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IS4250 Healthcare Analytics

Course Project

Group: Project Group #15

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Abstract:

In this report, we discuss the paper our team has chosen to study. We discuss its contributions to the field of health, and the methodology. Some issues and limitations of the study were also discussed. These include the use of impact factor, small sample size. One experimental plot is also replicated using RStudio.

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1. Introduction

For this project our team researched for various articles before choosing a suitable paper for discussion. The paper that our team will analyse in this report is a review article from the Journal of Experimental and Clinical Medicine, published by Elsevier Taiwan LLC. This paper is titled ‘A Bibliometric Study on Second-generation Antipsychotic Drugs in the Asia-Pacific Region’ (López-Muñoz et al., 2014). The paper analysed the changes in the research on second-generation antipsychotic drugs (SGAs) in the Asia-Pacific region, and performed a bibliometric study of the literature in this region on atypical antipsychotic drugs (AAD) (e.g., clozapine, olanzapine, ziprasidone, quetiapine).

The authors made several important contributions which would be discussed in the report. The methodology the article’s authors use will also be mentioned. Contributions of this paper to the field of health would also be highlighted. Some issues and limitations of the study will also be addressed. A replication of one experimental plot using RStudio is also mentioned in this report and comparisons with the original graph in the article are also evaluated.

2. Contribution of the paper to the field of health

Research shows that 1 in 5 American adults take psychiatric drugs such as antidepressants, antipsychotics and anti-anxiety drugs (CCHR International, 2016). While these drugs have side effects, SGAs are less likely to cause motor control disabilities in patients who use them as compared to the first-generation or typical drugs which are more commonly used. Nonetheless, only a few SGAs are more effective than typical drugs.

Firstly, the paper mentioned the exponential growth of scientific literature on SGA drugs, crediting the increase in antipsychotic drugs over the past 20 years to the clinical introduction of many SGAs. As a result of the SGAs being available and approved to treat medical conditions like bipolar disorder (BP), there has been an increase in scientific production in Asia-Pacific. Due to this close correlation between bibliometric data and prescription data of the SGAs, it would be reasonable to note that this article shows the importance of scientific research and the use of these drugs. These could potentially help more psychotic patients suffering from medical conditions which can be treated with use of SGAs and pose less side effects to them. It must be noted that the ideal drug is still not found, and it is largely through research which better drugs can be introduced.

This article also focused on the relation between the country's health and R&D spending with her research production. It was observed that higher spending on health and R&D leads to a higher research production. This finding may encourage more countries to increase spending on health and R&D, thus increasing the research production. This also seems to have a spillover effect in the field of health, as illustrated by the mention of Japan in this article, which is a good example for others to follow. Japan has the highest PI/per capita health expenditure and she has also developed 5 SGAs. With mental health an important concern and the high rates of schizophrenia in Japan, these SGAs have improved the quality of life of psychotic patients and have contributed to weakening stigmatization against schizophrenia (López-Muñoz & Álamo, 2011).

This article also provided a summary of SGA research in the health industry at the current stage. Countries can have a holistic overview about the development of SGAs research and compare themselves with other countries.

3. Methodology

The countries chosen for this study were Japan, Australia, South Korea, Taiwan, Hong Kong and Singapore. They used EMBASE Biomedical Answer web database to collect their data and their criteria was as follows:

- Year of publication until 2011,
- Keywords in author's field contained any of the 6 countries chosen for the study,

- Title field contained atypical, second-generation antipsychotic, etc

The authors applied Price's Law, one of the bibliometric indicators in this study, to analyse the productivity of scientific literature by fitting exponential growth models. Before they used Price's Law for further analysis, the authors decided to examine whether the expansion of scientific production on SGAs followed Price's Law by fitting the data into both linear and exponential equation:

- Linear regression => r = 0.8149
- Exponential curve => r = 0.8978

Since the exponential equation obtained a stronger correlation coefficient (r = 0.8978) and smaller variance (4.91%) of unexplained results, they concluded that exponential curve was more fitted to the analysed database than a linear fitting.

