Research Article

Analyzing Nursing Leadership at an Academic Historical Event: A Descriptive Study Based on Social Networks

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ABSTRACT

Purpose: To analyze the leadership network structure among nursing leaders in Spain identified through the Grupo40Enfermeras y Universidad event.
Methods: A descriptive cross-sectional study using social network analysis was used. Study sample consisted of 210 individuals, of whom 119 received nominations as referents. Structural analysis of the network was conducted using centrality and cohesion.
Results: A network structure was generated in which different leadership strategies were identified through InDegree, Eigenvector, and Betweenness Centrality. Five leaders were identified as bridges to other individuals using Betweenness. The whole network presented little cohesion although two highly cohesive cores were detected by K-core measurements.
Conclusion: A strategy is needed to support nursing leaders with high degree of Betweenness to serve as bridges to connect other nursing leaders.
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Introduction

Currently, nursing in Spain is a university-based profession with several specialities that have been achieved over the past 40 years. However, its social recognition as a profession is not enough.

The 27th October 2017, the Commemorative Meeting of the 40th anniversary of the transformation of nursing studies into university studies was held in Madrid. This event motivated a group of seven people united by friendship and nursing interests to create the *Grupo40Enfermeras y Universidad* to commemorate the date of entry of nursing into the university, in 1977. The group aimed to remember how achievements were made in the past and how the future might be approached. It produced various documents to build on the historical memory of Spanish Nursing (www.grupo40enfermeras.org). This has been considered especially useful because it has created a "movement" while bringing together senior leaders and professionals from new generations.

New health and management demands challenge current health systems [1]. Considering a nursing perspective, the increase in patient numbers, the need for a generational change of leaders, the improvement of nurses' satisfaction and motivation, fostering mutual respect between different disciplines, staff recruitment, and the creation of healthy work environments are some of these priorities [2]. The development of innovative nursing leadership strategies at a global level and understanding "leadership" as the ability to guide others toward desired outcomes [3] might be crucial to tackle some of these issues [2].

Nursing history acknowledges examples of nursing leadership while demonstrating the relevance of exploring this competency at the present. Also, gaining a historical overview of the roles and

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impact of nurses is essential to construct a professional nursing identity and represent the basis for understanding and developing the future nursing leadership [4,5]. For example, at the individual level, Florence Nightingale led through the social impact of her academic, political, and managerial work [6]. At the institutional level, organizations such as the American Nurses Association [7], the National Organization for Public Health Nursing, the National League of Nursing Education, and on an international level, the International Council of Nurses [8] have promoted nursing leadership with the capacity to influence health planning and policies. For example, the American Nurses Association has developed its Strategic Plan 2017−2020, which includes objectives aimed at promoting the profession and improving the population's health [7]. In Spain, the Spanish Association of Nursing Teachers (Spanish initials: AEED), founded in 1979, has played a significant role in promoting the scientific and professional development of nursing, mainly from the field of education [9].

In general, nursing leadership can be described in terms of actions involving relationships and contacts aimed at achieving common goals. For example, strengthen relationships with workmates of the same clinical unit to increase motivation and improve the work atmosphere [10]. In this regard, an analytical description of the scenarios formed by contacts can be obtained by applying the social network analysis (SNA) method. The SNA comprises analytical methods that examine the ties between various social entities and the impact of these ties [11]. A social network contains a set of points, some of which are joined by lines. The points represent individuals or groups, and the lines indicate that the individuals interact between them, generating a social structure [12]. The contact exists not only between individual members but also between their goals and objectives because the latter are achieved through relational connections and behaviors [13−15]. These connections transmit inherent resources to the structure of ties between individuals [16]. These inherent resources, or social capital, highlight the idea that people with "good" social connections can use other types of capital such as financial resources, knowledge, or skills to achieve their goals, better than other people who do not have such "good" connections [17]. Ties can be analyzed in two types of networks: sociocentric networks and ego networks. Sociocentric networks identify the relations between actors belonging to a previously defined group [18]. Ego networks examine an individual's connections in the network, analyzing the structure that is developed between the individual and his or her contacts [19].

