2020

# Measuring Research Performance of the Oldest Medical School of Pakistan

Shakil Ahmad
shakil@psu.edu.sa

# Measuring Research Performance of the Oldest Medical School of Pakistan

## Abstract

This study evaluates the research performance of King Edward Medical University, the oldest school of medical education in Pakistan. Bibliometric indicators are used to assess the research output. A comparison is made with peer universities running under the same government to know King Edward Medical University's research standing at provincial and country level. The study observes the citation patterns of research publications. The study revealed that researchers in KEMU collaborate with local and international institutes. The highest collaboration is seen with the researchers in Mayo Hospital, Lahore. International research collaboration spans over seventy countries. Trend of publishing in open access journals is not very common in researchers of KEMU and other studied universities. The highest percentage of 25 % of its research papers published in open access journals is recorded by University of Health Sciences. Further, the researchers opt to publish their research in locally published journals more frequently. The study recommends publishing in good quality journals that are indexed in international indexing databases.

## Introduction

This paper evaluates the research performance of King Edward Medical University (KEMU hereafter), the premier and oldest institution of medical education in Pakistan. The system of modern higher education in Pakistan goes back to middle of 19<sup>th</sup> century though the area is known to the centuries old traditions of traditional learning. It was the British rulers who introduced the western style of education in sub-continent. They established institutions throughout the sub-continent. The first such institute established in the area of current day Pakistan was Lahore Medical School. The school is the oldest seat of medical education in Pakistan, 87 years older than the country. The school was established in 1860 and was the third medical institute in un-divided India. The first two medical institutes, Calcutta Medical College, and Grant Medical College Bombay were established in 1835 and 1845 respectively. The school was renamed three times as Lahore Medical College in 1886, King Edward Medical College in 1911 and King Edward Medical University in 2005. It shows the institution's evolution during 160 years of its life.

Academics in medical schools of Pakistan have diverse roles to perform; teaching, patient care in teaching hospitals and conducting research. Publishing research is one of the requirements set by Pakistan Medical and Dental Council and Higher Education Commission of Pakistan for promotion of faculty at higher education institutes of Pakistan. Evidence-based research is considered vital for the development of any field of knowledge and contributes to the well-being of society. Despite its importance, the research has been ignored in Pakistani medical institutes. Although there is progress in recent years, however, this increase is not sufficient in terms of quantity and quality considering the size of medical institutes.

One argument supporting the low productivity of research publications is the low research funding from Pakistan Medical Research Council (PMRC) and other funding agencies. Low allocation of budget from federal and provincial governments for healthcare is another

influencer. Pakistan spent with an average of 2.69 percent of its GDP on health care during the years from 2000 to 2016. The highest allocation of 3.14 percent was recorded in year 2007 during this this time period ("Pakistan Health spending as percent of GDP - data, chart | TheGlobalEconomy.com," n.d.). Further the environment that encourage the healthcare research is lacking (Farooq, Syed, & Zulqernain, 2019). With few exceptions, the quality and visibility of published research by faculty of medical schools of Pakistan is another problem. Pakistan's problems in medical research are same as of other developing countries. Most of research papers from the developing countries are not published in good quality journals in their respective field. Publishing in the journals that are not indexed in renowned indexing and abstracting databases like, PubMed, Scopus and Web of Science leads to under representation (Ghaffar, Zaidi, Qureshi, & Hafeez, 2013; Smith, 2002).

The research output of an academic institution needs to be examined to set priorities in research funding. Another purpose of assessing such data and research is to fill the gap in already published literature and body of knowledge. Being the premier and oldest institute of medical education in Pakistan, it is imperative to know how KEMU has performed in research activities along with its teaching excellence. With this inquisitive sense this study is carried out to answer the following research questions:

- What is the research output of KEMU in terms of research publications during its life of more than one and half century?
- What is KEMU's relative position in research output in similar universities of Punjab province?
- What is the impact of KEMU's research in the form of citations?
- What are the local and international collaboration patterns of KEMU researchers?

**Review of Literature**

The analysis of baseline data in any field of knowledge helps preparing new research themes and agendas. To achieve these agendas active research is needed. Research on medical and health sciences create awareness and consequently contribute in improving public health. To achieve the general principles of public health, the active participation of researchers and academics is important. Research outcome of the faculty is an important element among others to examine the quality of an academic institute. To measure this outcome, bibliometrics is widely adopted method (Kazakis, Diamantidis, Fragidis, & Lazarides, 2014). Several studies have been carried out to measure the research performance of universities, disciplines, authors, journals, and countries using this method.

(Abolghassemi Fakhree & Jouyban, 2011) conducted a study to measure the comparative research performance of seven major medical universities of Iran. Tehran University of Medical Sciences (TUMS) contributed the most in form of research publications and related citations. Researchers associated with TUMS were found the most productive ones. Authors observed that researchers in the studied universities prefer to publish their research in Iranian journals. A similar study carried out by (Kazakis et al., 2014) examined the research output of Greek medical schools. The study observed that experienced and high ranked faculty in Greek medical

schools publishes more impactful research. The new researchers and faculty with lower ranks publish less recognizable work. The study found that self-citations had negligible impact on bibliometrics of Greek medical researchers.

