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Original article

Social network analysis of Iranian researchers in the field of violence

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ABSTRACT

Purpose: The social network analysis (SNA) is a paradigm for analyzing structural patterns in social relations, testing knowledge sharing process and identifying bottlenecks of information flow. The purpose of this study was to determine the status of research in the field of violence in Iran using SNA.

Methods: Research population included all the papers with at least one Iranian affiliation published in violence field indexed in SCIE, PubMed and Scopus databases. The co-word maps, co-authorship network and structural holes were drawn using related software. In the next step, the active authors and some measures of our network including degree centrality (DC), closeness, eigenvector, betweenness, density, diameter, compactness and size of the main component were assessed. Likewise, the trend of the published articles was evaluated based on the number of documents and their citations from 1972 to 2014.

Results: Five hundred and seventy one records were obtained. The five main clusters and hot spots were mental health, violence, war, psychiatric disorders and suicide. The co-authorship network was complex, tangled and scale free. The top nine authors with cut point role and top ten active authors were identified. The mean (standard deviation) of normalized DC, closeness, eigenvector and betweenness were 0.449 (0.805), 0.609 (0.214), 2.373 (7.353) and 0.338 (1.122), respectively. The density, diameter and mean compactness of our co-authorship network were 0.0494, 3.955 and 0.125, respectively. The main component consisted of 216 nodes that formed 17% of total size of the network. Both the number of the documents and their citations has increased in the field of violence in the recent years.

Conclusion: Although the number of the documents has recently increased in the field of violence, the information flow is slow and there are not many relations among the authors in the network. However, the active authors have ability to influence the flow of knowledge within the network.

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Introduction

The World Health Organization introduced violence as an important public health challenge in 1996. Violence can be divided into three types including self-violence, interpersonal violence and collective violence based on the person/persons who committed the violence.¹ Currently, violence is the cause of 1.5 million deaths annually in the world.² More than 8 million people in the United States of America reported violence by their sexual partner in 2012.³ In developing countries, accurate and sufficient information

related to deaths and injuries caused by violence are not known, but the available data suggest that these countries have more problems regarding this issue.⁴

The social network analysis (SNA) is a paradigm analyzing structural patterns in social relations, providing the methods to explain and test knowledge sharing process and identifying bottlenecks of information flow.

Considering network theory, social networks such as co-authorship network have formed a set of nodes (researchers) and links (relations between individuals). Each node has a special place in the network and the extent of participation is specified by the number of links which authors establish together.

Co-authorship social networks can identify researchers in a particular field of work. Also, these networks explain and draw researchers' extent of collaboration and their impact on the scientific community.

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Using this method, the establishment of new academic disciplines, research teams and centers for research investment and policy decision-making are provided.

Nowadays, the status of research in the field of violence is not clear in our country. Hence, forming a research team to conduct systematic studies in this field is not possible.

Numerous studies have already conducted SNA and co-authorship network in medicine.^{5–16} However, it seems that few studies have been done in the field of violence particularly in Iran.

Frank et al¹⁷ reviewed the published articles in the field of violence in 2010. They collected their data from MEDLINE, PsycINFO, LILACS and SciELO databases. Of the 176 published articles, 84% were English and 49.4% were in biomedical journals. 42% of studies were conducted in North America. Most papers focused on healthcare services. The authors proposed effective policies to reduce violence.

Likewise, Rodríguez Franco et al¹⁸ examined domestic violence in a bibliometric study in 2009. The purpose of the study was to investigate the number of articles, the year of publications, the relationships of victims-perpetrators and the most active authors.

The aim of present study was to identify the status of scientific outputs of Iranian researchers in the field of violence using SNA. So, we intended to identify the main clusters and hot topics, co-authorship network, structural holes, active authors, and in next step, we were going to analyze the structural indices of our network and evaluate the trend of the published articles based on the number of documents and their citations in the field of violence from 1972 to 2014.

