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Comparisons of citations among clusters of medical subject headings using visualizing topic burst on neuropsychiatry: a bibliometric analysis

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Abstract

Background: PubMed is a primary source of biomedical information comprising search tool function and the biomedical literature from MEDLINE. A new method using Medical Subject Headings (MdSH) is needed for searching the knowledge in the neuropsychiatry field.

Methods: A new method is proposed in this study for visualizing the recent research trends based on the retrieved MeSH terms corresponding to a search query given by the user. MeSH terms are extracted from Pubmed Central (PMC) based on the keyword of neuropsychiatry [All Fields] through a series of calculations on correlations between terms using Social Network Analysis (SNA). We illustrated four bibliometrics to compare differences among MeSH clusters and verified whether article types might be disparate regarding MeSH terms and citations. We programmed Microsoft Excel VBA routines to extract data. Google Maps and Pajek software were used for displaying graphical representations.

Results: We found that (1) the dominant nation on the topic of neuropsychiatry is the US; (2) the MeSH terms of neuropsychiatry, diagnosis, and physiopathology gain the top degree centralities based on SNA; (3) the Mesh term of physiology owns the highest metrics with Impact Factor (IF)=30.37, h-index=6, and x=14.97, respectively; (4) differences were found significantly among MeSH clusters on neuropsychiatry ($p<0.05$) using 95% confidence intervals of the bootstrapping method; (5) the article(PMID=2190539) published in 1990 was cited most (with 285 times and two MeSH term of diagnosis and psychiatric status rating scales.

Conclusions: The application of the MeSH cluster analysis, which could be used as a "guide map for travelers," allows users to quickly and easily acquire the knowledge of research trends. Combination of PubMed and MeSH citations is expected to be an effective complementary way for the researchers in the biomedical field experiencing difficulties with search and information analysis.

Keywords: h-plus index; Medical subject headings; Google Maps; Social network analysis, Neuropsychiatry; Bibliometric analysis

Introduction

Neuropsychiatry is a branch of medicine that deals with mental disorders attributable to diseases of the nervous system. It needs the current disciplines of psychiatry and neurology trained in clinical settings [1]. However, psychiatry and neurology have subsequently split apart and are typically practiced separately.

As of January2, 2019, more than 20,795 papers were published on Pubmed.com by searching the keyword neuropsychiatry and 3,222 in the paper title including neuropsychiatry, which presents the importance of author collaborations in academics in the past. On the journal perspective, the Journal of neuropsychiatry has published 40 articles from 1952 to 2018 in Pubmed Central (PMC).The most productive and cited authors have been reported [2-4] in other disciplines. The topic burst in recent years on neuropsychiatry is still unknown.

Given the importance of neuropsychiatry, many scientific researchers [5-7] have focused on reviewing related literature to identify the characteristics and status of neuropsychiatry in recent years. However, much of these efforts were only considering specific subfields of neuropsychiatry, with conclusions being drawn from the descriptive analysis, systematic reviews, and medical subject headings (MeSH) [8-10]. Even some [11-13] have conducted citation analyses on articles related to neuropsychiatry; none reports topic burst incorporated with citations on neuropsychiatry until now.

Papers on the bibliometric perspective of neuropsychiatry research can provide readers with methods of analyzing data of scientific literature quantitatively and then gain knowledge of the meta-information related to the research in question [14,15]. The combined use of methodologies that give information on different aspects of scientific output is generally recommended [16]. Also, discussion relating to the collaborative status and overall topic burst on neuropsychiatry remains relatively scarce.

We are thus interested in following four topics: (1) which nations was dominant in the field of neuropsychiatry; (2) which medical subject headings (MeSH) were cited most by papers in the past years; (3) is any difference in scientometricsamong MeSH clusters; (4) which article was cited most in the past.

We aim to apply h-plus index that can effectively improve the h-index [17] in bibliometric analyses [18,19] and investigate the four questions mentioned above. Google Maps will be applied to the study results as dashboards in an interactive way.

