

Delineation and analysis of co-authorship network among the academics of biostatistics and epidemiology department at Kerman University of Medical Sciences using Network Analysis method

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ABSTRACT

The aim of this research is exploring the co-authorship network among the academic staff of Biostatistic and Epidemiology College in five levels: academic staff of the college, colleges of the school, colleges of the university, between schools and the other universities. Data were analyzed by the use of Social Network Analysis approach and with Visone, Netdraw, and UCINET software packages and required networks were delineated. Results of the research showed that co-authorship among the colleges of Medical Sciences University of Kerman is in an acceptable level in 2013. Amount of the co-authorship in different levels was not the same: most of the academic staffs of the college had cooperation with each other but the cooperation among the colleges of the school was less and only three of colleges had cooperation with each other. Amount of cooperation is considerable in larger levels among the colleges of the university and also among the schools. Based on the results, relation density among the colleges is low in some of the relational levels and there is a need to increase it. So, it is necessary to highlight the role of Biostatistics and Epidemiology College in the research network and authorities and policy makers in the level of university and ministry should support it.

Keywords: Co-authorship- Scientific Cooperation- Network Analysis

Introduction

Scientific Cooperation Network is one of the outstanding features of academic research ^[1]. Scientific research usually cannot be done individually and there is a need for a scientific cooperation network in order to accomplish it. Therefore, in order to find solutions for social, political and economic

problems, there is need for a multidisciplinary approach ^[2, 3].

In recent decades, scientific cooperation among various sciences is increasing, and co-authorship network is often considered as a valid indicator of research cooperation ^[4, 5]. One of the reasons for the increasing attention to scientific cooperation network is that using this network is one of the effective approaches in development of research products and promotion of their quality ^[6].

In 2001, for the first time, an American researcher named Newman used social network analysis in order to examine the structure of scientific networks in the fields of biomedical sciences, physics and computer ^[7-9]. The relationship between authors in scientific communities can be examined through co-authorship network. In order to measure the level of co-authorship network, three main methods of research are proposed, including: qualitative method (interviewing),

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bibliographic method (enumeration) and networking method^[10].

Social network analysis is a visual method for examining the relationship between individuals (components) creating the network. Communication model and network structure affect the type of behavior and communications between individuals^[6]. Co-authorship network is in fact a type of social network. In this network, authors are the main actors of the network and the type of their cooperation with each other in writing the article is the purpose of study^[6]. Co-authorship analysis is done on three levels: individual, inter-organizational, and national or regional^[11]. Present evidences show promotion of cooperation in publishing articles, although this amount is not the same in various disciplines and scientific areas^[12, 13].

Iran is one of the countries in the East Asia that has had significant growth in the last few years in publication of scientific papers^[14]. Cooperation between Iranian authors has been examined in several studies. These studies have been carried out in different regions and on different social networks, for example, study on network of medical faculties^[15], medical engineering^[16], medical emergencies^[17], and surveys conducted on 3 medical universities of Tehran^[18].

According to our searches, most of the articles published regarding research collaborations of faculty members in medical science universities have been conducted generally, and so far no article has been published on intra-sectional cooperation in the Department of Biostatistics and Epidemiology. Therefore, given that publication of articles by Department of Biostatistics and Epidemiology in Medical Sciences Universities is usually higher than other sections, so, this study aimed to investigate cooperation network of faculty members working in this department.

Methodology:

This study is part of a large cross-sectional study. The main purpose of this study has been to identify the cooperation network between faculties of Kerman University of Medical Sciences in 2012. The results of the present study are related to Biostatistics and Epidemiology Departments of Kerman University of Medical Sciences. In this study, a widespread search was done in Scopus website in order to find the related articles. In order to find the articles, firstly, a complete list of all faculties was provided and people working in each section were determined. Then all the articles having the name of Kerman University of Medical Sciences existing in the website were retrieved, and the articles written by people other than faculty members of the university, meaning the students or the staff, were excluded and did not enter the analysis phase. The total eligible studies published in Scopus were 237 among which

49 were related to the Department of Statistics and Epidemiology.

The information extracted from the articles included the authors' first name and last name, the authors' type of affiliation with the university and their area of activity. Then, each article was weighted according to the number of faculties in each section, and the extracted information was inserted into Excel software, and then was transferred into Vision program in order for network analysis.

The data were analyzed in 5 levels: among faculty members of Department of Biostatistics and Epidemiology; among different parts of Faculty of Public Health; among groups within the university; among different faculties of the university; and outside the university, using social network method.