Materials and methods

Research population included all the papers with at least one Iranian affiliation published in violence field indexed in SCIE, PubMed and Scopus databases. Ravar Matrix and Netdraw software was used to map the co-authorship network and structural holes. Also, VOSviewer software was used to draw co-word maps. In the next step, the active authors and some measures of our network including degree centrality (DC), closeness, eigenvector, and betweenness were evaluated. Then, some other measures of social network analysis such as density, diameter, compactness, and size

of main component and cut-points were assessed. Likewise, the trend of the published articles was evaluated based on the number of documents and their citations from 1972 to 2014. Following search strategy was used to collect data separately for PubMed and Scopus databases and wholly for ISI database, respectively.

ti = (Violence OR assault* OR offens* OR rape OR conflic* OR war OR suicid* OR homicid* OR tolerance OR aggressi* OR self-infliction OR self-mutilation OR genital mutilation OR coercion OR threatened OR repression OR genocid* OR deprivati* OR battered OR bullying OR refugee OR firearm OR gang OR harassment OR human right OR fight OR victim) and cu = (Iran).

Results

We identified 1316, 545 and 327 records through ISI, PubMed and Scopus databases searching, respectively. After removing duplicated results, 760 of records were remained.

Since some of the key words were interdisciplinary, a lot of records were irrelevant to our study. Consequently, the titles of articles were reviewed again by a violence and injury expert and those irrelevant documents were excluded. Finally, 571 records were obtained and the final analysis was performed on the data.

First of all, we reviewed active authors who published more paper in the field of violence in Iran. Soroush, Rezaeian, Ghanei, Nojumi and Ghazanfari were the top authors who published 23, 20, 20, 12 and 12 papers, respectively.

Figs. 1 and 2 show label view of clusters and hot spots in the field of violence using co-word maps designed by VOSviewer software. In the label view, each color represents a separate cluster and the sizes of circles are the clusters with high weight which are located as head clusters. The hot spots are in red colors and if there is high distance from the center of gravity, the color will be changed, indicating that they are far from hot topics and the integrated clusters will be changed to non-integrated ones. As illustrated in Figs. 1 and 2, the five main clusters and hot spots were mental health, violence, war, psychiatric disorders and suicide.

Fig. 3 shows the researchers' co-authorship network in the field of violence in Iran. The network is complex and tangled. This network consisted of 4 dyadic components, 7 triad components, 10 quadr components, 1 component with 6 nodes, 1 component with 7 nodes and 1 component with 14 nodes. The main component

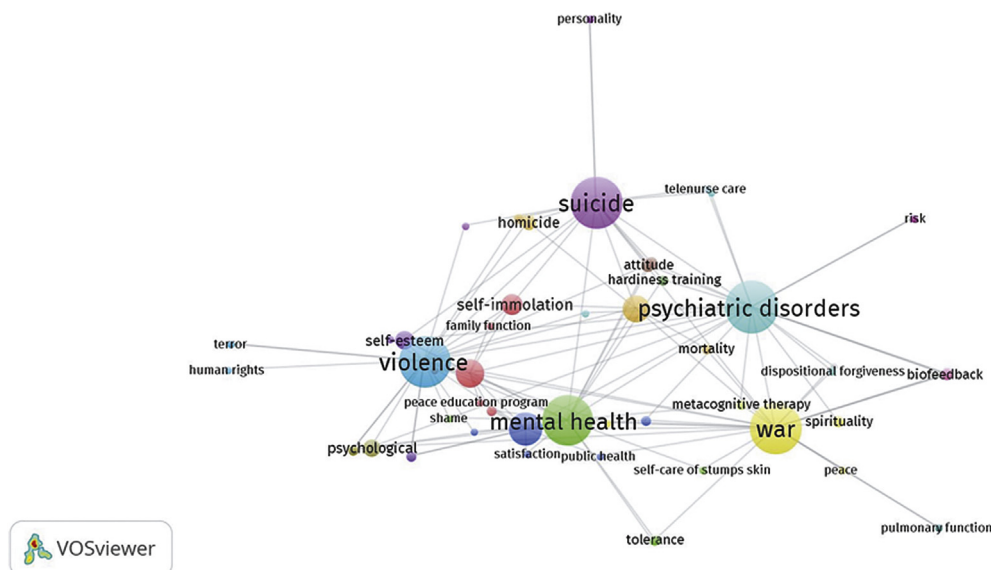


Fig. 1. Label view of the published articles in the field of violence in Iran domain.