Methods

Data Sources

We programmed Microsoft Excel VBA (visual basic for applications) modules to extract abstracts and their corresponding coauthor names as well as the countries/areas of the first authors for each article on January 2, 2019, from PMC based on the keyword of neuropsychiatry [Title].Only those abstracts published In PMC and labeled with Journal Article were included. Others like those labeled with Published Erratum, Editorial or without author nation name were excluded from this study. A total of 1,526 eligible abstracts were obtained from PMC.

A total number of 212 citing articles matching to the 505 citable papers were attained. The number of152articleswere quoted by at least one publication. The overall impact factor of 4.62 (=2335/505) was obtained. All data were downloaded from PMC, which means the study is not necessary for ethical approval according to the regulation promulgated by the Taiwan Ministry of Health and Welfare.

The MeSH weighted scheme and the h-plus index used for quantifying citations

Referring to the weighted impact factor equation [2,3,20] in Eq.(1):

$$F = \frac{\sum Cited.papers.based.on.W_i}{\sum Citable.papers.\times W_i.in.the.given.yrs} = \frac{weighted.citations}{weighted.publications} \quad (1)$$

The weight is defined by the Eq.(2) $W_i = \sum_{i=1}^{n} \frac{c_i}{n_i}$), as for where ni as the number of authors of i-th publication(i.e., equal size to coauthors) and ci as the citations of i-th publications collected by searching PMC. Like other indices, such as h-index [18], g-index [21], and x-index [22] assumed all coauthors are contributing equally with a weight (=1.0) in an article byline. We define the MeSH weighted scheme as Eq.(2) and $W_i = \sqrt{\sum_{i=1}^{n} \frac{p_i}{n_i}}$ Eq.3, for citations and publication outputs, respectively, where pi as publications on the i-th article.

The h'-index [18] can be divided into three parts [18,19]. The ratio (=rh=excess citations/tail parts=eh/th) can be defined as authors with perfectionists (>1.5), the prolific (>0.5), and the productive (≤0.5) [18,19]. We applied the ratio, named rh for short in this study, as h-plus index (=h+rh/(1+rh)) to complement the h-index unable to discriminate well rankings of authors (or MeSH terms in this study) due to many identical integers occurred to the authors. Also, Ag, derived from g-index, means the average onto the g core articles and MeSH Impact Factor (MIF) as defined as Eq.1 were incorporated with h and x indexes for comparing differences among MeSH clusters.

Social network analysis using Pajek software

In keeping with the Pajek guidelines [23] using Social Network Analysis (SNA), we defined a MeSH term as a node (or an actor) that is connected to another counterpart at another node through the edge of a line. Usually, another weight is defined by the number of connections between two nodes.

Graphical representations to Report

A visual display with the publication outputs labeled by the1st author nations was made for presenting the distribution of nations on anesthesiology. The quantity is colored by the size of publications. The most cited MeSH terms sized by MIF and colored by L-index were shown based on both axes (i.e., x-index on the x-axis and h-plus index on the y-axis).

MeSH clusters using SNA to separate

SNA was applied to determine the representative for each cluster. The algorithm of community partition was performed to identify the clusters. Each MeSH was assigned to the cluster represented by the MeSH which was similar to the author analysis being highlighted with the highest degree centrality in the cluster. As such, each MeSH contributes equally proportional parts (i.e., 1/n) in an article and then can be matched to the respective metrics and clusters.

The bootstrapping method [24] was applied to examine differences in metrics among MeSH clusters. A total of 1000 medians retrieved from the median of the 100 random cased were used to estimate the 95% Confidence Intervals (CI) for a metric of a given cluster. As such, the difference can be determined by judging the two 95% CI bands separated from each other.

Creating dashboards on Google Maps

We appliedthe author-made modules in MS-Excel and the SNA in Pajek to gain the MeSH clusters. The pages of Hyper Text Mark-up Language (HTML) used for Google Mapswere created. All relevant bibliometric indices were linked to dashboards on Google Maps.

