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RESEARCH ARTICLE

A dashboard on Google Maps to show the most influential author on the topic of health behavior: A Bibliometric Analysis

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Abstract: Background:Health behavior is an action taken by a person to maintain, attain, or regain good health and to prevent illness. As such, health behavior reflects a person's health beliefs and attracts many published papers in academics. However, who is the most influential author (MIA) remains unknown. Objective: The purpose of this study is to apply the algorithm of between centrality(BC) in social network analysis (SNA) to select the MIA on the topic of health behavior using the visual displays on Google Maps. Methods: We obtained 3,593 abstracts from Medline based on the keywords of (health [Title]) and (behavior [Title] or behaviour [Title]) on June 30, 2018. The author names, countries/areas, and author-defined keywords were recorded. The BCs were applied to (1) select the MIA using SNA; (2) display the countries/areas distributed for the 1st author in geography, (3) discover the author clusters dispersed on Google Maps, and (4) investigate the keywords dispersed for the cluster related to the MIA on a dashboard. Pajek software was performed to yield the BC for each entity (or say node). Results: We found that the MIA is Spring, Bonnie (US). All visual representations that are the form of a dashboard can be easily displayed on Google Maps. The most influential country and the keywords are the US and health behavior. Readers are suggested to manipulate them on their own on Google Maps. Conclusion: Social network analysis provides wide and deep insight into the relationships with the pattern of international author collaborations. If incorporated with Google Maps, the dashboard can release much more information regarding our interesting topics for us in academics. The research approach using the BC to identify the same author names can be applied to other bibliometric analyses in the future.

Keywords: Gini coefficient, authorship collaboration, Google Maps, social network analysis, health behavior

1 Introduction

Health behavior is an action taken by a person to maintain, attain, or regain good health and to prevent illness.[1] Health behavior reflects a person's health beliefs. Some common health behaviors are exercising regularly, such as eating a balanced diet, and obtaining necessary inoculations. Even if the signs of Attention deficit hyperactivity disorder (ADHD) are included in the research of health behavior.[2]

As of June 30, 2018, there are 3,593 abstracts in search from Medline based on the keywords of (health[Title]) and (behavior[Title] or behaviour [Title]). Who are the most influential author(MIA) or the most productive author(MPA) remains unknown.

It is hard to find the relationship using the traditional research approach. For instance, we often can only get a sense of our concerned entities independent of each other. This is, when many customers purchase their goods by placing them in a shopping cart, the traditional way to calculate the quantity of each goods instead of analyzing their correlations. An apocryphal story was often told to tell us the concept of co-occurrence that is about beer and diaper sales which usually goes along with a strong correlation on Friday.[3–5] Many data scientists have developed ways to discover new knowledge from the vast quantities of increasingly available information,[6] particularly applying social network analysis (SNA)[7–10] to big data analysis.

Authorship collaboration using SNA is an example illustrated by many authors in recent years[7] because coauthors among researchers form a type of social network.

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Many of those authors[7–10] applied degree centrality to analyze or select their authors of interest. None to date used betweenness centrality(BC) to study their entities. Particularly, the duplicate names in their bibliometric study data might result in biases because some different authors with the same name exist.[10] We thus are interested in using BC to select the MIA on the topic of health behavior and investigating other interesting features such as author countries/areas and the keyword dispersions in clusters.

Google maps have provided users to gain an overall geospatial visualization.[11,12] However, few applied Google Maps to display author collaboration with a dashboard format. Our aims applied the BC algorithm[13,14] to select the MIA and display the pattern of international author collaboration in health behavior by (1)selecting the MIA using SNA; (2)displaying the countries/areas distributed for the 1st author in geography, (3)discovering the author clusters dispersed on Google Maps, and (4) investigating the keywords dispersed for the cluster related to the MIA on a dashboard.

2 Methods

2.1 Data Collection

By searching the PubMed database (Pubmed.org) maintained by the US National Library of Medicine, we used the keywords of (health[Title]) and (behavior[Title] or behaviour [Title]) on June 30, 2018, and downloaded 3,593 articles. The inclusion criteria are all downloaded abstracts based on the type of Journal Article. Ethical approval was not necessary for this study because all the data were obtained from the Medline library on the Internet.