Bradford's Law was also used to assess the exponentially diminishing returns of scientific literature on SGA drugs in a Bradford zone. This model could identify the most widely used journals or the greatest weight scientific production in this field.

Another indicator applied in this article is impact factor (IF) which has been used to measure the quality of scientific contributions. They counted average number of citations in a journal within a certain period of time to compare with other journals within the same field. It is the most widely used way to evaluate the clinical and social relevance through quantitative analysis.

The authors used the national participation index (PI) of the studied countries, which was the ratio of number of publications in that country over total number of publications on SGAs topic obtained. By using PI, the authors not only compared the contribution of a particular country with the global PI in the psychiatry and neurology field, also correlated with several socioeconomic factors such as per capita health expenditure and the gross domestic expenditure on R&D in that country.

4. Issues & Limitations

In this section, we discuss some of the issues and limitations that could impact the study conducted by the authors. The results obtained in the study may be affected as a result.

4.1. Use of Impact Factor

One particular issue is the choice of impact factor that the authors use to analyse the quality of scientific production. It is assumed that journals with higher impact factor publish articles which are cited more often, as compared to journals with lower impact factor. Impact factor allows direct comparison between journals in the same field or discipline. Impact factor is one of the bibliometrics indicators in this study which reflects the average number of citations received by recent paper published in the source journal of the Science Citation Index (SCI) within a certain period of time. This means that more times the paper is cited equals more impact that paper can make, instead of how well the paper has been utilised. The impact factor is also affected by the age of the article in the journal - if the journal's article is older, it has a higher chance to be cited. Impact Factor counts all citations equally without measuring the quality of scientific publications. Simkin & Roychowdhury, 2002, estimated that only about 20% people who cited a paper had actually read it.

Moreover, there are several reasons that an author chose to cite the paper, such as reference to a particular methodology, indication of similar work has been done, or even using as a bad example of mistaken result or methods. As a result, it does not measure how impactful the scientific contributions of the paper have been made to this particular field or the entire society, in terms of improving patient outcomes and significant discovery of SGAs. Furthermore, journal impact factor does not reflect the difference in article citation rates, as it is observed that articles in the most cited half of articles in a journal are cited 10 times as often as the least cited half (Seglen, 1997). Hence, the result obtained in the study might not be reliable due to the use of the impact factor to assess the quality of scientific production.

4.2. Appropriate Number of Publications

The term bibliometrics indicator is essentially used for the results of a bibliometrics study which provides quantitative analysis of published literatures in the journal. This means that researchers have to deal with a vast number of publications and citations in the database to ensure a highly reliable statistical analysis of the data is possible. Gathering large sample sizes can also be a challenging task and it may be difficult to gauge an appropriate sample size (Williams & Bornmann, 2014). Additionally, the large majorities of the scientific papers are seldom or never have been cited at all in the scientific literature, while there are some papers that earn an extremely large number of citations. If the number of citations is not sufficient, as a result, it will not ensure the high representativeness, reliability, and statistical robustness of citation-based indicators. Moreover, insufficient number of publications will incur large variances in the result, if one or a few numbers of publications are not collected in any case. Therefore, a large number of publications is required to apply for bibliometrics indicators in order to yield reliable and relatively unbiased statistical value.

4.3. Issue of Coverage

In this article, the authors used the publications in the EMBASE Biomedical Answer web and confined the year of publication until 2011. Although EMBASE is a comprehensive biomedical and pharmacological database which consists of over 29 million records and widely covered from 90 countries, the authors did not extract the data from the outside databases such as PubMed, Web of Science, EBSCO, etc. Moreover, both EMBASE and bibliometrics study are only applied to the published journals, rather than covering the unpublished journals and non-journal printed works such as books, reports, and theses. In addition, international study in any particular field, in this case is the study on SGAs, is much more extensive than what has been stored in databases, because many contributions were coming from scientific conferences and meetings instead of indexed in such databases. Hence, due to lack of coverage from external databases, it might affect the accuracy of the findings of bibliometrics studies.