Previous studies have described how the SNA methodology is relevant in healthcare settings, specifically to promote communication, collaboration, and dissemination of new practices in work teams, which would have an impact on patient care [20]. In addition, SNA has been applied to nursing leadership before, demonstrating the impact of nursing networks in the care of patients with dementia [21], the influence of communication networks on job satisfaction [22], the ability of identifying issues that can affect patient safety outcomes, such as medication [23], the mediating leadership of nurses in support and motivation networks in different clinical units [24], the influence and connectivity of nurses through informal networks in rural communities [25], and the impact of nurse leader networks on organizational communication [26,27].

A visible example of nursing leadership in Spain occurred when nursing education became a university degree program. To commemorate this historic moment and create a forum for reflection on the future of the profession, some of the leaders involved organized an event called *Grupo40Enfermeras y Universidad* [Group40Nurses and University] [28]. These leaders aimed to encourage and motivate new nurses (in formal or informal leadership roles), demanding a nursing presence in power structures and access to relevant decision-making processes. Given this,

the purpose of this study was to analyze the leadership structure of nursing leaders in Spain, identified through the "Group40Nurses and University" event. The specific objectives were to (i) identify the leadership of nominated leaders (referents) in terms of their structural position in the event network, (ii) describe the ego network of the most frequently nominated leaders, and (iii) examine the structural cohesion of the network.

Methods

Study design

A descriptive cross-sectional study using historical event data and social network analysis was used.

The "Group40Nurses and University" event was held in Madrid on the 27th of October, 2017. The event aimed to commemorate the 40th anniversary of the introduction of nursing at the university sector in Spain. A core group of nursing leaders who had been involved in achieving this milestone 40 years ago organized the event.

Setting and sample

The study population comprised of 212 nurses. Two of them were excluded because they were not nurses, resulting in a final sample of 210 individuals. All the Spanish nurses were invited to vote their leaders for this event. The final sample included professionals who nominated nursing leaders as well as the nurses who were nominated (referents). Of the 210 nurses, 119 were nominated as referents. The five most relevant leaders in the network were selected based on their capacity for Betweenness (Table 1).

Ethical consideration

This study was approved by Group40 Enfermeras y Universidad. The research team contacted the Group40 organization to request permission to analyze the data published on the website. It was explained what SNA was and stressed that only the data that were publicly available on the website would be used. Besides, it was specified that authorization from Group40 would be subject to the prior reading of the final manuscript and knowledge of the means selected for its publication. The organization uploaded a first graph about the event onto the website to inform the participants about the study and facilitate potential questions.

Data collection

The event's official website (https://www.enfermeria21.com/grupo40enfermeras/el-grupo/) was used to nominate the referents. The website contained a tab stating the following: *Nominate your reference nurse, upload a photo of her/him and describe why you consider him/her a referent.* The event website defined "referent" as follows: *A referent is a nursing professional who has made a significant contribution to the profession.* A scientific committee examined the nominations and included only those who provided data and information on the professional career of nominated nurses. Nominations were accepted over 8 months.

The names of the professionals submitting nominations were displayed to the public on the website, as well as the names of the leaders nominated with a summary of their careers. The data obtained were used to construct a *nxn* matrix with 210 rows and 210 columns. The matrix was read as follows:

- For rows, "A nominates B";
- For columns, "A is nominated by B".

Table 1 *Leading Actors According to Betweenness.*

Actor	Betweenness	NBetweenness	InDegree	NrmInDeg	Eigenvector	NEigenvector
Mompart MP	165.00	0.38	12.00	5.74	0	0
Martínez JR	105.00	0.24	1.00	0.48	0	0
Megías F	103.00	0.24	7.00	3.35	0	0
Alberdi RM	66.00	0.15	5.00	2.39	0	0
Santo Tomás M	54.00	0.12	3.00	1.44	0	0

Note. NBetweenness = Normalized Betweenness Centrality; NEigenvector = Normalized Eigenvector Centrality; NrmInDeg = Normalized Indegree Centrality.