2.2 Social network analysis and Pajek software

Social network analysis (SNA)[15] was applied to explore the pattern of entities in a system using the software of Pajek.[16] In keeping with the Pajek guidelines, we defined an author (or paper keyword) as a node that is connected to other nodes through the edge (or say the relation). Usually, the weight between two nodes is defined by the number of connections.

Centrality is a vital index to analyze the network. Any individual or keyword lies in the center of the social network will determine its influence on the network and its speed to gain information.[13,14,17] The Betweenness centrality(BC) is used in this study.

2.3 The pattern of author collaboration on health behavior

The countries/areas of the 1st author for each published paper were extracted for showing the distribution of countries/areas on Google Maps.

The bigger bubble means the most pivotal role played as a bridge in the network if the BC algorithm is performed. The wider line indicates, the stronger relations between the two (i.e., the nation or the author). Clusters separated by the algorithm of the partition communities are filled with bubbles in different colors.

Similarly, the authors and keywords of medical subject headings(MESH) with the most influential power were extracted by the SNA method and shown on Google Maps. All of which were selected by the top 100 authors first and screened out the largest cluster as the base to define the popular MESH terms, see Figure 1.

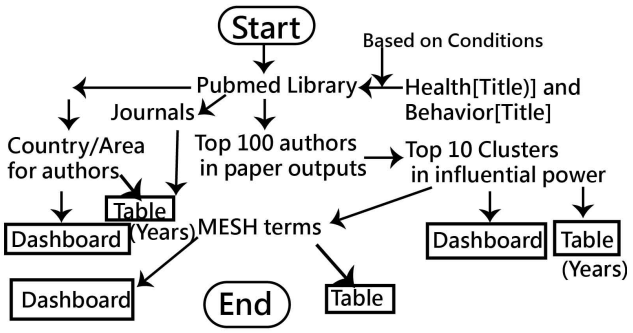

Figure 1. Study flowchart

3 Results

3.1 The most influential author

The most productive author with ten article regarding health behavior is Loprinzi, Paul D from the US, see Table 1. The MIA with some 141 members in the cluster is the author Spring, Bonnie from the US, see the top of Table 2 when the correlations among coauthors were considered in this cluster analysis.

In Table 2 we show many cluster density coefficients. The CC means the cluster coefficient constructed by the number of triangle relations divided by the possible triangle relations in the cluster. The t-statistics is the t-value for the CC. The density indicates the number of connection lines divided by the possible number(= $n \times (n-1)/2$, where n=the number of members in the cluster). The Weighted coefficient allows the duplicate connection lines related to the possible number of connection. The EI is derived from the formula=(external relations minus the internal relation) divided by the sum

of external and internal relations). The node=n, The Degree denotes the total unique number of connection. The Dweighted allows the duplicate number of connections in the cluster.

The dispersion of coauthor clusters is shown in Figure 2. The biggest one is related to the MIA Spring, Bonnie(US). Interested readers are recommended linking to the reference.[18]

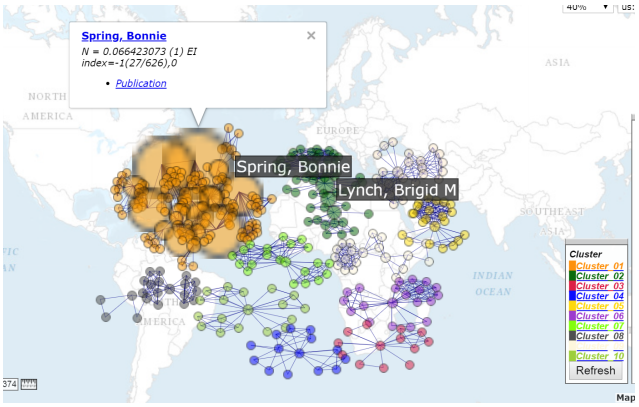

Figure 2. Dispersion of coauthor clusters

3.2 Journals and the trend on health behavior

A total of 3,591 eligible abstracts were included in the current study of health behavior for journal analysis. The most numbers of journals in production outputs are ed(69 papers) followed by Health Psychol(55) and Prev Med(54), see Table 3. All of those Top ten are included by the journal citation reports with impact factors.

