Dominican Republic

** United Kingdom

' Trinidad and Tobago

Globally, there is an enormous inequity in biomedical research when the report on health research held in Geneva in 2000 admits that less than 10% of the world's research resources are earmarked for 90% of the health problems [30]. Moreover, the Arab world's output represents less than 1% of the world's medical publications [5]. Having said these facts, we acknowledge that the Lebanese medical publications are scarce on the international scene. This low productivity could have mutliple reasons, some of which are common for many developping countries. The most important are:

• The insufficient financial resources. In fact, the Commission on Health Research for Development recommended about two decades ago that in order to narrow the scientific biomedical gap between the North and the South, all countries should allocate 2% of public health expenditure to health research [31]. Twenty years have passed and the biomedical research sector is still suffering from miniscule investment as it was shown by serveral studies [5,8,31].

• The lack of training and building the research and articles capacities within the undergraduate medical students as was forewarned in many studies [10,13,28].

• The conflicts of the region and espcially the Lebanese civil war. This cause shows the fragility of the health system in the Arab world. A recent study compared the 16 most productive Arab countries to other Middle Eastern countries, Iran, Turkey and Israel who are also touched by the unstability of the region. It found that the Arabs were lagging behind these 3 countries in biomedical research [32].

• The law fundings and the instability of the region caused much of scientifc departures which drained much of the Lebanese production capacities [10]. In this issue, Lebanon's emigration factor (19,3%) is the 7th highest in the world and the highest in the Middle East and North Africa [33].

On the other hand, the main goal of biomedical research is to spot the health related problems of the community and to set a strategy for solving them. In order to succed in its mission, the research must concern all parts of the counrty. However, our study showed that 98% of the Lebanese productivity originated from the governorate/capital Beirut, while two others had no publications although they represent more than 20% of the Lebanese area. This is due to the fact the five Lebanese medical schools and their main teaching hospitals are located in the capital. Our findings were similar to most of the studies from Arab countries [13,26] Particularly Tadmoury's in 2009 [25]. In fact, when only the capital becomes responsible of the country's medical research, then the goals that could be set would not match the need of the whole community.

Finally, In the matter of specialties, the Anesthesiology was the most productive over the years publishing 10,4% (205 articles). This finding is probably due to the fact that Anesthesiology as a specialty interacts with many disciplines, including surgery, neurology, cardiology, obstetrics, pulmonology, critical care, and hematology. This enables anesthesiologists to collaborate in clinical research with many disciplines, hence providing a lager population for study with richer demographic charactersitics and more various diseases. Moreover, and taking into consideration the security issues of Lebanon, the surgical injuries were in the front line of the Lebanese medical activity. Consequently, Anesthesiology had to be more active which could have been a boost for research in this field. A recent study [4] conducted a Medline search for English-language publications from 2000 to 2005 which included words relating to anesthesia (e.g., anesthesiology, anesthesia, etc.). Turkey had the highest percentage of randomized controlled trials (88%) and Finland had the highest productivity when adjusted for population (36 articles/ million population).

Meanwhile, Lebanon was ranked 11th with 11,7 articles/million population. On the other hand, where this specialty was found the most prolific in this country, a new article [34] found a negative trend in research publications worldwide estimated at -1% and was more pronounced in the United Kingdom (UK) with -5,7%. One of the reasons of this decline is the introduction of the Clinical Trials Directive where Worldwide, the number of research papers fell by 3,6% and 18% in the UK alone [35].

To finish with, we can conclude that the main features of the Lebanese medical publications over a 20 years period from 1985 to 2004 were: a weak and unstable productivity, a centralism of the capital and Anesthesiology was the most prolific specialty. Thus, Integrating courses about research methodologies and scientific writing in the medical program for the pre and post-graduates, extending the bibliometrics to reach the Lebanese articles in non indexed journals and other international databases, and increasing the investment in R&D to attain 2% of GDP are actions that would enhance the Lebanese medical publications.

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