Data analysis

The SNA was applied to the matrix of *nxn* data, using measures of centrality at the individual level and cohesion at the group level. An actor's centrality is the extent to which the individual occupies a central position in the network [29]. Individual leadership was analyzed using the following measures of centrality: InDegree, Betweenness, and Eigenvector, with normalized measures [29]. Briefly explain of the measures used: InDegree centrality is defined as the number of people who ask the actor for advice [29] and Betweenness centrality is defined as the Extent to which an actor serves as a potential "go-between" for other pairs of actors in the network by occupying an intermediary position on the shortest paths connecting other actors [29]. Eigenvector centrality corresponds to the measure of actor centrality that takes into account the centrality of the actors to whom the focal actor is connected. Thus, an actor whose three friends have many connections will have higher Eigenvector centrality than an actor whose three friends have few connections [30]. Finally, K-core being defined as a subgraph in which each node is adjacent to at least a minimum number, K, of the other nodes in the subgraph [11].

To identify correlations between InDegree, Eigenvector, and Betweenness, a normality test to determine whether the variables presented a normal distribution was conducted. Spearman correlation coefficients were determined for Eigenvector, Betweenness, and InDegree with normalized values to determine existing relations between the variables.

Furthermore, to obtain a more detailed description of the network of actors that present a higher degree of leadership using Betweenness centrality [31], the ego networks of the five main leaders were analyzed. Cohesion refers to the existence of many ties between similar others [32]. Network cohesion was analyzed by studying K-core subgraphs [11]. This metric was selected to identify large cohesive groups that might explain the social influence of leaders at the local level.

SNA variables were calculated using UCINET 6.627 software [33]. Graphs were created using the UCINET tool, NetDraw. In this regard, the use of network visualization might facilitate the identification of patterns in ties between individuals and provide insights into the ego's position in the network and effective means of communicating findings to others [34].

Results

Results for leadership

The target population consisted of 210 nurses, of whom 119 were nominated as referents. Correlation results indicated that Betweenness correlated significantly with InDegree ($p < .001$); therefore, as Betweenness increases, so will Indegree. Thus, actors with higher InDegree values had a higher intermediary position in the network. Spearman's correlation coefficient ($p = .45$) indicated a moderately positive relationship, whereby the higher the InDegree, the greater the Betweenness. Eigenvector did not correlate with the other two variables, and in both cases, p was higher than .05 (Table 2).

On the other hand, measures were performed to describe the statistics and correlations of Betweenness, InDegree, and Eigenvector. The general mean and standard deviation for InDegree was 0.46 ± 0.69, for Eigenvector 1.15 ± 9.69, and for Betweenness 0.01 ± 0.00. The lowest mean corresponded to Betweenness metric, given that few actors achieved this position in the network. This finding indicates that individuals with a high degree of Betweenness were leading actors with a substantial capacity to serve as a bridge between other actors in the network (Table 1). Public information was collected from these five leaders, showing that they have been developed as nurses in both clinical and academic roles.

To better understand structural leadership, a visualization of the ego network for each of the five leaders (Figure 1) was created, showing the structural differences between them. In particular, Figure 1 shows that the leader node Mompart MP presented a higher number of contacts and capacity for Betweenness.