3.3 Author countries/areas and their relations using the betweenness centrality

A total of 2,711 eligible papers with complete author countries/areas based on journal article are shown in Table 4. We can see that the most number of papers are from the US(1438,53%) followed by Canada(93, 3.4%), Netherlands(82, 3%), the UK(75, 2.8%) and China(75, 2.8%). The trend in the number of publications is present in the column of growth in Table 4 (in the most left column). All continents present a positive increase in paper publications.

The diagram is shown by SNA using the algorithm on Google Maps in Figure 3 and displays the pattern of author's collaboration among countries/areas based on the topic of health behavior. As expected, the US plays an influential role with the biggest bubble in Figure 3.Interested authors are recommended to click the bubble of interest to see details on a website at the reference.[19]

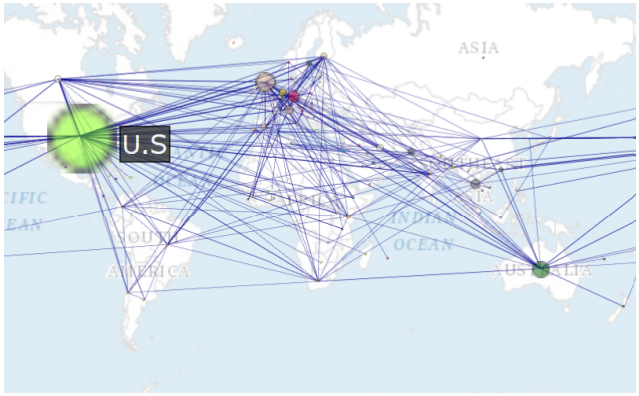

Figure 3. Dispersion of author countries/areas

3.4 Keywords on health behavior

The most influential keyword is health behavior, see Figure 4. Interested authors are suggested click the bubble of interest to see details on Google Maps at the reference.[20] The most number of nodes in the cluster are health behavior (33), psychology(24), and diagnosis(21), See the bottom in Table 2. When comparing the coefficients of CC and EI between clusters of authors and MESH terms in Table 2, we can see that the author clusters earn the higher density of CC, but the MESH terms gain the greater EI which means that MESH terms have somewhat relations among clusters. In contrast, the author clusters show independent among clusters(i.e., EI=external linkages minus internal connection divided by the sum of both external and internal number of connections).

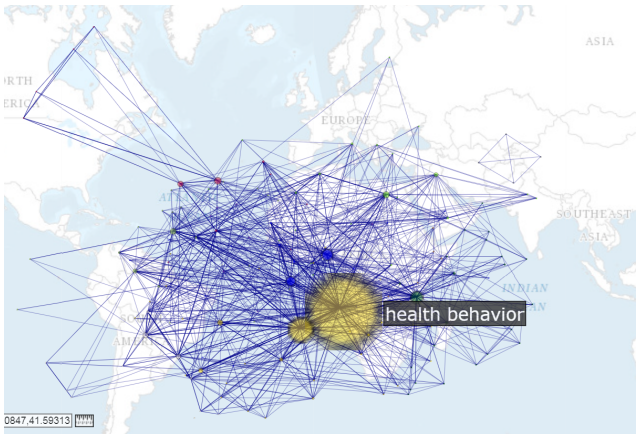

Figure 4. Dispersion of MESH terms

4 Discussion

This study found that the MIA is Spring, Bonnie(US). All visual representations that are the form of a dash-

Table 1. The most productive authors

Author	Country	Year											Total
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	
Loprinzi, Paul D	US						2	3	2	3			10
Hedman, Erik	Sweden						3	2	2		2		9
Peltzer, Karl	South Africa		2						1	3	2		8
Jung, Minsoo	South Korea					2	2	3			1		8
Han, Kyungdo	South Korea								1	1	2	2	6
Hagger, Martin S	Australia								1	2	2	1	6
Jimenez, Daniel E	US								2	2	2		6
Rogers, Laura Q	Canada		2				2			2			6
Epton, Tracy	UK	2					2		2				6
Lovallo, William R	US					2	2	2					6