Results

Task 1: The dominant nations on anesthesiology around the world

The dominant nation on the topic of neuropsychiatry is the US, followed by the UK and Australia (Figure 1).

Task 2: Presenting the most cited MeSH terms on neuropsychiatry

The Mesh term of physiology owns the highest metrics with Impact Factor (IF)=30.37, h-index=6, and x=14.97, respectively. Interested readers are invited to scan the QR-Code in Figure 2 to see the MeSH terms regarding relevant outputs in PMC by clicking the specific MeSH bobble.

Task 3: Selecting the ten top MeSH clusters with high degree centrality

The top 10 MeSH clusters were separated as shown in Figure 3. The representatives with the most Degree Centrality (DC) are shown for each cluster. The term neuropsychiatry earns the highest DC, implying the neuropsychiatry with high h-plus and x-index at the right top

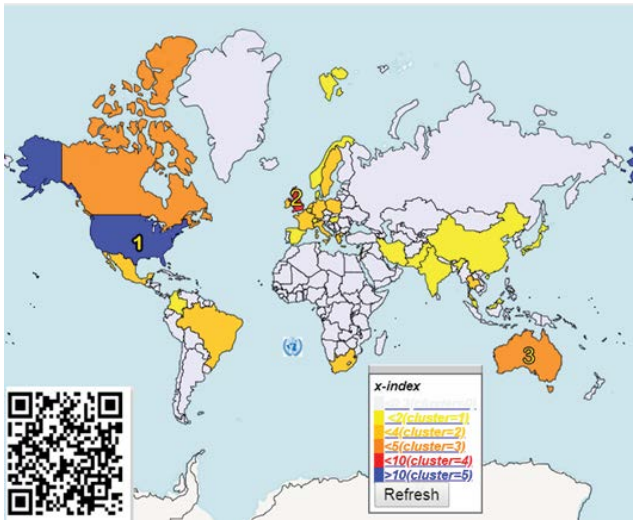

Figure 1: The x-indexes for each nation dispersed on Google Maps.

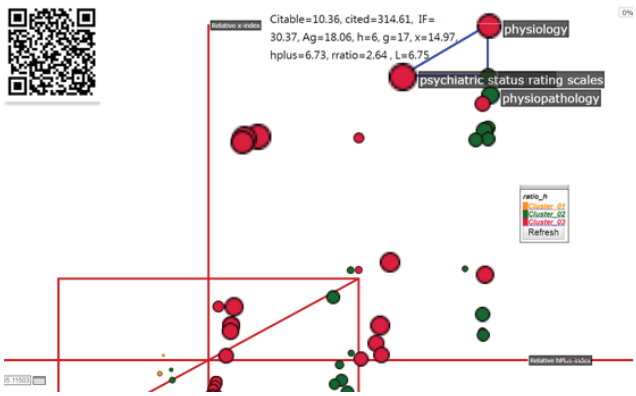

Figure 2: The most cited Mesh terms dispersed on a dashboard.

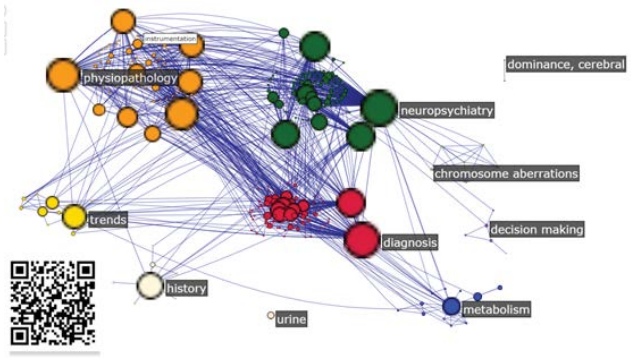

Figure 3: The top ten MeSH cluster separated by the SNA.

position in Figure 3. The interested readers are also recommended to scan the QR-coed in Figure 3 to see the detailed information in PMC by clicking the word of publication when the specific MeSH bubble is selected.