In this study, the authors of the articles were indicated as nodes and the cooperation between them was indicated through lines between the nodes (Network is a series of nodes and lines between them, in which the nodes indicate the people in the network and the lines represent the relationship between people in the network)^[19]. We used these features in order to describe communication network between faculty members. A network can be defined and interpreted through a variety of methods, but some of the features that are more common in network interpretation include: network density, namely, type of individuals' communication with each other within the network^[19], degree of network centralization, interstitial centralization, and shear points, each of these indicators indicates importance of each person's presence in the network. Degree of centralization shows the number of communications to each person in the network^[20], and interstitial centralization shows the impact of each person's presence on establishing the relationship between people in the network^[5] and shear points are individuals in the network that if they are removed, the network will be disunited^[19].

Results:

Co-authorship network among the academics of biostatistics and epidemiology department

Figure (1) shows co-authorship network among the academics of biostatistics department (Faculty of Public Health) in Kerman University of Medical Sciences in 2012, which has been drawn in NetDaroo software environment. The points represent the faculty members of the considered department, and the lines indicate the existence of scientific cooperation between these individuals. The density of the considered network was calculated to be equal to 38.1, using UCINET software. In Figure (1), points shown with squares represent shear points of the studied network.

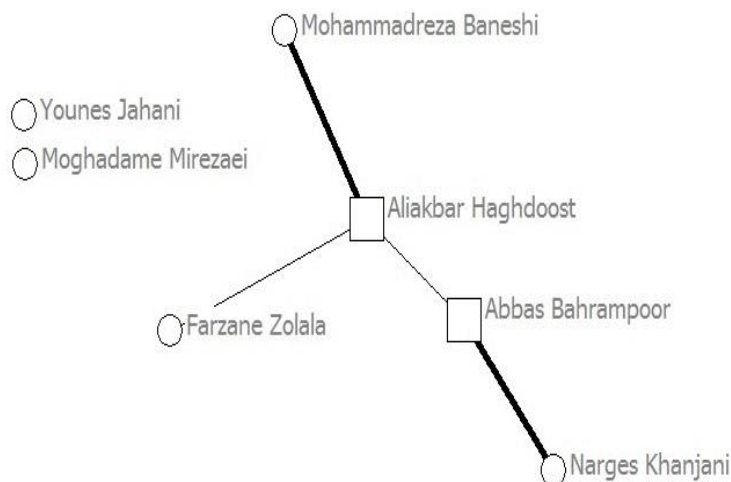


Figure 1: co-authorship network among the academics of biostatistics department in Faculty of Public Health

Inter-departmental intra-faculty co-authorship network in Faculty of Public Health in 2012

The educational departments of Faculty of Public Health include departments of “Environmental Health”, “Professional Health”, “Biostatistics and Epidemiology”, “Health Services and

Health Education”, “Entomology”, and “Health Sciences and Nutrition”. The density of relationships in the studied network is 1.71%. In Figure (2), three educational departments of “Health Services and Health Education”, “Entomology”, and “Health Sciences and Nutrition” have been identified as the isolated points of the studied network.

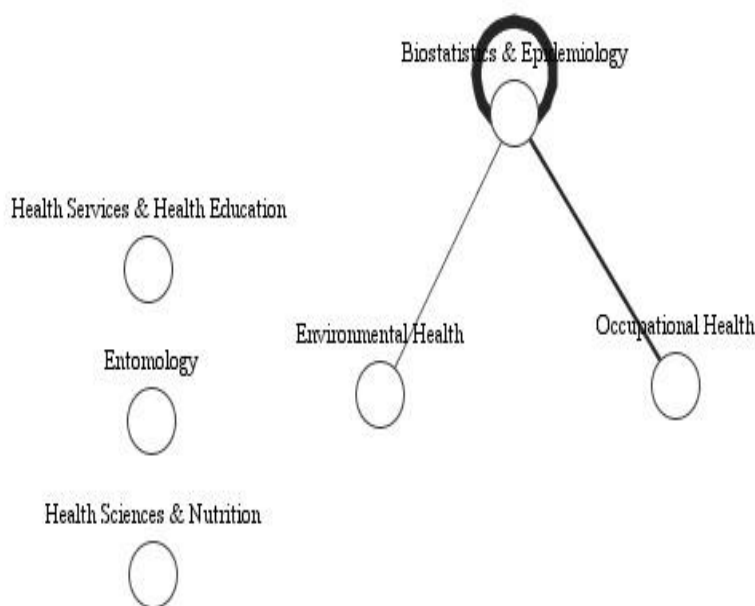


Figure 2: Inter-departmental intra-faculty co-authorship network in Faculty of Public Health