4.4. Language Bias

The international visibility of scientific production is highly dependent on the language the article is published in. English, as the world's common language, is the important language for researchers and writers to communicate about scientific productions. According the table from MEDLINE (Fig.1), it shows that the number of citations to English language articles is more than 13 times of non-English language articles (MEDLINE®, 2016) This means that English language publications are more favoured by researchers to cite or there are tremendous number of English language publications than the non-English language publications. In this study, among the six studied countries, only Australia and Singapore are major English speaking countries, who are most likely to publish English language articles. In addition, USA and UK, the two major English-speaking countries, are the top 2 most productive counties in biomedicine and health sciences mentioned in this article. Despite other factors such as longer psychiatric development history and large health expenditure, one reason they have high PI is because of documents published in English language and they origin from English-speaking countries. Researchers from the other four non English-speaking countries may write their articles in their own local languages, but these publications might receive less citations due to language bias. Articles published in English would be more visible in EMBASE database. Therefore, language bias due to selection of English-only articles is one of the limitations of this study.

Years of Publication	Total # Records	# English (%)	# Non-English (%)	# with Abstracts (%)[2]
2010-2014*	3,401,633	3,170,087 (93%)	231,546 (7%)	2,868,497 (84%)
2005-2009	3,291,017	2,979,110 (91%)	311,907 (9%)	2,721,314 (83%)
2000-2004	2,639,770	2,355,257 (89%)	284,513 (11%)	2,077,941 (79%)
1995-1999	2,176,977	1,908,815 (88%)	268,162 (12%)	1,638,803 (75%)
1990-1994	1,974,261	1,652,150 (84%)	322,111 (16%)	1,438,812 (73%)
1985-1989	1,743,598	1,349,608 (77%)	393,990 (23%)	1,067,712 (61%)
1980-1984	1,439,097	1,069,015 (74%)	370,082 (26%)	724,310 (50%)
1975-1979	1,288,878	894,339 (69%)	394,539 (31%)	533,453 (41%)
1970-1974	1,107,927	694,176 (63%)	413,751 (37%)	40,394 (4%)
1965-1969	948,090	517,415 (55%)	430,675 (45%)	20,403 (2%)
1960-1964**	616,359	298,638 (48%)	317,721 (52%)	7,982 (1%)
1955-1959**	443,785	208,955 (47%)	234,830 (53%)	2,228 (1%)
1950-1954**	452,170	206,621 (46%)	245,549 (54%)	1,301 (<1%)
pre-1950**	170,906	107,389 (63%)	63,517 (37%)	432 (<1%)
Totals* **	**21,694,483**	**17,411,590 (80%)**	**4,282,893 (20%)**	**13,143,597 (61%)**

Fig.1 - Table from MEDLINE

4.5. Limited Licensed and Available SGAs

Drugs regulation is the control of drug used by regulatory authorities in different countries such as US Food and Drug Administration, the Japan Pharmaceutical and Medical Devices Agency. Each authorisation needs to concern about the side effects, efficiency, and quality of each intended licensing drugs, and this assessment is varying from country to country. This article mentioned that there are two factors that limit the productivity of scientific production in particular counties. During the period of study, there were only 9 SGAs had been licensed in Hong Kong. Less available drugs that can be studied within the counties will result in less scientific production on the basis of volumes. One of the major findings in this paper concludes that the number of scientific literature is growing over the years, measured by using Price’s Law. However, Hong Kong was an outlier, which we feel may be attributed to the few limited SGAs available there.