Table 1

The normalized centrality metrics of top ten authors and whole network by degree centrality, closeness, eigenvector and betweenness.

No.	Author's name	Degree centrality	Closeness	Eigenvector	Betweenness
1	Soroush MR	5.471	0.763	49.128	5.492
2	Ghazanfari T	4.545	0.762	42.661	0.146
3	Faghihzadeh S	4.491	0.762	41.956	0.146
4	Yaraee R	4.491	0.301	41.956	0.146
5	Ghasemi H	3.974	0.762	37.324	0.177
6	Hassan ZM	3.729	0.762	34.031	0.1
7	Moaiedmohseni S	3.402	0.762	30.435	0.083
8	Shams J	3.375	0.762	31.139	0.064
9	Pourfarzam S	3.348	0.762	30.6	0.095
10	Naghizadeh MM	3.321	0.762	29.985	0.241
Whole network	Mean	0.449	0.609	2.373	0.338
	Standard deviation	0.805	0.214	7.353	1.122
	Network centralization	5.05%	Not computed for connected graphs	49.61%	10.99%

The results of the normalized closeness showed that Karami with the score of 0.764 was in the first place and Bazargan Hejazi, Khateri and Falahati with the score of 0.763 were in the next rankings.

Eigenvector is another centralization index which presents the idea that the centrality of a single node cannot be estimated without considering the centrality of the other nodes connected to it. It assigns relative scores to all nodes in the network based on the concept that connections to high-scoring nodes contribute more to the score of the node in question than equal connections to low-scoring nodes.²¹ The results showed that Soroush with normalized eigenvector score of 49.128, Ghasanfari with the score of 42.661 and Faghihzadeh and Yaraei with the score of 41.956 had the highest scores, respectively (Table 1).

Betweenness is another central metrics. It is a point between most of the other pair points. In fact, they are connecting paths which other nodes are passed through them. These actors have the power to isolate or enhance their communications. Betweenness can be summarized as follows: The number of people on the

network that a person connected indirectly is through their direct links.

The results of normalized betweenness showed that Bazargan Hijazi with the score of 11.299, Ahmadi with the score of 7.669 and Karami with the score of 6.874 had the best rankings, respectively.

To understand easier, co-authorship network was drawn based on betweenness. As seen in Fig. 4, people with high betweenness scores are determined by larger circles.

Additionally, we identified the authors with cut point role. In Fig. 5, these authors were shown by green and larger circles. Ghanei, Azizi, Rahimi-Movaghar, Ebadi, Balohri, Ghasemi, Hedayati, Amini and Mohammadiar had strong mediating role. Thus, if these authors were deleted from the network, communications among the parts of the network would be cut and the core network would be divided into smaller networks.

These authors had a key role in the network as a bridge among the others. Indeed, they filled the structural holes within the network and they maintained network cohesion and prevented network breaking.