Reviewing the peer-reviewed publications of British occupational therapy authors (Brown, Ho, & Gutman, 2018) observed a gradual annual increase of five (5) in 1991 to seventy seven (77) in 2014 in research publications in occupational therapy field. It was observed that British occupational therapy authors have contributed to the existing scholarly literature in the field. (Shehatta & Mahmood, 2017) explored the research collaboration patterns of Egyptian health researches. The study observed that Egyptian authors in health sciences have tendency to collaborate. Authors observed that collaboration increases the impact of research. The collaborative works with international authors has greater visibility and impact than that of single authored or locally collaborated papers. Rheumatology, infectious diseases, tropical medicine and immunology are the research areas where the most collaboration is seen in Egyptian health researchers.

(Zyoud, Zyoud, Al-jabi, Sweileh, & Awang, 2016) observed the Arab world's share of research in pharmaceutical wastewater. The publications get noticed by other researchers and received citations with the mean of 9.13. The study observed that authors of pharmaceutical wastewater research in Arab countries are collaborating the most with the authors of Western Europe and North America. The highest contributor is Saudi Arabia in the region followed by Egypt. King Saud University had the highest number of research papers on the topic.
(Chinchilla-Rodrı´guez, Zacca-Gonza´lez, Vargas-Quesada, & Moya-Anego´n, 2015) in their study to measure scientific output of Latin America in public health, combined the bibliometrics, socio economic, and public health indicators. The study find that Brazil and Mexico have better research system to communicate the research results among the countries in the region contributing 67% and 14.7% of the total research publications. Over 80% of the total research produced in the region is published in form of journal papers. The study observed that papers published in English language had the higher impact than the other languages.

(Howaidi, Howaidi, & Howaidi, 2017) measured the research publications output of the government hospitals in the capital city of Kingdom of Saudi Arabia. Scopus databases used to conduct the study using bibliometric methods. King Faisal Specialist Hospital added 44% of total publications followed by King Faisal University Hospital with 15% contribution. The top five most cited research papers were published in "The Lancet" journal.

(Mufti, 2003) stated that financial investment in health sector in Pakistan is pathetically low. He stated that Pakistan's spending on public health is as low as 0.7% of GNP. The study emphasized for the availability of established health research system in the country. Poor research planning and deficiency of monetary support for researchers in health sciences is one of the basic problems in health care research.

Several studies are prepared in and on Pakistan discussing its research and education system (Ghaffar et al., 2013; Herciu, 2016; Hoodbhoy, 2009; S. A. Javed & Liu, 2018; Khattak, 2009; Mahbuba & Rousseau, 2010; Mufti, 2003; Mushtaq, Abid, & Qureshi, 2011; Osama, Najam, Kassim-Lakha, Gilani, & King, 2009). Bibliometric and scientometric studies in Pakistan are

mainly prepared to see the publications patterns of journals and to evaluate the research output in particular subject areas (Anwar & Saeed, 1999; Bajwa & Yaldram, 2013; Baladi & Umedani, 2017; Farooq et al., 2019; Ibrahim & Jan, 2015; Jan, 2013; Mahmood & Shafique, 2010; Naseer & Mahmood, 2009; Nasir, Ahmed, Asrar, Of, & 2015, 2015; Warraich & Ahmad, 2011). Few studies are conducted to measure the research performance of academic institutions as well (Hussain, Jan, Ibrahim, Salam, & Saeed, 2019; Y. Javed, Ahmad, & Khahro, 2020; Mushtaq, Abid, & Qureshi, 2012).

However, no comprehensive study is available measuring the research productivity of medical schools of Pakistan in general and of Punjab province in particular. Particularly, there is no research study available so far that could show the research productivity of the oldest institution of medical education in Pakistan. Consequently, the research contribution of the premier institute of medical education in Pakistan is little known to the researchers, medical practitioners, administrators, decision makers and other stake holders. This gap in the literature validates the necessity of conducting this study with the following objectives:

1. To examine the research productivity of KEMU faculty in the form of research publications
2. To find out the historical development of research at KEMU
3. To find out the relative position of KEMU with other comparable medical institutes in the province
4. To find out the impact of KEMU publications in terms of citations by other researchers
5. To find the subject areas in which KEMU authors are publishing
6. To find out the most prolific authors of KEMU
7. To find out the most preferred journals their associated metrics

**Methodology**

This study is prepared using bibliometric methods. Data for this research is retrieved from Scopus database. Scopus is the largest indexing database of peer-reviewed literature. The data is taken in March 2020 till the year 2019.

KEMU is situated in Punjab province of Pakistan; hence it comes under the administration of the government of Punjab. Similar institutions running under the administration of government of Punjab are selected for comparison with KEMU to know its position in peer institutions.

Similar/Peer universities are selected using the guidelines of (Carnegie Foundation for the Advancement of Teaching, 2001) and using the following criteria: The selected institutions:

- are registered in Punjab province
- are public sector universities
- are registered under medical and health sciences categories
- have upgraded to the university status

**Limitations of Study**

- The data for this study is taken from Scopus database only.