This limitation is also applicable to Japan. Although Japan is more interested in mental health research and she has the highest participation index among the other countries in Asia, the weight of SGA research over the psychiatric research in general is relatively lower. The main reason is because Japan has a longer regulatory process period in order to license new drugs or approve new indications for a drug. The delay of issuing drugs may affect the progress of scientists who are willing to do a research on the new SGAs, which results in inaccurately determining the contributions or the interest in SGA research when authors conduct bibliometric studies on SGAs.

4.6. Use of gross domestic product - GDP Statistics

The article uses the GDP statistics of the countries, in particular the per capita GDP. While they are useful to compare between countries, they may not display the true value of a country. There are also various disadvantages of using per capita GDP to compare among countries (BUCK, 2008). Hence, this may impact the correlation of the per capita GDP with the PI-AAD.

5. Replication of one experimental plot using RStudio

Our team decided to replicate Figure.5 from the review article paper (article page 5), which shows the relationship between the production of scientific literature on SGAs and gross domestic product (GDP) per capita of some chosen countries in the Asia-Pacific region. The figure in the article is shown in Appendix A. While the paper mentions the GDP per capita was obtained from the World Health Organization's website, the production of scientific literature on SGAs was obtained from the column 'SGAs (%)' of Table 2 (article page 4).

Following that, our team also obtained GDP per capita in international dollars for the countries discussed in the paper. The paper did not include the United States in the

Figure.5 to give a clearer reflection of the rest of the countries. The PI-AAD data was obtained from the column ‘SGAs (%)’ of Table 2 in the article. Next, our team created a csv file which consisted of 4 columns - Country Name, Country, PI-AAD and GDP per capita. We then used RStudio to replicate this plot, firstly by importing the csv file containing the dataset into RStudio. Next, for the purpose of replicating this plot, we imported the relevant library (ggplot2). The y-axis shows the GDP per capital of the country, while the x-axis shows the PI-AAD. We then piloted a graph of the data points and then labelled the data points with the corresponding country. To make our plot similar to the one as shown in Figure.5, we also changed the x, y axes sequences. Finally, we added a regression line and changed the x and y axes labels to the names shown in Figure.5. The plot obtained is shown below (Fig.2).

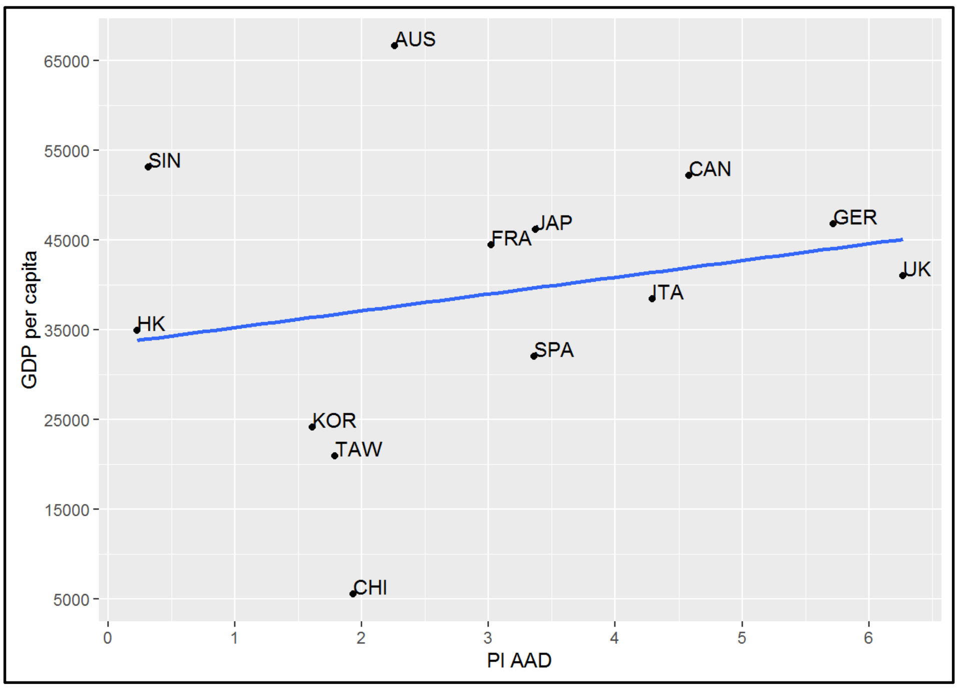


Fig.2 - Relationship between GDP per capita and PI-AAD (obtained from RStudio)