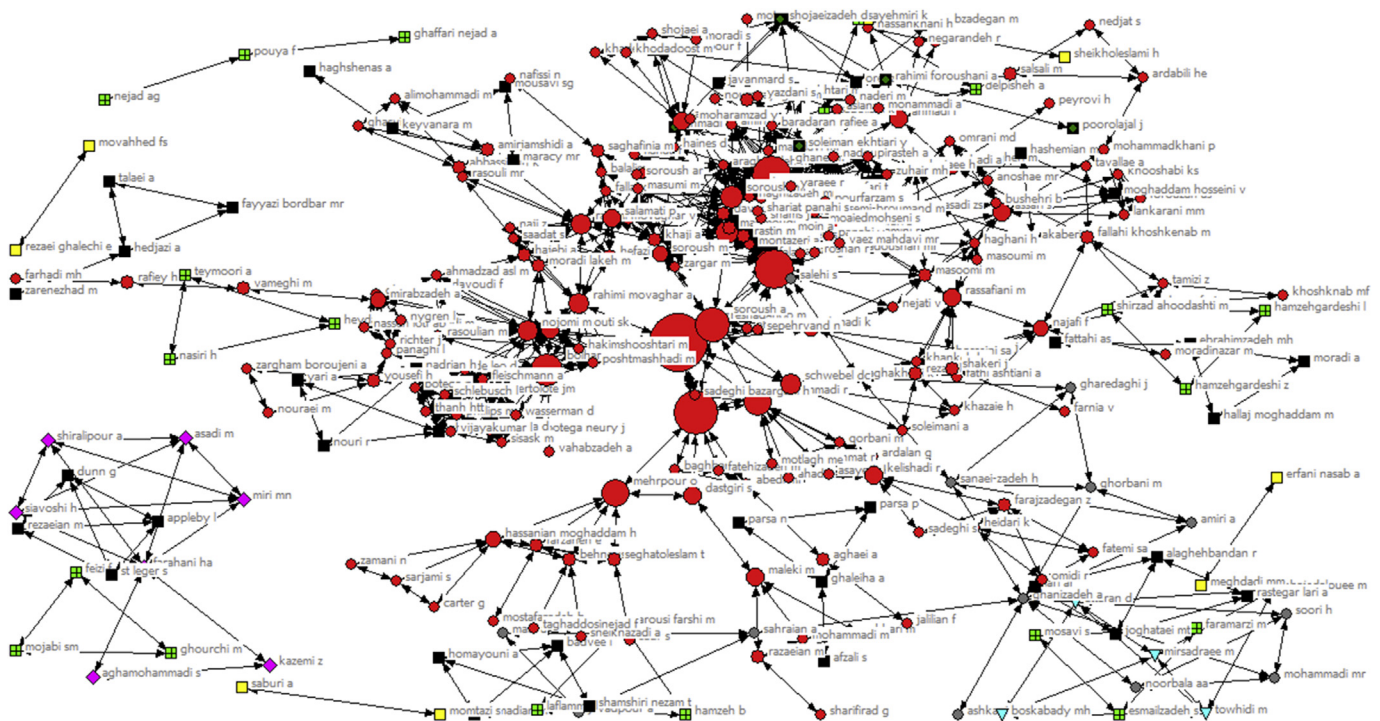


Fig. 4. The co-authorship network of the published articles in the field of violence based on betweenness scores.

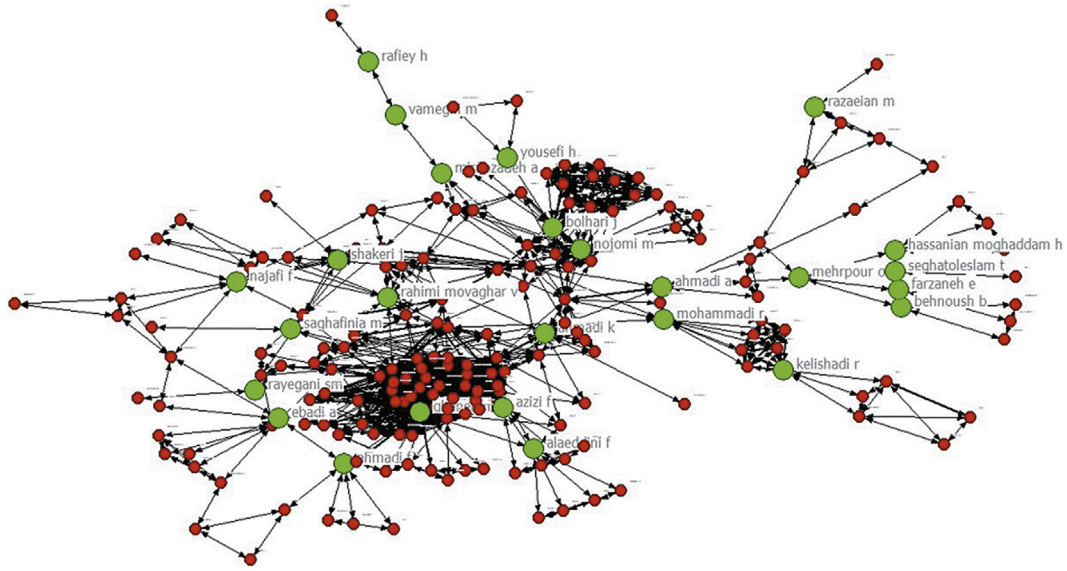


Fig. 5. The structural holes in the co-authorship network in the field of violence (main component).