Results for cohesion

Figure 2 shows the "Group40Nurses and University" event network. Women are represented in light blue, and men in dark color. Nominations can be seen in the graph with the arrows lines linking nodes. The network presents an almost elliptic shape, with areas where the line of the ellipse appears broken because some groups of actors were not connected. In general, the network evidenced low density and little cohesion, except two subgroups with more nodes and connections showing greater cohesion than the

Table 2 *Correlations Between Variables Using Normalized Data (N = 210).*

Correlation	Variables	Characteristics	NBetweenness	NEigenvector
Spearman's rho	NEigenvector	Correlation Coefficient	.07	
		p-value	.34	
		N	210	
	NrmInDeg	Correlation Coefficient	.45	
		p-value	<.001	.17
		N	210	210

Note. NBetweenness = Normalized Betweenness Centrality; NEigenvector = Normalized Eigenvector Centrality; NrmInDegree = Normalized Indegree Centrality.
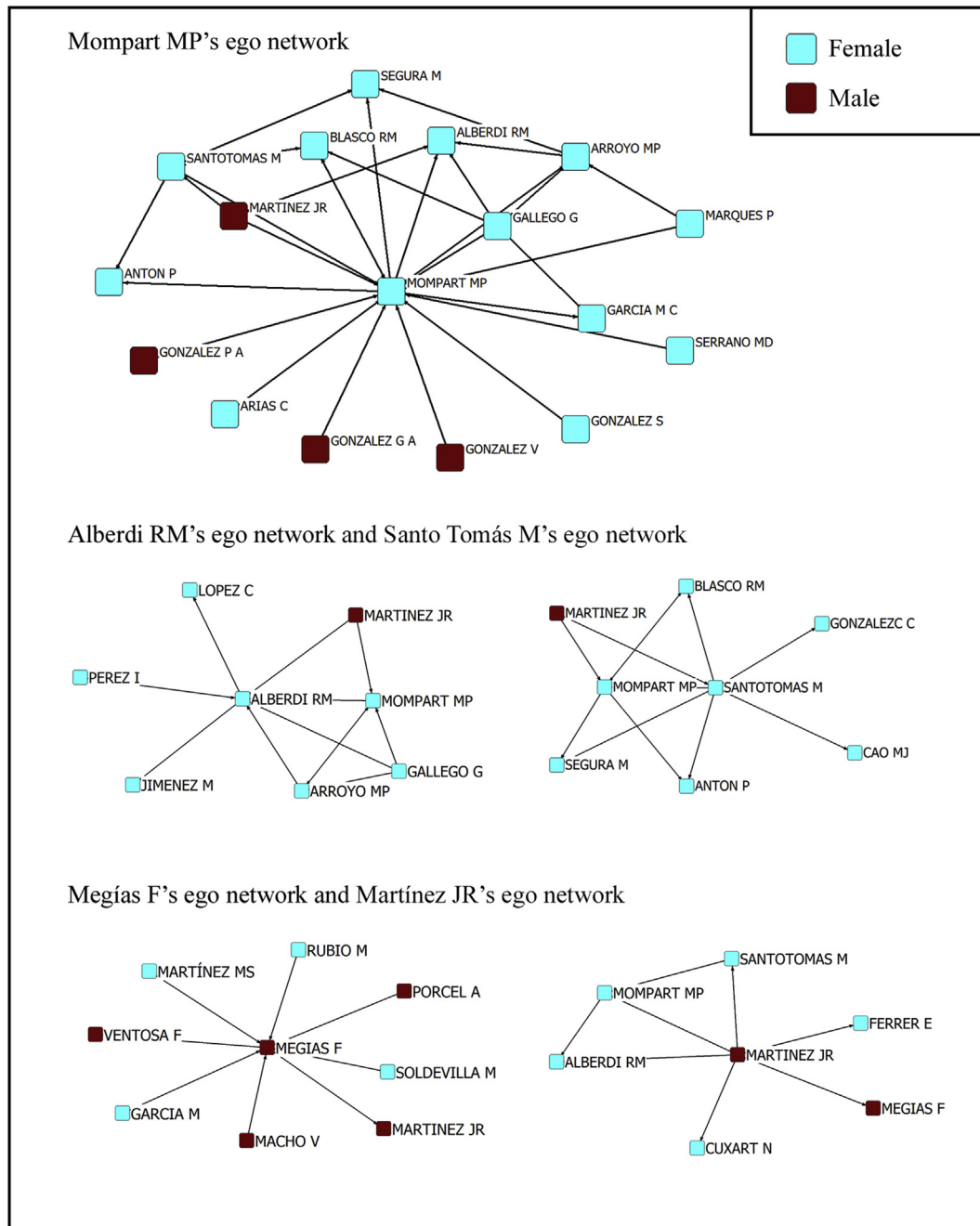
Figure 1. Nursing leaders' ego networks.