Table 2. The density coefficients for the most influential author clusters

No	CC	t	Density	Weighted	EI	Node	Degree	DWeighted	Name
A. Author cluster									
1	0.67	10.64	0.06	0.08	-1	141	625	752	Spring, Bonnie(US)
2	0.62	5.59	0.16	0.18	-1	52	217	243	Lynch, Brigid M(Australia)
3	0.66	4.21	0.36	0.39	-1	25	107	116	Sun, Xinying(China)
4	0.92	10.5	0.54	0.58	-1	22	125	135	Simons-Morton, Bruce(US)
5	0.68	4.04	0.42	0.51	-1	21	89	107	Malta, Deborah Carvalho(Brazil)
6	0.72	4.52	0.36	0.39	-1	21	75	82	Krist, Alex H(US)
7	0.73	4.53	0.42	0.47	-1	20	79	90	Baranowski, Tom(US)
8	0.82	6.08	0.39	0.39	-1	20	74	74	Beehler, Gregory P(US)
9	0.5	2.31	0.27	0.33	-1	18	42	50	Hagger, Martin S(Australia)
10	0.49	1.95	0.37	0.41	-1	14	34	37	Sharma, Manoj(US)
B. MESH term cluster									
1	0.35	2.08	0.26	0.59	-0.08	33	135	311	health behavior
2	0.55	3.09	0.25	0.36	-0.06	24	70	99	psychology
3	0.67	3.93	0.33	0.47	-0.14	21	69	99	diagnosis
4	0.45	2.14	0.26	0.54	-0.02	20	49	102	standards
5	0.37	1.59	0.29	0.62	0.15	18	44	95	health promotion
6	0.56	2.14	0.52	1.14	-0.11	12	34	75	pharmacology
7	0.4	1.31	0.38	1.36	0.32	11	21	75	organization & administration
8	0.67	2.39	0.44	0.61	0	9	16	22	adverse effects

Table 3. Paper productions for top 10 journals

Journal Name	Year											Total	IF
	1951--2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018		
Soc Sci Med	43	2	1	1	4	6	2	3	2	3	2	69	2.797
Health Psychol	31		1	1		4	5	4	5	2	2	55	3.458
Prev Med	30	2	5	1	2		4	3	4	3		54	3.434
PLoS One	0		4	1	3	7	6	5	8	7	6	47	2.806
Am J Health Behav	19	4	5	1	2	2	4	2	1	3		43	1.479
BMC Public Health	1	1	2	6	4	6	4	5	5	3	4	41	2.265
J Med Internet Res	2	1	1	1	3	5	4	4	10	7	2	40	5.175
J Sch Health	28		3	2	1			1	1		1	37	1.434
Patient Educ Couns	9	3	1	4	4	2	5	2	7			37	2.429
Health Educ Res	27	2		1		1			1	1		33	1.816
Others	2929	232	259	281	328	358	399	439	463	409	3307		
Total	1606	113	157	144	179	205	220	242	270	266	189		

Table 4. Dispersion of the 1st authors countries/areas over the years

Continent	<-2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total	%	Growth
AFRICA	11	2	6	2	4	8	3	5	7	10	7	65	2.4	0.7
Ethiopia	0		2		2	3	1	1	4	3	1	17	0.6	0.6
Nigeria	5		2	1	1		1	1	1	2		14	0.5	0.3
Kenya	1					1	1	1		2	1	7	0.3	0.7
Others	5	2	2	1	1	4	0	2	2	3	5	27	1.0	0.2
ASIA	122	14	20	33	28	41	37	62	48	44	37	486	17.9	0.8
China	20	2	5	2	6	7	7	5	5	9	7	75	2.8	0.7
Japan	24	4		3	4	4	4	3	6	3	4	59	2.2	0.4
Iran	0		2	6	2	5	6	10	8	6	7	52	1.9	0.8
South Korea	8		2	1	4	3	4	10	6	9	4	51	1.9	0.9
India	8	1	2	8	2	9	1	9	2	3	4	49	1.8	0.1
Taiwan	15	2	3	4	1	3	5	5	2	3	1	44	1.6	0.2
Others	47	5	6	9	9	10	10	20	19	11	10	156	5.8	0.8
EUROPE	159	20	26	25	32	31	40	40	44	44	37	498	18.4	1.0
Netherlands	20	5	4	5	5	6	11	6	9	6	5	82	3.0	0.6
U.K	16	5	3	3	4	7	3	7	7	13	7	75	2.8	0.7
Germany	16	4	4	5	4	5	5	6	1	3	10	63	2.3	-0.3
Finland	24	1	1	1	3		2	3	8	1	1	45	1.7	0.5
Sweden	16		1	1	2	4	2	5	6	3	2	42	1.5	0.8
Norway	11	1	4	1	1		3	3		3	2	29	1.1	0.1
France	9			1			4	1	6	1	2	24	0.9	0.6
Others	47	4	9	8	13	9	10	9	7	14	8	138	5.1	0.5
N. AMERICA	673	65	77	66	83	87	83	89	114	123	79	1539	56.8	0.9
U.S	632	63	71	60	79	85	77	83	107	110	71	1438	53.0	0.9
Canada	40	2	3	6	3	2	5	6	6	12	8	93	3.4	0.7
Others	1	0	3	0	1	0	1	0	1	1	0	8	0.3	-0.1
OCEANIA	13	3	5	5	4	5	9	10	11	12	6	83	3.1	0.9
Australia	12	2	3	5	4	4	8	9	10	11	6	74	2.7	1.0
Others	1	1	2	0	0	1	1	1	1	1	0	9	0.3	
S. AMERICA	11		4	2	1	2	5	2	5	4	4	40	1.5	0.6
Brazil	6		4	2	1	1	4	2	1		3	24	0.9	-0.2
Others	5	0	0	0	0	1	1	0	4	4	1	16	0.6	0.8
Total	989	104	138	133	152	174	177	208	229	237	170	2711	100.0	1.0