- The data for study is taken up to the year 2019.
- Citation data is taken for last five years i.e. from 2015-2019 as the citation data is available for limited years in Scopus database.
- The institutions for comprehensive comparison are selected from Punjab province of Pakistan.

**Data Analysis**

Analysis of this study comprises of two categories. Several metrics of research performance of KEMU are analyzed using bibliometric methods in first category. A comparison of KEMU's research output and its metrics is made with similar universities in the province in the second category. Figure 1 explains the year wise contribution of KEMU and other compared universities. A sharp increase in the research publications productivity is seen at end of first decade of 21$^{st}$ century. This remarkable increase can be attributed to the rise of information and communication technology (ICT) and Higher Education Commission of Pakistan (HEC)'s role in facilitating the education and research at higher education institutes of Pakistan (Mahmood & Shafique, 2010; Warriach & Tahira, 2014). KEMU contributed more than one third (38%) of total publications of studied universities. KEMU together with UHS shared 65% of total research output of these universities. KEMU published its first research paper in 1930, seventeen years before Pakistan came into existence. A very low progress with very few publications is observed during the first one hundred (100) years of KEMU.
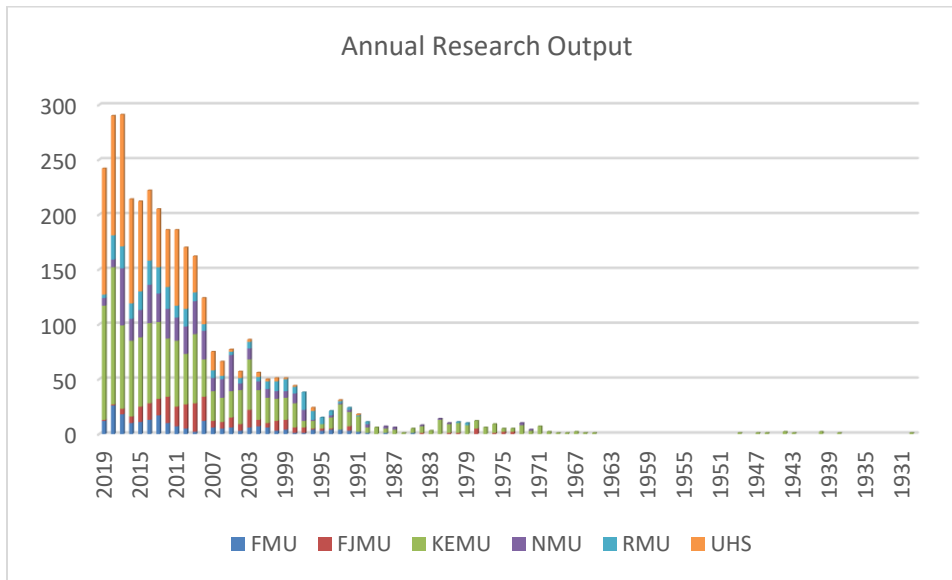


Figure 1 shows the annual research output of KEMU and peer universities.

| University | Documents | Citations | Average Citations/Docs | Cited Docs | % of Cited Docs | Non-cited Docs | % of Non-cited Docs |
|---|---|---|---|---|---|---|---|
| **FMU** | 215 | 1392 | 6 | 135 | 63 | 80 | 37 |

| FJMU | 272 | 2499 | 9 | 157 | 58 | 115 | 42 |
| KEMU | 1311 | 9885 | 8 | 709 | 54 | 602 | 46 |
| NMU | 446 | 1380 | 3 | 165 | 37 | 281 | 63 |
| RMU | 288 | 3443 | 12 | 208 | 72 | 80 | 28 |
| UHS | 928 | 9296 | 10 | 652 | 70 | 276 | 30 |

Table 1 shows research output and citation data of KEMU and compared universities.

KEMU leads in total number of research publications and citations on these publications in the group of studied universities. The average number of citations per document is calculated to get insight of citation patterns. KEMU received eight (8) citations on average per document on its publications. More than half of KEMU publications are cited one or more times. UHS follows the KEMU in overall output and number of citations. Seventy (70) % of its documents cited at least one time with an average of ten (10) citations per document. The lowest average of three (3) citations per document is recorded for NMU. RMU recorded the highest percentage of 72 % of cited documents with the highest average of twelve (12) citations per document in the group.

To further investigate the citations patterns of KEMU and other compared universities, a comparative data is prepared for the recent five years' time span i.e. 2015 to 2019. UHS leads in getting highest number of citations on its publications during this time period. KEMU follows the UHS in number of citations for its publications. The lowest two in the group are NMU and FMU respectively during studied time span.

