

RESEARCH ARTICLE

Social Network Analysis of Alzheimer's Teams: A Clinical Review and Applications in Psychiatry to Explore Interprofessional Care

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Abstract: Introduction: Understanding the social networks of professionals in psychiatric hospitals and communities working with persons with Alzheimer's (PWA) disease helps tackle the knowledge management in patient care and the centrality of team members in providing information and advice to colleagues.

Objectives: To use Social Network Analysis (SNA) to confirm or reject the hypothesis that psychiatric professionals have equal status in sharing information and advice on the care of PWA and have reciprocal ties in a social network.

Methods: The sample consisting of 50 psychiatric professionals working in geriatric psychiatry in the UK completed an anonymous online survey asking them to select the professional categories of the colleagues in the interprofessional team who are most frequently approached when providing or receiving advice about patient care and gathering patient information. SNA is both a descriptive qualitative analysis and a quantitative method that investigates the degree of the prestige of professionals in their working network, the reciprocity of their ties with other team members, and knowledge management.

Results: The social network graphs and numerical outcomes showed that interprofessional teams in geriatric psychiatry have health carers who play central roles in providing the whole team with the knowledge necessary for patient care; these are primarily senior professionals in nursing and medical roles. However, the study reported that only 13% of professionals had reciprocal ties with knowledge sharing within teams.

Conclusion: The current research findings show that knowledge management in interprofessional teams caring for PWA is not evenly distributed. Those with apparently higher seniority and experience are more frequently consulted; however, other more peripheral figures can be equally valuable in integrated care.

Keywords: Alzheimer's disease, social network analysis, interprofessional, psychiatry, knowledge management, care.

1. INTRODUCTION

1.1. Interprofessional Care in Alzheimer's Disease

Interprofessional practice includes collaborative learning among healthcare professionals who aim to advance their teamwork and their patients' care by utilizing proper communication skills and by understanding their own roles as well as the roles of their teammates [1]. Data suggest that there are 850,000 people in the United Kingdom (UK) with dementia, this number representing 1% of the population [2]. Persons with dementia engage 25% of hospital beds and remain under secondary care longer than people with other illnesses [3]. A Nationwide survey resulted in more than one million carers trained to support people with dementia

consisting in 400,000 National Health Service professionals and 100,000 social workers [3, 4]. This substantial number of professionals working with persons with Alzheimer's disease (PWA) in the hospital and community will be able to integrate their care as long as they focus on interprofessional practice.

Working collaboratively with other employees in interprofessional teams is reported as the primary target in patient-centered care in the healthcare system [5-7]. At times, shared participation and knowledge management are less than optimal. One study found that healthcare workers who were not nurses or doctors reported the desire to participate more in interprofessional practice, as corporate communication appeared inadequate [8]. Other times a prejudicial attitude towards other professions can hamper interprofessional practice. The presence of biases and simplifications about other professional roles might reduce collaborative practice and information sharing between team members [9]. Being

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able to embrace the perspectives of other professionals rather than focusing exclusively on one's own is the inter-professional skill most valued by team members [10]. In a cooperative activity, each psychiatric professional is encouraged to analyze a problem using the frame of understanding and inquiry of other professionals in the team [11].

The complexity of cases and patient management in psychiatric wards can pose extra challenges to the collaboration within the staff. A study of psychiatric teams in Sweden has shown that staff members might already know the standards of patient care and interprofessional teamwork; however, the hurdles they deal with in routine work, such as inadequate settings, inequalities in authority, and deficiencies in work organization, increase their isolation from colleagues and reduce opportunities for teamwork [12].

According to a series of publications by the Royal College of Physicians, professional negligence cases are frequently due to ineffective cooperation and information sharing in interprofessional teams [5]. A recent systematic review of 30 studies evaluating challenges to quality care in different countries found that the causes of poor patient care in 70% of cases are from poor interprofessional practice and rigid hierarchical leadership in 57% of cases [13]. Furthermore, hierarchies within healthcare teams are considered obstacles to open communication within a team [6].

Instead, the primary route to interprofessional cooperation within healthcare teams is to promote a give-and-take culture of feedback [7]. Improved teamwork, communication, and collaboration and the reduction of silo management have been associated with reduced readmissions of patients after discharge from the hospital [14]. During a systematic review of databases, including 47 studies from 1980 to 2015, 55% of reports found that interprofessional consultation was the area needing significant improvements for increasing workplace cultures and effectiveness in surgical wards [15].

1.2. Background to the Topic

Significant challenges to healthcare partnerships can derive from a lack of collaboration, coordination, and mutual trust in an interprofessional team [16]. Collaborative care means acting supportively, adopting welcoming and empathic communication, and acknowledging diversity in reflective practice [17]. Stereotypes about other professionals and little understanding of members' roles in interprofessional teams are other obstacles to collaboration [18]. Cooperating teams reduce risks to patients and enhance the quality of care, but they also make the hospital's climate or ward more optimistic, involved, and robust [19].

1.3. Social Network Analysis in Healthcare

Social Network Analysis (SNA) can assess organizational relationships, opinion leadership in networks, how knowledge is shared in teams, and recommendations on quality of care and patient safety [20]. There is growing research in this direction, although only Pomare *et al.* (2018) have used SNA to study interprofessional teams in psychiatry [21]. A social network is a relationship between a

group of persons or units [22]. Table 1 shows a list of key topics in SNA.