Task 4: Comparisons of differences in metrics among clusters

The differences in metrics (i.e., h-plus, x-index, MIF, and Ag-index) were found ($p < .05$), when any two 95% CI bands were separated from each other. The representative of physiopathology and metabolism place the top two in these four indices among MeSH clusters. In contrast, theMeSH terms of neuropsychiatry and chromosome aberrations rank the bottom in metrics among clusters (Figure 4).

Task 5: The most cited article on neuropsychiatry

The article (PMID=2190539) published in 1990 was cited most(with 285 times and two MeSH term of diagnosis and psychiatric status rating scales [25].

Task 6: The most cited authors on neuropsychiatry

The most cited author was J KWing from England who published a single article in 1990 (PMID=2190539) mentioned above, gained high metrics: Citable=0.63, cited=180.18, AIF=180.18, Ag=180.18, h=1, g=1, x=13.42, h_plus=1.93, rh=13.39, and was cited most (with 285 times and two MeSH term of diagnosis and psychiatric status rating scales [25]. It is worth noting that the Citable=0.63 is derived from the author weighted scheme [2,3] highlighting the more contributions allocated to the first author (i..e, 63% in nine coauthors in an article) (Figure 5).

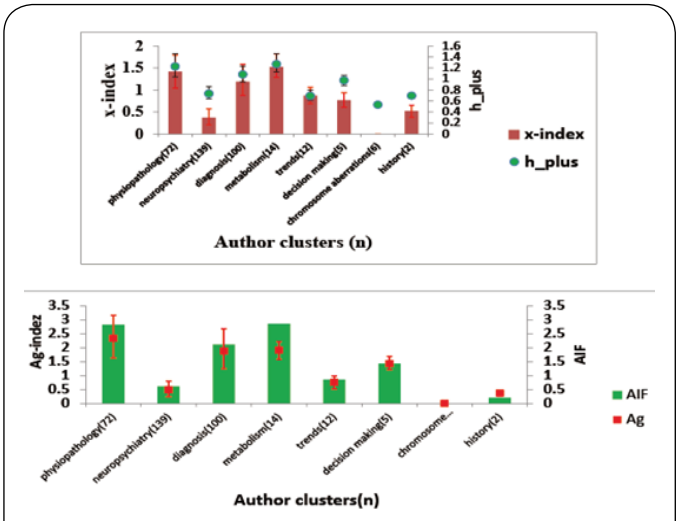

Figure 4: Comparisons of indices among MeSH clusters.

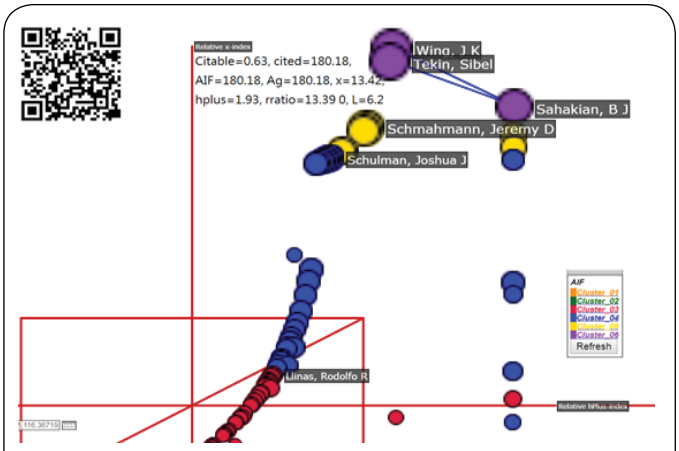

Figure 5: The most cited authors dispersed on a dashboard.