To see the impact of self-citations, data excluding self-citations is prepared for the same period of recent five years i.e. 2015 to 2019. Figure 3 shows the comparative data showing the self-citation impact. No significant change in the citation patterns is observed excluding self-citations except slightly reducing the number of total citations resulting slightly lowering the h-index. This endorsed the observations of (Kazakis et al., 2014) for their study of Greek medical universities. The same pattern is observed when the citations data including and excluding self-citations is analyzed without applying any time limit. Figure 4 shows the citation data of total citations without applying any time limit.
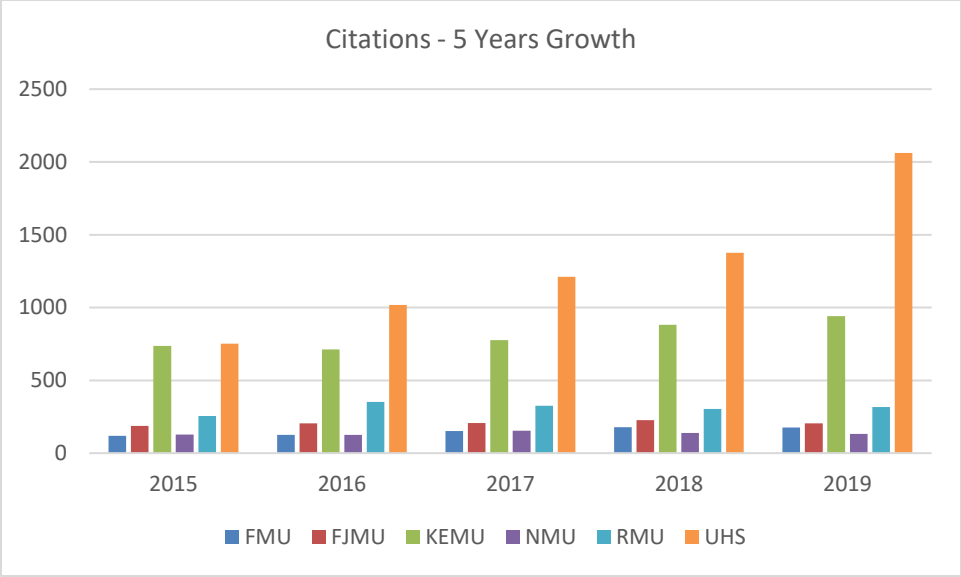
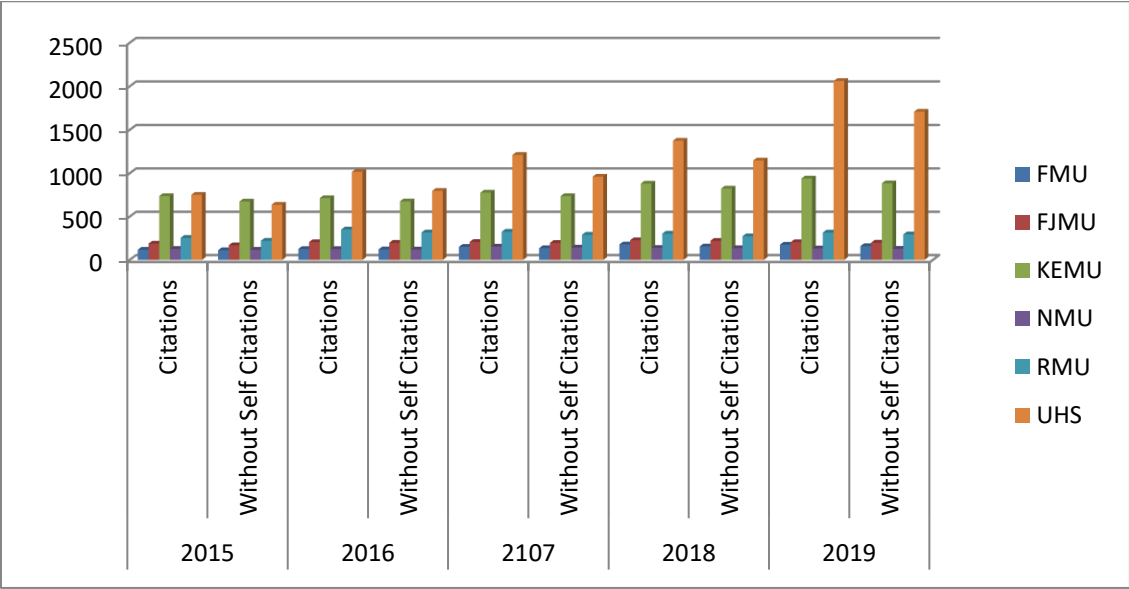Figure 2 shows citations to the publications during 2015 to 2019.