rest of the network. Centrality metric was used using the UCINET tool "NetDraw" to visualize more these two subgroups within the whole network and to conduct a more detailed study of these two subgroups (Figure 2).

Two K-cores emerged (Figure 3). The K-core on the right shows a very cohesive central group with individuals in an advantageous structural position, who serves as a link between the network center and other individuals of the periphery. If these individuals disappear from the network, the social capital transmitted through their connections would be lost. In the K-core on the left side, an individual connects other individuals. This person is essential because he/she forms the only link between the two subgroups. Red color indicates the maximum K-core, which contains many of the leaders identified in this study concerning their degree of Betweenness.

These findings show a different approach to interpreting the construction of leadership in comparison with other traditional methods. The results show the behavior of a global network, the relational behavior of central individuals in the network, and describe the network of the leading actors. This knowledge is useful for nursing organizations to consider the relevance of networks to empower nursing.
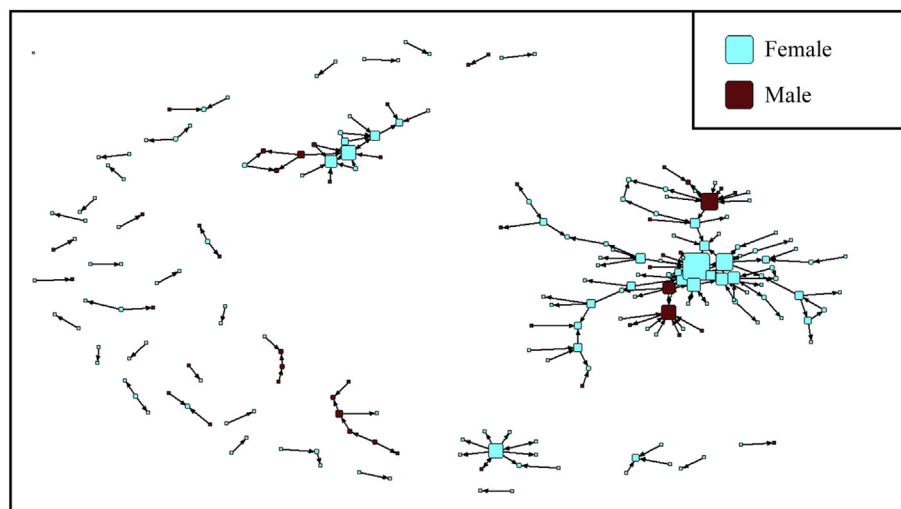
Figure 2. Social network of the "Group40Nurses and University" event (Spain), based on centrality measures.

Discussion

In Spain, a need for nurse leadership has been detected. Health organizations, Nursing Professional Councils, and professional associations are not sufficiently interconnected. Thus, professionals with leadership competencies and professionals who can adapt to the new demands are required [35]. Therefore, in research on nurse leadership, it is necessary to apply dynamic, social and relational paradigms capable of explaining the structure of leadership at different levels: individual and collective or global. Thus, it will be able to answer questions such as: Are there different types of leadership, depending on the structural pattern they have? Are there subnets capable of promoting collaborative relationships focused on professional empowerment? How are the networks of the people who have led us? SNA offers an approach to the development of nurse leadership [36].