board can be easily displayed on Google Maps. The most influential country and the keywords are the US and health behavior. Readers are suggested to manipulate them on their own on Google Maps.

Many previous types of research[7–10] have inspected coauthor collaboration using social network analysis. Their results were similar to this study that dominant nations in science come from the U.S. and Europe.[21,22] We showed a novel method incorporating SNA with Google maps to explore the data of publication outputs on health behavior. It can be seen that visual representations provided to the reader are rare in literature. Traditionally, it is very hard to observe the association of two or more symptoms or ties together appeared in a network at a moment glance.

Journal authorship collaboration can be compared with each other using SNA on Google Maps. Such a network can be defined as a collaboration pattern which results are similar to the previous study.[4] Accordingly, the researchers have a high level of international coauthor collaboration on health behavior, which is consistent with the previous studies on investigating scientific collaboration of Iranian Psychology and Psychiatry Researchers.[23,24]

There are 1,084 papers with the keyword social network analysis in the paper title when searching Medline on December 21, 2017, in which two papers[25,26] incorporated MeSH into SNA to disclose relevant knowledge to readers. However, no such papers have incorporated Google maps as a dashboard.

Scientific publication is one of the objective measurements to evaluate the achievements of a medical spe-

cialty or discipline.[27] It is worth combining SNA and Google Maps to disclose knowledge and information to the readers for reference in the future.

Many algorithms and measures (or indicators) have been developed using SNA to graphically explore data.[7] This kind of author names should be identified for the bibliometric study. The BC is a way to examine any one with duplicate names through the link to Pubmed by clinking the bigger bubble on Google Maps which is never seen before in previous studies.

5 Limitations and Future study

The interpretation and generalization of the conclusions should be cautious. First, the data were extracted from Medline. It is worth noting that any generalization should be made in the similar fields of paper contents.

Second, although the data were extracted from Medline and were carefully dealt with in every linkage as correctly as possible, the originally downloaded contexts including some errors in symbols which might affect the resulting reports in this study may be present.

Third, there are many algorithms used for SNA. We merely applied community cluster and density with weighted degrees in Figures. Any changes made along with algorithm will present different pattern and inference making.

Fourth, the social network analysis is not subject to the Pajeck software we used in this study, Others such as Ucinet[28] and Gephi[29] are suggested to readers for use in the future study.

6 Conclusion

Social network analysis provides wide and deep insight into the relationships with the pattern of international author collaborations. If incorporated with Google Maps, the dashboard can release much more information regarding our interesting topics for us in academics. The research approach using the BC to identify the same author names can be applied to other bibliometric analyses in the future.

7 Competing interests

The authors declare that they have no competing interests.

8 Authors contributions

SH conceived and designed the study, TW performed the statistical analyses and were in charge of dealing with data. SB and TW helped design the study, collected information and interpreted data. CC monitored the research. All authors read and approved the final article.

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