Figure 3 shows citation data of recent five years, including and excluding self-citations.
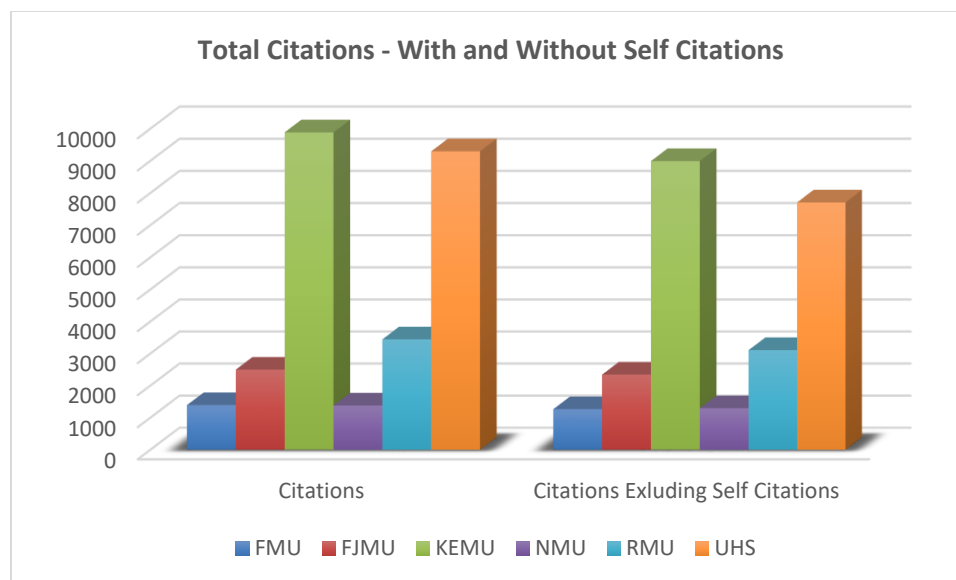
Figure 4 shows total citations data without applying time limit.

Data from the research indicates that researchers in studied medical universities preferred to publish their research in local journals. None of the top five preferred journals by each of these universities are categorized in Q1 and Q2 categories of journal rankings. Pakistan Journal of Medical and Health Sciences is the most preferred journal publishing 15% of total research of these universities. Journal of the College of Physicians and Surgeons Pakistan is the 2nd most preferred journal publishing 8% of total research of this group of universities. Researchers of KEMU publish 20% of their research in the most common journal in the group "Pakistan Journal of Medical and Health Sciences". Table 2 indicates the most preferred journals along with following research metrics:

- **SiteScore:** a method to measure the citation impact of journals.
- **SNIP:** a ratio of a journal's average citation count per paper and the citation potential of its subject area.
- **SJR:** used to measure the prestige of a journal.
- **Quartile:** are bands of journals grouped together due to alike position in their subject areas. There are four quartiles; Q1 with journals in 75-99th percentiles, Q2 with journals in 50-74th percentiles, Q3 with journals in 25-49th percentiles and Q4 with journals in 0-24th percentiles ("How are CiteScore metrics used in Scopus? - Scopus: Access and use Support Center," n.d.).

| Journal Title | In Top 5 of Universities | No of Papers | % of Total Papers | CiteScore | SNIP | SJR | Quartile |
|---|---|---|---|---|---|---|---|
| Pakistan Journal of Medical and Health Sciences | FMU, FJMU, KEMU, NMU, RMU, UHS | 521 | 15% | 0.07 | 0.112 | 0.121 | Q4 |
| Journal of the College of Physicians and Surgeons Pakistan | FMU, FJMU, KEMU, NMU, RMU, UHS | 272 | 8% | 0.41 | 0.38 | 0.222 | Q3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Journal of the Pakistan Medical Association | FMU, FJMU, KEMU, NMU, RMU, UHS | 199 | 6% | 0.57 | 0.494 | 0.273 | Q3 |
| Medical Forum Monthly | FMU, FJMU, NMU, RMU | 221 | 6% | 0.03 | 0.045 | 0.112 | Q4 |
| Pakistan Journal of Medical Sciences | FMU, KMU, NMU, UHS | 125 | 4% | 0.93 | 0.579 | 0.36 | Q3 |
| Journal of Ayub Medical College Abbottabad JAMC | FJMU, UHS | 65 | 2% | 0.39 | N/A | 0.191 | Q3 |
| Journal of Pakistan Association of Dermatologists | KEMU | 148 | 4% | 0.11 | 0.15 | 0.145 | Q4 |
| Rawal Medical Journal | RMU | 31 | 1% | 0.08 | 0.082 | 0.119 | Q4 |

Table 2 shows preferred journals and their associated metrics.