Discussion

We found that (1) the dominant nation on the topic of neuropsychiatry is the US; (2) the MeSH terms of neuropsychiatry, diagnosis, and physiopathology gain the top degree centralities based on SNA; (3) the Mesh term of physiology owns the highest metrics with Impact Factor (IF)=30.37, h-index=6, and x=14.97, respectively; (4) differences were found significantly among MeSH clusters on neuropsychiatry ($p<0.05$); (5) the article (PMID=2190539) [25] published in 1990 was cited most (with 285 times and two MeSH term of diagnosis and psychiatric status rating scales.

Although the h-index [17] being a popular author-level metric that can measure both the productivity and citation impact of the publications of a scientist, one of its short comings is less discriminative power [26] due to many with identical value in an integer unit. Many concepts of bibliometrics have already been proposed in the past [18-22], but we have not seen any that can be applied to the scientific disciplines in use successfully. We propose the one as the h-plus index that can effectively improve h-index with high discriminative power for evaluating authors (or MeSH terms) as we did in this study.

We demonstrated the usage of the h-plus index on neuropsychiatry by using the MeSH terms Weighted Scheme (MWS) for quantifying

contributions among MeSH terms in an article byline, which was never seen in literature before. In Figure 2, we see the MeSH-based x-indexes an h-plus index shown on a dashboard using Google Maps that can be recommended to authors for use in the future.

The bibliometric indices are dependent on the quantity (i.e., the number of publications) and the quality (i.e., the number of articles being cited), which is suitable for use in journal topics like we did as the MeSH terms in this study. In comparison to the author-based bibliometrics [2-3], the MeSH-based metrics gain higher values than the author indices because of a huge amount of frequency relatively occurred in the past years. On the Figures 2 and 3, it is easy to see the topic burst regarding neuropsychiatry since 1944.

Similarly, the x-index [22] on neuropsychiatry in Figure 2 is higher than (or equal to) the h(or h-plus) index due to the inclusion of excessive citations, referring to the reference [22] to see the characteristics of x-index. For instance, ten publications with ten citations each have an identical h-index and x-index at 10(or $\sqrt{10*10}$ for x-index). In contrast, One publication with 100 citations leads to a difference in h-index (=1) and x-index (=10=$\sqrt{1*100}$), and 100 publications with only one citation each have different results in h-index (=1) and x-index (=10=$\sqrt{100*1}$) [17]. The h-plus index as proposed in this study might have a high correlation, theoretically, with x-index than h-index. The most worth-noting is the general MWS fully congruent with the true scenario in practice. That is, the contributions were determined by the weights (=1/n) instead of all with an identical value (=1) no matter the ordering of MeSH terms.

The second feature is the intrinsic dynamic character of the years moving average impact factors, like the Journal Citation Report (JCR) locating JIF each year in June, to examine the change of MeSHIF (or h-plus index). Unlike the h-index, which is a growing measure taking into account the whole career path [17].

The reason we applied x-index in this study is the strength of the index in practice. According to the illustration in the study of Fenner and his colleagues [22], the x-index can truly extend the feature of an author with quality and quantity achievements in academics as mentioned above.

Although findings are based on the above analysis, there are still several potential limitations that may encourage further research efforts. First, all data were extracted from the PubMed database. There might be some biases of understanding the matched MeSH terms because of some different terms with the asterisk represented by major MeSH in the article, which will affect the result of MeSH relationship analysis by the accuracy of the indexing MeSH terms.

Second, many algorithms havebeen usedfor SNA. We merely applied the algorithm of degree centrality in the Figures. Any changes in the algorithm used in this study might present a different pattern and judgment to the results.

Third, the data extracted from PMC cannot be generalized to other major citation databases such as the Scientific Citation Index (SCI; Thomson Reuters, New York, NY, USA) and Scopus (Elsevier, Amsterdam, The Netherlands). Such as the most cited authors are determined by the paper selections on Pubmed.

Conclusion

The application of the MeSH cluster analysis, which could be used as a "guide map for travelers," allows users to quickly and easily acquire the knowledge of research trends. Combination of PubMed and MeSH citations is expected to be an effective complementary way for the researchers in the biomedical field experiencing difficulties with search and information analysis.

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