5.1. Comparison with the original graph from the article

While we ensured that the graph we replicated is same as the figure shown in the article, we realised that there were some discrepancies which may cause the graph to differ slightly from the one in the article. Firstly, the x-axis data was the PI-AAD as shown in Fig.3 (taken from the article), which shows Japan having a higher PI-AAD of 3.37 than France which has a PI-AAD of 3.02, however the figure in the article (Appendix A) showed Japan on the left on France with respect to the x-axis, signalling Japan having a lower PI-AAD. Our graph (Fig.2) correctly displays the data plots, as we use the data from the table and Japan has a higher PI-AAD than France, hence it is on the right side of France with respect to the x-axis.

Country	%	Psychiatry–Neurology† (%)	SGAs (%)
USA‡	25.84§	35.58	29.11
UK‡	7.35§	9.90	6.27
Japan‡	6.59§	6.81	3.37
Germany‡	6.29§	7.91	5.72
France‡	4.53§	4.93	3.02

Fig.3 - Table of PI-AAD

The second bone of contention that may have resulted in some data plots not appearing at the same spots in Fig.2 as compared to the original figure from the article could be attributed to the per capita GDP data (y-axis) used. The article mentioned the data used was expressed in international dollars, but the year of the per capita GDP used was not explicitly mentioned. Hence, our team used various resources, such as World Bank and the online Knoema database (http://knoema.com/). We gathered data from 2011, 2012 and 2013, given that the article uses the 2011 journal impact factor and was published in 2014. We realised that the 2011 figures were the most appropriate and closest to the ones shown in the graph of the article. However, the article has not mentioned the exact figures and hence, our graph (Fig.2) may not be an exact replication, due to the lack of relevant data to plot the graph.