Researchers at KEMU published in twenty three (23) pre-defined subject areas of Scopus database. Seventy eight (78) % of publications are in the field of medicine. Other prominent subject areas are biochemistry, genetics & molecular biology, immunology & microbiology and agricultural & biological sciences. KEMU researchers are also publishing in pharmacology, toxicology, pharmaceutics, neuroscience and nursing.
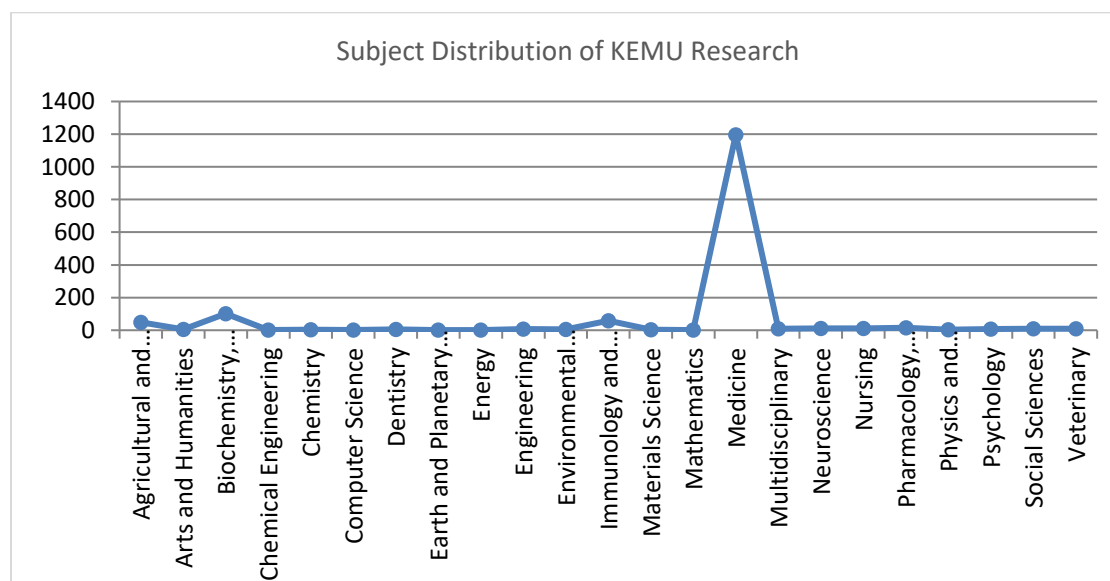


Figure 5 shows KEMU's published research distributed in relevant subject areas.

KEMU researchers have highest collaboration with Mayo Hospital Lahore, the teaching hospital of the university. Collaboration with local institutions is pre-dominant. Data indicates that the other top local collaborating institutes are Lahore based academic institutions and hospitals. KEMU researchers do collaborate with international institutions. Göteborgs Universitet is top

international collaborating institute followed by University of Maryland School of Medicine. Table 3 shows the top local and international collaborating institutes.

KEMU's collaboration in different countries is examined in this study. KEMU researchers' foreign collaboration spans to 70 countries around the world. They have collaborated the most with the researchers in United States followed by the United Kingdom adding 29% and 14% of their foreign collaborations respectively. These two countries along with Sweden constitute more than half of KEMU's total foreign collaborations. India, Japan, Saudi Arabia, and Australia are other noticeable countries in the list. Figure 6 shows the KEMU collaboration with other countries.

| Top Local Collaborating Institutes | Collaborating Authors | Top Intl. Collaborating Institutes | Collaborating Authors |
|---|---|---|---|
| Mayo Hospital Lahore | 596 | Göteborgs Universitet | 30 |
| Pakistan Medical Research Center | 81 | University of Maryland School of Medicine | 28 |
| Allama Iqbal Medical College | 45 | University of Maryland | 18 |
| Services Institute of Medical Sciences Lahore | 35 | St James's University Hospital | 16 |
| University of Lahore | 30 | Guy's and St Thomas' NHS Foundation Trust | 8 |
| University of the Punjab, Lahore | 27 | Organisation Mondiale de la Santé | 7 |
| Fatima Jinnah Medical College | 23 | Baylor College of Medicine | 6 |
| University of Health Sciences Lahore | 23 | University of Leeds | 6 |
| Lahore General Hospital | 19 | Karolinska Institutet | 6 |
| Children's Hospital Lahore | 18 | Medizinische Hochschule Hannover MHH | 6 |

Table 3 shows collaborating institutions

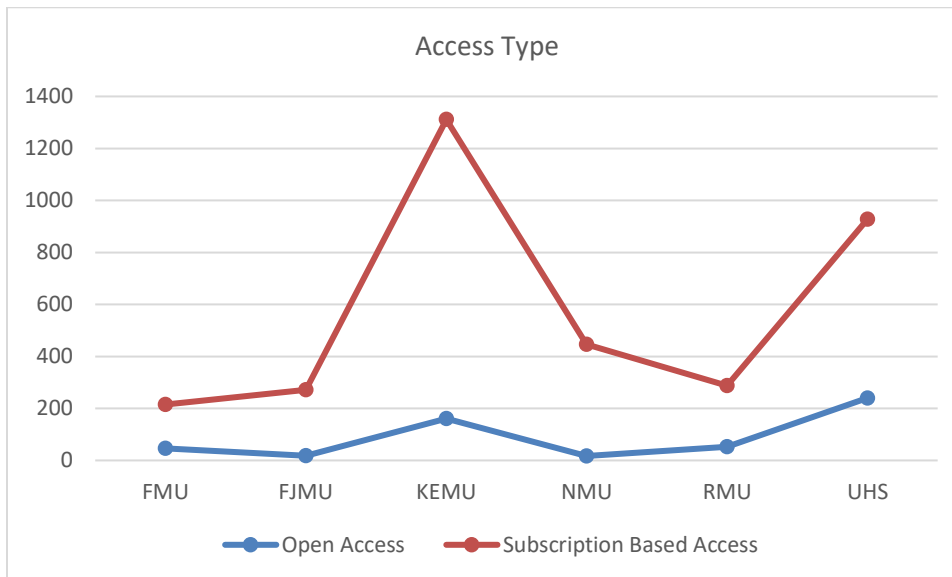Figure 6 KEMUs collaboration in other countries.