Inter-departmental and intra-university co-authorship network among academics of Kerman University of Medical Sciences

Figure (3) shows co-authorship network between different departments of Kerman University of Medical Sciences. The circles represent each department and the lines show the existence of scientific cooperation among the groups. Thickness of the relationships also indicates their value. Intra-

departmental communications are shown by rings around each department. The points at the end of the figure represent the isolated points of the studied network which had not have any communication, here scientific cooperation, with other points of the network. Density of relationships in the studied network is 0.57%, meaning that out of communication potential in the studied network, only 0.57% has occurred. Component calculations showed that in the investigated network, only the

isolated points and the points located in network communications can be considered as two components and there is no other component. According to Figure (3), the educational departments of “Anesthesia”, “Biostatistics and

Epidemiology”, “Endodontics”, “Oral Diseases”, and “Biochemistry” are the shear points of the studied network that removing any of them from the network will cause division of the network into two distinct networks.

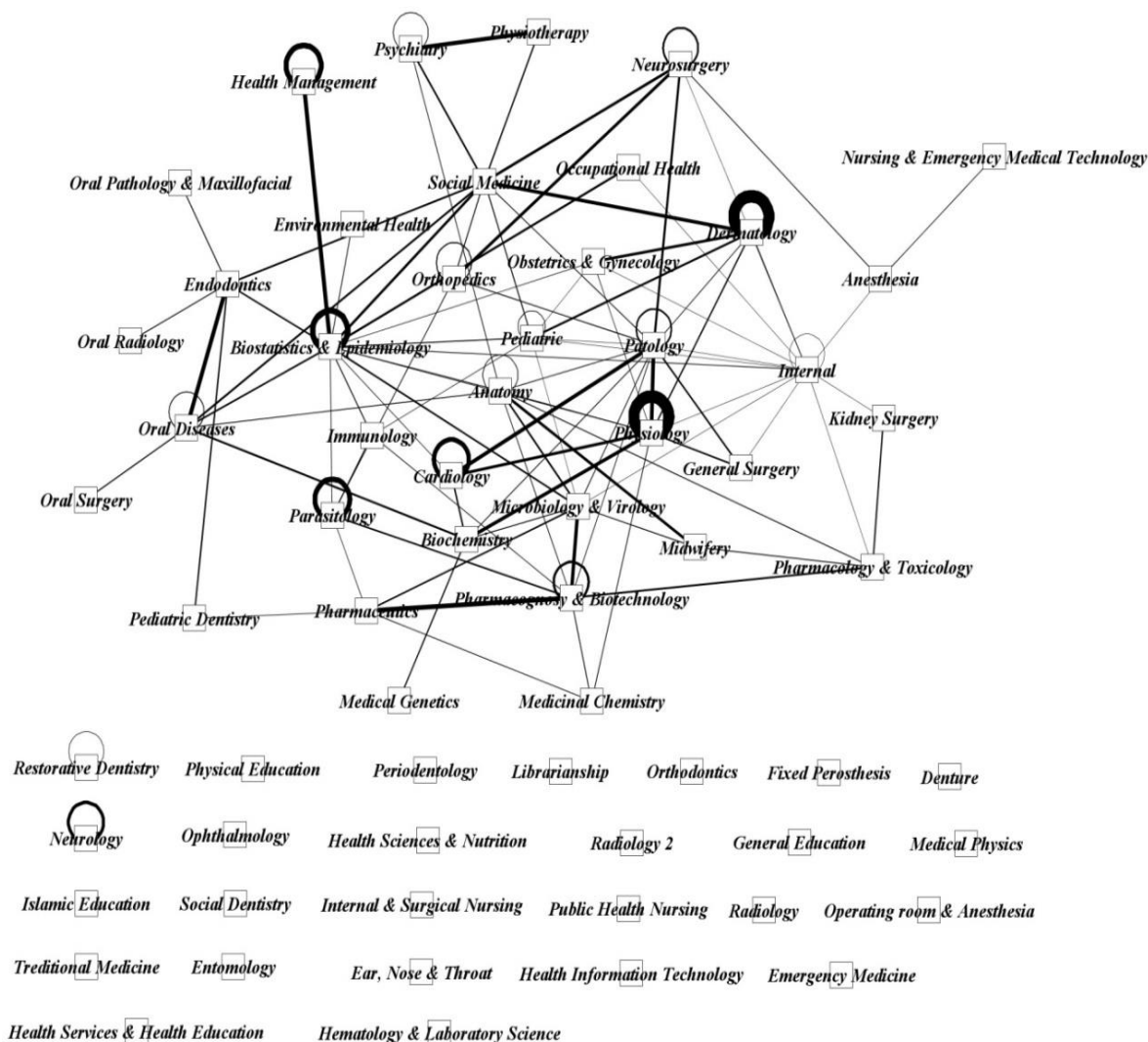


Figure 3: Inter-departmental and intra-university co-authorship network among academics of Kerman University of Medical Sciences