Furthermore, we assessed the density of the network. Density is defined as the number of direct relationship among the actors in a network.²² The score of density varies from zero to one.²³ Zero indicates very weak and holed structure and one indicates very high density structure. So, if the mean of density is high in a network, the nodes will have many links and ties with each other.

The density of co-authorship analysis of our network was 0.0494, indicating low density. It means that about 5 percent of the possible links were created among network nodes.

In next step, we also studied the diameter of our network. Network diameter is the longest geodesic distance in a connected network. The diameter of network shows how big it is. In other words, it means how many steps needed to go from one side of network to the other side.

The diameter of co-authorship analysis of our network was 3.955 and it means that the information exchange is slow.

In addition, we studied the compactness of our network. Compactness is a factor evaluating the cohesion of the network and helps to interpret the network diameter. Compactness is valued from 0 to 1. If compactness is close to 1, it indicates that the network has more cohesive and if it is close to zero, it indicates that the network has low cohesion. The mean compactness of our co-authorship network was 0.125 and it means that there is a long distance between main nodes in this network.

Likewise, we evaluated the trend of the published articles in the field of violence based on the number of documents and citations from 1972 to 2014. As shown in Fig. 6, both the number of the

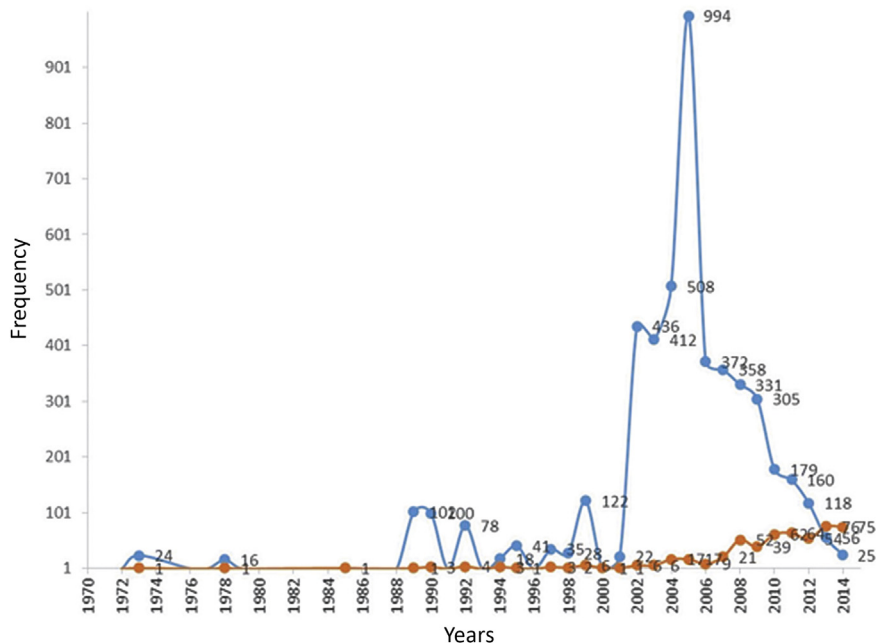


Fig. 6. Trend of the published articles in the field of violence based on the number of documents and citations.

documents and their citations have increased in the field of violence in recent years.

Discussion

The results of DC analysis showed that Soroush, Ghazanfari, Faghihzadeh and Yaraei were in top ranks. In general, the researchers with the higher DC score have more opportunities compared to the others. These people also have a privileged position because they have more nodes and have many alternative ways to satisfy their needs and hence are less dependent on the other people.²⁴

The mean of the DC was 16.496. It indicates that only a few researchers had high DC and other researchers had low or very low DC.²⁵ In other words, the Iranian co-authorship network in the field of violence was scale-free. Reviewing the DC of the main researchers confirmed the principle of "success breeds success".²⁶ Based on this principle, these researchers will be able to attract new researcher to the network and have a more central and better position.