Figure 7 shows preferred access types

Data indicates that researchers in all the studied medical universities preferred to publish their research in subscription based journals. UHS published 25% of its publications in open access, the highest in the group opting open access category. FMU follows the UHS with 21% of its research output published in open access journals. NMU gave the lowest preference to publish its research in open access journals with less than 4% of its research published in open access category.

To know KEMU's position at national level we extracted data of best performing public sector medical universities of Pakistan. Despite leading in public sector universities of Punjab in terms total number of publications and citations, the university is lagging behind Dow University of Health Science in Sindh province of Pakistan. Tables 4 shows KEMU's place at national level in

comparison with the best performing medical schools of other provinces and administrative areas of Pakistan. The data was not available in Scopus database for the public sector medical institutes of the missing provinces and administrative areas in the table.

| University | Province/Administrative Area | No of Research Publications | Citations | h-index |
|---|---|---|---|---|
| Pakistan Institute of Medical Sciences | Islamabad Capital Territory | 713 | 6398 | 35 |
| Khyber Medical University | Khyber Pakhtunkhwa | 1103 | 3744 | 27 |
| King Edward Medical University | Punjab | 1311 | 9885 | 44 |
| Dow University of Health Sciences Pakistan | Sindh | 2731 | 18206 | 45 |

Table 4 shows KEMU's position in public sector medical institutes at national level.

**Conclusion and Recommendations:**

The results of this study are based on the research publications data of studied universities and represent only a part of total quality of each studied university. Considering total number of research publications and citations, KEMU is ahead of all the public sector medical universities of Punjab, Pakistan. A sharp rise in publications output is observed in the 2$^{nd}$ decade of 21$^{st}$ century. The university recorded very low research output until the beginning of 21$^{st}$ century.

Researchers in medical universities of Punjab prefer to publish their research in local journals. The five most preferred journals by each university are published locally. None of these five most preferred journals fall in the upper two quartiles of Web of Science and Scimago journal rankings. The study revealed that self-citations do not have broad adverse impact on the bibliometrics of studied medical universities of Punjab province of Pakistan.

Majority of Pakistani journals in medical and allied fields are not indexed in Web of Science, Scopus, Medline and other widely used indexing services, consequently, resulting in poor visibility of published research. The medical journals being published in Pakistan need to improve their quality to be indexed in international indexing databases. Authors of KEMU and other medical schools of Pakistan need to publish their research in good quality journals for better visibility and impact.

**References**

Abolghassemi Fakhree, M. A., & Jouyban, A. (2011). Scientometric analysis of the major Iranian medical universities. *Scientometrics*, *87*(1), 205–220. https://doi.org/10.1007/s11192-010-0336-z

Anwar, M. A., & Saeed, H. (1999). Pakistani librarians as authors: a bibliometric study of citations in LISA-PLUS. *Asian Libraries*, *8*(2), 39–46. https://doi.org/10.1108/10176749910257623

Bajwa, R. S., & Yaldram, K. (2013). Bibliometric analysis of biotechnology research in Pakistan. *Scientometrics*. https://doi.org/10.1007/s11192-012-0839-x

Baladi, Z., & Umedani, L. V. (2017). Pakistan Journal of Medical Sciences: A bibliometric assessment 2001-2010. *Pakistan Journal of Medical Sciences*, *33*(3), 714–719. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5510133/

Brown, T., Ho, Y.-S., & Gutman, S. A. (2018). A Bibliometric Analysis of Peer-Reviewed Journal Publications by British Occupational Therapy Authors. *The Open Journal of Occupational Therapy*, *6*(1). https://doi.org/10.15453/2168-6408.1369

Carnegie Foundation for the Advancement of Teaching, T. (2001). *The Carnegie Classification of Institutions of Higher Education*.

Chinchilla-Rodrı´guez, Z., Zacca-Gonza´lez, G., Vargas-Quesada, B., & Moya-Anego´n, F. (2015). Latin American scientific output in Public Health : combined analysis using bibliometric , socioeconomic. *Scientometrics*, *102*, 609–628. https://doi.org/10.1007/s11192-014-1349-9

Farooq, R. K., Syed, Z., & Zulqernain, A. (2019). Bibliometric review of mental health research in medical colleges of Pakistan. *Sultan Qaboos University Medical Journal*, *19*(3), e242–e247. https://doi.org/10.18295/squmj.2019.19.03.011

Ghaffar, A., Zaidi, S., Qureshi, H., & Hafeez, A. (2013, June). Medical education and research in Pakistan. *The Lancet*. Lancet Publishing Group. https://doi.org/10.1016/S0140-6736(13)60146-4

Herciu, I. (2016). *Pakistan: Another BRIC in the Wall*.

Hoodbhoy, P. (2009). Pakistan's higher education system - What went wrong and how to fix it. *Pakistan Development Review*, *48*(4), 581–594. https://doi.org/April 10, 2015

How are CiteScore metrics used in Scopus? - Scopus: Access and use Support Center. (n.d.).