Inter-faculty co-authorship network among academics of Kerman University of Medical Sciences in 2012

Figure (4) shows the co-authorship network between faculty members of different faculties including “Faculty of Medicine”, “Faculty of Public Health”, “Faculty of Pharmacy”, “Faculty of Management and Information”, “Faculty of Dentistry”, “Faculty of Nursing”, and “Faculty of Para-Medicine” in Kerman University of Medical Sciences in 2012. The points show different faculties in Kerman University of Medical Sciences and the lines show existence of scientific cooperation among faculty

members of these faculties. Thickness of lines indicates the value of the relationships, and thicker lines are of higher value. According to Figure (4), scientific cooperation among faculty members of different faculties of Kerman University of Medical Sciences has led to establishing the communication network between them. Also, except the two faculties of Para-Medicine and Nursing, other faculties have intra-faculty communications. However, network density is only 2.12% and there is potential for more and wider communications in this communication network.

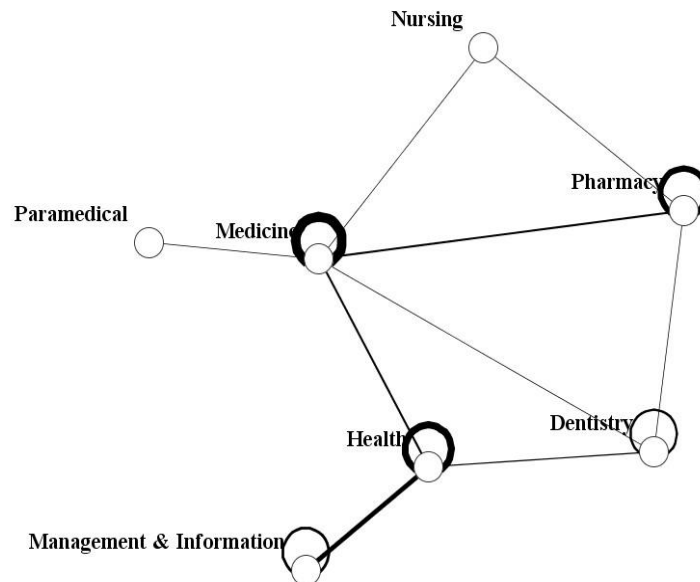


Figure 4: Inter-faculty co-authorship network among academics of Kerman University of Medical Sciences

Co-authorship network among academics of Kerman University of Medical Sciences as department-other universities in 2012

Co-authorship network among faculty members of educational departments of Kerman University of Medical Sciences and other universities including “Medical Universities of Iran”, “Non-Medical Universities of Iran”, “Medical Universities of Kerman”, “Non-Medical Universities of Kerman”, and “universities outside the country” in 2012 was drawn and examined using Vision software. Table (1) shows co-authorship network among faculty members of educational departments of Kerman University of Medical Sciences and other universities in 2012 which has been calculated based on the degree of centrality index.

Also, density of the studied network was calculated using UCINET software that the amount of this index in the studied network was obtained as equal to 17.28. Calculation of shear point index in NetDraw software showed that there is no shear point in this network.

Table 1: Ranking of departments based on the Centrality Degree Indicator among faculty members of Kerman University of Medical Sciences and other universities

Rank	Name of the Department	Centrality degree indicator	Rank	Name of the Department	Centrality degree indicator
1	Biostatistics and epidemiology	6/543	11	Social medicine	1/368
2	Physiology	5/458	12	Pharmaceutical Chemistry	1/286
3	Parasitology	3/955	13	Nursing and Emergency Medicine	1/286
4	Medical Genetics	3/049	14	Anatomy	./996
5	Healthcare Management	2/586	15	Environmental Health	./918
6	Immunology	2/131	16	Hematology and laboratory sciences	./918