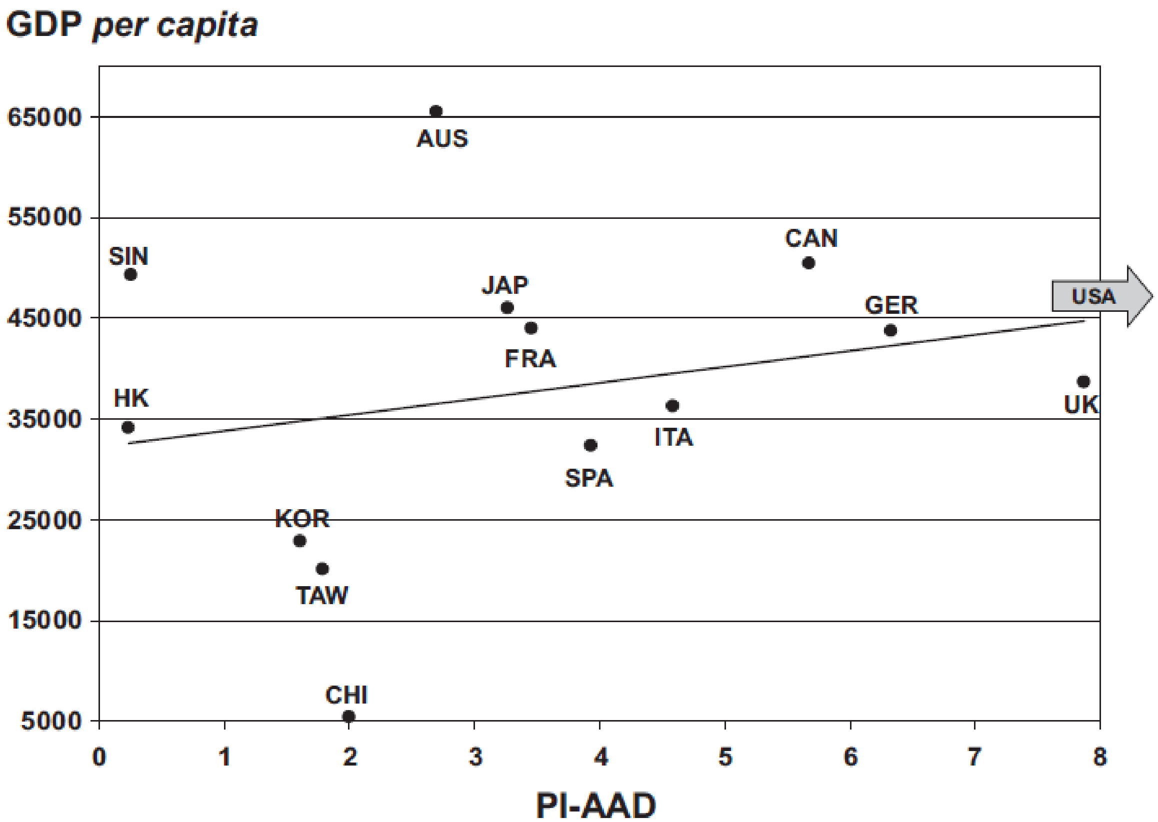
6. Conclusion

In conclusion, our team has discussed about the article we have chosen to study its contributions in the field of health. The data methodology was also discussed. We have also argued that the use of impact factor may be questionable among other issues and limitations like small sample size. An experimental plot using RStudio has also been replicated and it has been compared with the original figure in the article.

While we have mentioned the limitations of this study, it may be good to note that using bibliographic studies provide objective evaluations and are also prone to less human error or bias. These enhance the reliability of the results obtained. Use of bibliographic indicators, based on citations are increasingly popular, similar to the use of impact factor in this article studied (G, 2016). Future recommendations could include using other bibliographic indicators like the Scimago Journal Rank to consider the quality of scientific contributions as it uses a weighted citation score in a 3-year count window, where citations from a prestigious journal are given higher scores than others with a smaller citation network, which may be more precise. Another way to judge the quality of publication could be through obtained through expert surveys, where experts in the field are asked to rank the scientific publication. Using a combination of both bibliographic indicators and expert surveys may offer a more complete view into the quality of scientific production (Serenko & Dohan, 2011).

7. Appendix

7.1. Appendix A - Graph from the Article



7.2. Appendix B - Source Code

```
# choose and read csv file
dataset = read.csv("C:\\Users\\user\\Desktop\\data.csv")
# view dataset
knitr::kable(dataset)
```

Country.Name	Country	PI.AAD	GDP.per.capita
UK	UK	6.27	40981
Japan	JAP	3.37	46202
Germany	GER	5.72	46822
France	FRA	3.02	44430
China	CHI	1.93	5561
Italy	ITA	4.29	38412
Canada	CAN	4.58	52145
Spain	SPA	3.36	32009
Australia	AUS	2.26	66604
South Korea	KOR	1.61	24156
Taiwan	TAW	1.79	20912
Hong Kong	HK	0.23	34941
Singapore	SIN	0.32	53122

```
#import relevant library
library(ggplot2)
# plot graph of the data points
a <- ggplot(dataset,aes(x=PI.AAD,y=GDP.per.capita))+geom_point()
# label the data points with the country name
a <- a+geom_text(aes(label=dataset$Country),hjust=0, vjust=0)
# change the x, y axes sequences
a <- a+scale_x_continuous(breaks=seq(0,6,1))+scale_y_continuous(breaks=seq(5000,65000,10000))

# add regression line
a <- a+geom_smooth(method="lm", se=FALSE)

# change x,y axes labels
a <- a+xlab("PI AAD")+ylab("GDP per capita")
plot(a)
```

8. References

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