Howaidi, A., Howaidi, J., & Howaidi, H. (2017). Publication output of Riyadh government hospitals: A bibliometric analysis 2006–2016. *Journal of Health Specialties*, *5*(4). Retrieved from http://www.thejhs.org/article.asp?issn=2468-6360;year=2017;volume=5;issue=4;spage=199;epage=205;aulast=Howaidi

Hussain, A., Jan, S. U., Ibrahim, M., Salam, A., & Saeed, S. (2019). Statistical Analysis of the Journal of Saidu Medical College, Swat, Pakistan | Hussain | Journal of Saidu Medical College. *OURNAL OF SAIDU MEDICAL COLLEGE*, *9*(1).

Ibrahim, M., & Jan, S. U. (2015). Bibliometric analysis of the Journal of Pakistan Medical Association form 2009 to 2013. *Journal of Pakistan Medical Association*, *65*(9), 978–983.

Jan, S. U. (2013). Collaborative Research in Economics in Pakistan : The Case of Pakistan Development Review from 1973 to 2009.

Javed, S. A., & Liu, S. (2018). Predicting the research output/growth of selected countries: application of Even GM (1, 1) and NDGM models. *Scientometrics*, *115*(1), 395–413. https://doi.org/10.1007/s11192-017-2586-5

Javed, Y., Ahmad, S., & Khahro, S. H. (2020). Evaluating the Research Performance of Islamabad-Based Higher Education Institutes. *SAGE Open*, *10*(1), 215824402090208. https://doi.org/10.1177/2158244020902085

Kazakis, N. A., Diamantidis, A. D., Fragidis, L. L., & Lazarides, M. K. (2014). Evaluating the research performance of the Greek medical schools using bibliometrics, 1367–1384. https://doi.org/10.1007/s11192-013-1049-x

Khattak, S. G. (2009). *Research in Difficult Settings: Reflections on Pakistan and Afghanistan.*

Mahbuba, D., & Rousseau, R. (2010). Scientific research in the Indian subcontinent: selected trends and indicators 1973–2007 comparing Bangladesh, Pakistan and Sri Lanka with India, the local giant. *Scientometrics*, *84*(2), 403–420. https://doi.org/10.1007/s11192-010-0203-y

Mahmood, K., & Shafique, F. (2010). Changing research scenario in Pakistan and demand for research qualified LIS professionals. *Library Review*, *59*(4), 291–303. https://doi.org/10.1108/00242531011038596

Mufti, S. A. (2003). Capacity-Building in Bio-Medical Research in Pakistan. In H. A. Khan, M. M. Qurashi, T. Hussain, I. Hayee, & Z. H. Siddiqui (Eds.), *Capacity Building for Science and Technology* (pp. 57–63). Islamabad: COMSATS. Retrieved from http://www.comsats.org/Publications/Books_SnT_Series/01. Capacity Building for Science and Technology (May 2003).pdf#page=63

Mushtaq, A., Abid, M., & Qureshi, M. A. (2011). Students ' Corner Original Article Assessment of research output at higher level of educaton in Pakistan, 628–632.

Mushtaq, A., Abid, M., & Qureshi, M. A. (2012). Assessment of research output at higher level of educaton in Pakistan. *Journal of the Pakistan Medical Association*. https://doi.org/10.1371/journal.pmed.0020322

Naseer, M. M., & Mahmood, K. (2009). Use of bibliometrics in LIS research. *Libres*, *19*(2).

Nasir, S., Ahmed, J., Asrar, M., Of, A. G.-I. J., & 2015, U. (2015). A bibliometric analysis of pharmacy/pharmacology research in Pakistan. *International Journal of Pharmacology*, *11*(7), 766–772.

Osama, A., Najam, A., Kassim-Lakha, S., Gilani, S. Z., & King, C. (2009). Pakistan's reform experiment. *Nature*. https://doi.org/10.1038/461038a

Pakistan Health spending as percent of GDP - data, chart | TheGlobalEconomy.com. (n.d.).

Shehatta, I., & Mahmood, K. (2017). Bibliometric patterns and indicators of research collaboration of Egyptian health scientists :, *22*(2), 45–65.

Smith, R. (2002). Publishing research from developing countries. *Statistics in Medicine*, *21*(19), 2869–2877. https://doi.org/10.1002/sim.1291

Warraich, N. F., & Ahmad, S. (2011). Pakistan Journal of Library and Information Science: A bibliometric analysis. *Pakistan Journal of Library and Information Science*.

Warriach, N. F., & Tahira, M. (2014). Impact of Information and Communication Technologies on Research Development: A Case of University of the Punjab-Pakistan. *PAKISTAN*

*JOURNAL OF INFORMATION MANAGEMENT & LIBRARIES*, *15*, 47–53.

Zyoud, S. H., Zyoud, S. H., Al-jabi, S. W., Sweileh, W. M., & Awang, R. (2016). Contribution of Arab countries to pharmaceutical wastewater literature : a bibliometric and comparative analysis of research output. *Annals of Occupational and Environmental Medicine*. https://doi.org/10.1186/s40557-016-0117-0