The analysis of leadership networks helps to identify interpersonal ties that exert influence at the local and collective levels, shaping social change and systems. The SNA was used in this research to analyze leadership at the historic "Group40Nurses and University" event. Thus, (i) individual leadership using InDegree, Betweenness, and Eigenvector centrality metrics, (ii) the main leaders' network using their ego networks, and (iii) network cohesion through the K-core metric were analyzed.

The results showed that there were nurses with a high degree of centrality and a central position in the network (InDegree, Betweenness, and Eigenvector), which could predict leadership competencies in these nurses. These results are consistent with those reported by another study [32], who applied the same three metrics and concluded that leaders exert influence at three levels: through direct ties surrounding leaders, through direct and indirect ties in which they are embedded and through interorganizational linkages. Similarly, Marqués et al [24] showed that InDegree and Eigenvector values identified nursing leadership and was positively related to individual performance in the workplace. On the other hand, within this research, Betweenness identified the individuals whose leadership served to connect different nursing groups and profiles. This decision was based on previous studies that have used the Betweenness metric to explore leadership in organizations. De Brún and McAuliffe [31] applied Betweenness to measure leadership among senior hospital managers and reported that actors with a high degree of Betweenness connected more efficiently than the rest of the actors in the network. Nevertheless, this is the first time that SNA has been used to analyze nursing leadership cohesion at a scientific event. The results have given rise to two strongly cohesive groups with no possibility of fracture. Network analysis can be used in academic research and by professional associations to identify strong subgroups of nurses. The importance of weak ties could also be added because they allow new nonredundant information, necessary to generate innovation. Nevertheless, this research has not shown that distant relationships (in terms of geography or the frequency of contacts) could be useful to consider new projects.

Furthermore, the five leaders with the highest degree of Betweenness were selected and analyzed their ego networks to obtain more detailed information about their relational behavior. The results showed that the most prominent nursing leader with the highest degree of Betweenness presented a denser ego network than others, which could facilitate the transmission of social capital. Nurses that serve as a bridge might become key players with the capacity to mobilize and coordinate social activity [37]. The different ego networks can be "mirrors" for future nurses that want to lead the profession. Each of these nurses could consider what type of ego network might be similar concerning how they establish relationships. Nurse leaders consistently communicate and develop relationships within across professions to promote and maintain information exchange [38]. Measures of cohesion are useful to analyze leadership processes and dynamics because they permit an analysis of the strongest structures of interpersonal ties. It has been widely explored, most notably through cliques and density [11], two measures that were not used in this study. A clique
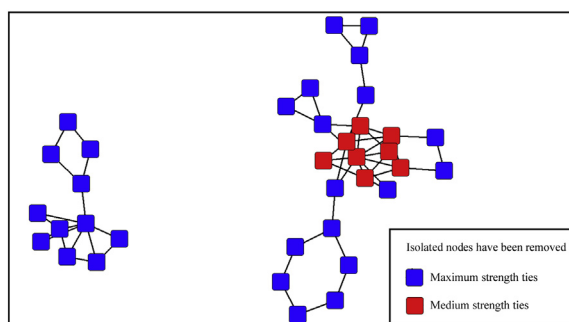

Figure 3. K-cores of the "Group40Nurses and University" event (Spain).

analysis would reveal several small cohesive subgroups in the global network [11]. This information is beyond the scope of this research, which aimed to analyze the presence of leaders in larger cohesive subgroups. Also, the density metric was not used. Density or proportion of possible lines provides information on connections at the global network level, but not at the local level [11].