Since social networks grows through adding new nodes and links and according to the principle of preferential attachment in which the new nodes are connected to old high central nodes,²⁷ it can be concluded that researchers with high DC play a very important role in the development and progress of co-authorship networks. Hence, collaboration of the key researchers as well as attracting more young researchers can be an effective strategy in growth and dynamism of networks.

Our betweenness results showed that Bazargan Hejazi, Ahmadi and Karami had the highest score. Researchers with high betweenness are able to intermediate the connections between other researchers. In addition, the mean of closeness showed that Karami, Bazargan Hejazi, Khateri and Falahati had the highest closeness. Closeness focuses on the distance of an actor to other actors. Whatever a person has higher closeness, the connections between the author and the other members of the network is done by fewer intermediates and it indicates that the diameter of the network is short and this will help to distribute information more quickly.

Acedo et al²⁸ showed that the mean score of DC and betweenness were 2.68 and 0.017, respectively in the field of management and organizational studies. So, findings of this research show that the mean score of DC and betweenness in our study was higher than the same indices in that field.

Otte et al²⁹ showed that the network centralization of DC and betweenness were 11% and 47%, respectively in the information sciences. So, our findings were lower than theirs.

Also, the mean score of the DC in our study was higher than the same one in the field of Iranian chemistry magazines.³⁰ Higher DC means that the authors had the maximum opportunity to communicate with other members of the network and the ability to create collaborative teams.

In our study, we found that there are different groups of authors in the network based on their DC. Some of them are the most active authors because of their high communications, low distance and easy access to the others.

The second group of authors is researchers who did not gain high DC. If these authors try to work with active authors, they may be considered in the future as part of active members in the network. The third group consisted of isolated members who did not play any role in flow of knowledge. Our results showed that most of the authors were in the last group. We suggest the authors in the second and third group to create collaborative teams and use the knowledge produced by active authors.

Fig. 2 shows the analysis of co-words in the titles of the articles indicating that there are five hot spots in this field including mental health, violence, war, psychiatric disorders and suicide.

Moreover, the density of our network was 0.0494. Therefore, it was low. Whatever size of a network grows, the network density decreases and more structural holes will be created within the network.

Baji and Osareh³¹ showed that the density of co-authorship network in the field of neuroscience in Iran was 0.42. Also, Gomez et al³² found the density of co-authorship network being 0.146 for physiology, 0.11 for medicine and 0.202 for biology, respectively.

Conversely, Acedo et al²⁸ and Wang et al³³ found lower results. They showed that the density were 0.0002 in the field of management and organizational studies and 0.0055 in the field of social computing, respectively.

The density of our co-authorship network showed that there were only about 5 percent of all possible relationships between nodes. The density and size of a network have reverse relationships. Considering the size of main component of our co-authorship network (17% of whole network), our results were compatible with Newman et al's study which reviewed the networks in the fields of biology, physics and mathematics.³⁴ They found the main components being from 82% to 92%.

The authors in the main component usually have main role in co-authorship network and they are located in the center of the main component.

The diameter of our social network was high (3.955). Diameter of a network tells us how big a network is. In other words, it means that how many steps needed to go from one side of a network to the other side. If the network diameter is shorter, there will be faster communication. So, the exchange of information in our co-authorship social network was slow and there were only a few links between researchers. They would better form research teams to increase their activity, productivity and communication. If the density increases within the network, the productivity of their researchers will improved in next step.

Our research had some limitations. Given that the names of Iranian researchers and universities might be written in different ways, there were likely missing records. So, the authors tried to correct the contradicting items manually.

Moreover, it was possible that our keywords were not used in the title of some related studies and they were not retrieved through our methodology.

To sum up, although the number of the documents has recently increased, the information flow is slow and there are not many relations among the authors in the network. However, the active authors are available to the other members of the network and have ability to influence the flow of knowledge within the network.

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