7	Pharmacognosy and Biotechnology	2/790	17	Oral diseases	./915
8	Biochemistry	1/829	18	Pathology	./785
9	Pharmacotics	1/829	19	Endodontics	./77
10	Occupational Health	1/524	20	Pharmacology and Toxicology	./759

Discussion and conclusion:

Results of the present study showed that research collaboration in Biostatistics Department of Kerman University of Medical Sciences in 2012 has been at an acceptable level; however, the level of cooperation was different at different levels, for example, the level of cooperation between authors at the level of two-people groups had high degree of centrality and the two people were isolated and did not have any relationship with the network. In a study conducted by Akamoto, gender, academic rank, and organizational status were related to the individual’s position in the network and his/her relationship with other people in the network [21]. According to a study by Bills et al. in Columbia University of Medical Sciences, usually the articles published in journals with high impact index had at least one author with scientific rank of professor; and the number of articles published in journals with high impact index having one author from basic sciences department was significantly higher compared to the clinical department [22].

The Department of Biostatistics and Epidemiology among other departments in the Faculty of Public Health and among other faculties had a high degree of centrality and elimination of this department has led to the co-authorship network among faculty members being disunited. In terms of out-of-university communication also this department has had the highest degree of centrality among 18 university departments. However, the results of this study were not unexpected as Biostatistics and Epidemiology Department is considered one of the basic sciences departments in medicine, and the prerequisite for all

the research affairs in medical sciences is domination on statistics and epidemiology sciences, that is, research in medical sciences is valuable only when quality of designing the studies is appropriate and correct statistical methods are used when analyzing the data. According to the results of this study, Department of Biostatistics and Epidemiology has had a significant role in the researches conducted in Kerman University of Medical Sciences. A 13-year study by Zhang *et al.* on research cooperation in health sector showed that cooperation between authors in health management researches has increased significantly from 1991 to 2011, but cooperation between authors in health management sector compared to other clinical units such as oncology and heart is not tight and permanent, and removal of the central person will disunite the network ^[11]. In the study by Newman who compared the articles of three disciplines of medicine, physics and mathematics, the difference between the three fields was in the number of co-authors, that is, the number of co-authors in medicine was significantly higher than that in math and physics, that the reason was considered to be practical and experimental nature of medical researches ^[5]. In a case study by Yousefi *et al.* on English language published articles in three research centers affiliated with Tehran University of Medical Sciences, it was indicated that network structure is related to scientific productions, meaning that centers which had more scientific products, had more open and broader communication networks, too ^[18].

Iran is a developing country with an increasing rate of production of scientific publications ^[14]. However, there are limited studies on network of colleagues in Iran, and some of them have not directly investigated the structure of these networks ^[23]. Results of a study indicate that there is a weak network of communications among universities of medical sciences ^[15], but another study has reported an acceptable level of cooperation among medical engineers. They have reported cooperation at the level of international organizations to be 48% and at national level to be 38%. However, they have acknowledged that in order for better understanding of this pattern, it is better to analyze the information related to several years ^[24].

In recent years, the tendency to publish scientific articles has grown significantly, which has led to increased competition in production of scientific documentations. Publication of scientific articles, also called life force, is considered credit and financial driver of universities around the world ^[25]. Scientific cooperation, as already mentioned, is an effective method for increasing awareness and scientific productions. By scientific cooperation, it is not just meant cooperation during scientific research, but it is also cooperation in writing the scientific articles ^[6]. In addition, deep understanding of knowledge production process at any scientific institution is dependent upon recognition of network of colleagues ^[26]. Network analysis method, which is widely used in social articles, has already been considered in other areas such as study of network of colleagues ^[6, 27, 28]. Among the limitations of the present study are lack of

examination of variables such as work experience of individuals, their scientific rank and organizational position, that with the help of these variables, it may be possible to justify position of people in the network and their communications with other network members. Therefore, it is suggested that in the next researches, gathering information about these variables will also be considered, and in addition to network of cooperation among faculty members in writing the works, quality of articles will also be examined.

Given the growth of scientific productions, now it seems that in addition to quantity of articles, improvement of quality of these products should also be considered in line with the increase in the number of articles. One of the strategies that may be effective in improving quality of scientific productions in medical sciences is improvement of inter-group communications, especially relationship between other departments and the Department of Biostatistics and Epidemiology of universities in order for systematic and scientific designing of academic researches. According to the results of the present study, at some of the levels, communication density between departments is low and there is a need for further promotion of these communications; therefore, more planning and support must be provided by authorities and policymakers at the university and ministry level in order to strengthen the role of Department of Biostatistics and Epidemiology in network of research products.

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