The literature [39] proposed an alternative approach to network cohesion based on the minimum degree in combination with a study of local density, which is useful to analyze network characteristics and compare networks. Thus, K-cores at the "Group40-Nurses and University" event were analyzed. K-cores have received less research attention in general but provide essential information to gain a better understanding of leadership. To determine if the identified leaders were part of a single core or not, it was necessary to study large cohesive regions. The results of this study yielded a graph with two K-cores, one smaller than the other. The explanation for the existence of two highly cohesive cores may be that these two groups share similar interests that are different from the other network members. The five leaders identified were all members of the larger K-core, suggesting a high concentration of relational resources on the part of the leaders and poorly disseminated leadership, a potentially harmful aspect for the whole network. Other studies [40] examined the concentration of intragroup relational resources and found that if a subgroup possesses the most of the group's social capital, this could negatively affect the effectiveness of the whole network. On the other hand, low intragroup cohesiveness has been significantly related to higher perceptions of intergroup conflict [41]. A balance between intragroup and intergroup connections may be the best option.

By applying SNA methods to existing data, five nursing leaders were identified in Spain who share their experience in the field of health and higher education. It is important to emphasize that these five leaders live in different locations and geographically far from each other. This may explain they could exert a scattered influence on geographically distant individuals to access nonredundant information, link unconnected individuals, and tackle nursing challenges. The findings show a strategic way to build new nursing leadership networks. Individuals who are identified as central and influential actors could act as key conduits, both for the dissemination and collection of information [42].

Although this event is a small representation of the thousands of nurses in Spain, its value is a touch of attention to the mobilization of nursing leadership because it has been promoted by a group of historical Spanish nursing leaders. The SNA shows that Spanish nursing has different leaders who are embedded in small subgroups that support them, dispersed and with lack of connections between them.

This work with leadership networks analyzed in Spain has helped to rethink this weaving process using SNA-based methods. The SNA is a method that allows us to build leadership and also detect leadership roles, among which bridges must be built. The daily support of a collective leadership network requires that members can meet and form active groups [36]. Year of Nursing, 2020, will be an excellent time to consider networks as precursors of leadership. Initiatives, such as the Nightingale Challenge, aim to train nurse leaders. The directors of these strategies should consider the SNA as a framework for building sustainable leadership.

This study presents some limitations that should be addressed in future research. First, data such as the workplace or seniority should have been collected; this would have allowed the analysis of networks related to similarity aspects. Second, it would have been useful to collect more data from networks, for example, from networks of friendship or collaboration in work or research. Third, it would have been relevant to incorporate some qualitative methods,

such as observation and in-depth interviews to complement the quantitative data.

Nursing leaders need to understand how network structures derive from formal and informal contacts function. Further research is required to explore how individuals and subgroups are embedded in larger groups, in larger networks or organizations and also to determine how formal and informal networks interact [40]. Finally, it would be necessary to elucidate the characteristics of leaders presenting a high degree of Betweenness because of their capacity to serve as bridges and conduits for cross-boundary relationships, such as those between senior and junior nurses, nurse researchers, teachers and assistants, and nurses working in political institutions, healthcare organizations universities, and other heterogeneous groups. Future research should examine social capital among nursing leaders based on their interactions. In this sense, qualitative research could complement the traditional quantitative approach of SNA.

Conclusions

In light of the above, the main conclusions of the present study are as follows:

1. Social network analysis offers a new perspective on nursing leadership which could be applied to daily practice, identifying future leaders based on their ability to build relationships.
2. Social network analysis allows identifying different types of relationship-based nurse leadership: InDegree Leadership (many actors come to the leader), Eigenvector leadership (the leader influences other nurses even if they do not contact directly), and Betweenness Leadership (leader who act as a bridge).
3. SNA offers the opportunity to explore the ego networks of the leaders identified within the whole network.
4. SNA captures the most cohesive groups among nurses, because they share affinities and a common engagement.
5. The structure of the "Group40Nurse and University" network underlines the need to identify more leaders who serve as bridges. This finding suggests that it is necessary to think of a network-based strategy for local and global leadership.
6. The SNA methodology, which analyzes the structure of social networks, is useful for designing strategies for transgenerational leadership in nursing. Future strategies should include senior and influential individuals in new generations of nurses.

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Conflict of interest

There is no conflict of interest for the authors.

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