SNA is the study of the relationships or links in a network that a person or entity has with other persons and entities to share values, capital, and knowledge [23]. SNA can also help recognize areas of improvement in interprofessional care [24]. SNA has some additional advantages compared to quantitative methods, as it can graphically illustrate hidden relations within the actors of a network [24, 38]. Hence, SNA is a set of qualitative research methods showing social events comprising exchanges, links, and negotiations that relate one actor or node to other actors or nodes while looking for the statistical significance of the configuration of these relations [39]. The components of a social network are 'nodes' or 'actors' that represent individuals or organizations and 'ties' or 'edges or arrows' that symbolize the interactions between the nodes [28, 25]. Double-headed arrows symbolize the sharing of data or resources and represent the interactions between nodes or actors or some form of collaboration between the units of a social network [25]. Multiple mathematical parameters are used to characterize social networks. The one used in the current study and that frequently characterizes the relations in the healthcare system is 'degree of centrality' [28]. SNA is based on the theory that all ties between units are interdependent [40]. Besides, 'centrality' is when an actor has many inward and outward ties with others, while 'prestige' is where inward ties prevail [27].

Various software packages can do the mathematics relating to social networks. The current study uses open-source SocNetV 2.4 [29]. A social network researcher tends to focus on single individuals interacting as a group within networks of interpersonal relationships; however, these networks of direct interactions can become collective events and develop as autonomous activities [41]. A sociogram can thus provide a pictorial representation of the configuration of a team and highlight who occupies the more central and influential positions in it [42]. Each unit or node of the network interacts with other units or nodes to exchange expertise, skills, knowledge, and ideas [23]. When a social network is constructed to investigate interpersonal selections or relations, the researcher asks the participants to indicate another member of their network according to a significant object of investigation [30]. Arrows directed from one actor to another actor represent the relationship between nodes in the network [24]. An outbound arrow begins from one node/actor, which initiates an action or a relationship, to another actor accepting the act, as in the one-mode matrix, or to another class of categories as in the two-mode matrix [24]. In this last case, the arrowhead will point to the second actor/node accepting the undertakings from the first actor; in a case where the actions are mutual, the arrowheads point to both nodes/actors [24]. Hence, actors or nodes in the network are connected to share information, resources, and goals [23]. An advantage of the graphic illustration of SNA is that it shows concealed connections within the actors of the network (Fig. 1) [24, 38].

Understanding social networks, inclusive of the dynamics of the interchange of information and advice between different professional figures on interprofessional teams, is

Table 1. Key topics in SNA.

Social Network Feature	Key Structural Finding	Study or Source
Social networks	Relationships between a group of persons or entities	Wasserman and Faust, 1994 [22]
Social Network Analysis	Study of the relationships in a network	Crossley <i>et al.</i> , 2015 [23]
Node or actor	Each unit of the network	Crossley <i>et al.</i> , 2015 [23]
One-mode matrix	A network where the units share the same characteristics and are of the same group	Lockhart, 2017 [24] ; Yang, Keller and Zheng, 2017 [25]
Centrality	Central is the person who is more well-liked in his or her network	Scott, 2000 [26]
Prestige	The degree to which an actor collects or performs the aim of the interactions directed by other actors in the network	Knoke and Yang, 2008 [27]
Reciprocity	Is the relation of two nodes or actors where each one is a contributor and recipient of the action	Prell, 2012 [28]
Degree of reciprocity <i>r</i>	Measures of how intense are dyadic interactions within actors in a team	Social Network Visualizer, 2019 [29]
SNA enquire	Method where the researcher asks the persons participating in the research to select another member of their network according to a significant object of investigation	De Brún and McAuliffe, 2018 [30]
Adjacency matrix	A table with nodes described both in rows and columns and defining their relationships	Yang, Keller and Zheng, 2017 [25]
Homophily	Social networks where individuals tend to select others based on some similarities	McPherson, Smith-Lowin and Cook, 2001 [31]
Heterophily	Social networks where actors are linked to other actors in the network who have characteristics dissimilar from their own	Xie <i>et al.</i> , 2016 [32]
Hubs	Areas of social networks with a high density of ties between nodes	Franks <i>et al.</i> , 2008 [33]
Opinion leaders	Actors of the network who are more central and contacted more frequently when other actors require information	Yousefi Nooraie <i>et al.</i> , 2017 [34]
Core-periphery	A network where there is a center with nodes more closely related and a periphery of less tied nodes	Gamble <i>et al.</i> , 2016. [35]
Gap	Lack of partnership within actors or social distance between nodes	Bright <i>et al.</i> 2019; [36] Qiao <i>et al.</i> , 2014 [37]
Edges	Are the lines or ties that connect the nodes	Crossley <i>et al.</i> , 2015 [23]
Core-periphery	Core-periphery configuration has a central part with actors intensely tied between them and a periphery with dispersed nodes mostly tied to core actors than between themselves	Crossley <i>et al.</i> , 2015 [23]

considered vital for patient safety and the quality of care [42]. SNA analysis captures the areas of interprofessional practice that need remedial actions to reduce gaps in patient care [43]. The application of SNA in healthcare research has found correlations between social networks and outcomes in patient care [44]. These interactions usually occur between actors or nodes, while the intensity of these connections is captured by mathematical models and figuratively by the thickness of the ties or arrows in SNA [28].

1.4. Key Topics in Social Network Analysis

Different terms and categories are linked to the study of social networks (Fig. 1). Networks, where there is a flow of knowledge and information, tend to conform to a layout called core-periphery, with the core represented by individuals closely tied and often independent from individuals in the peripheral area of the network, frequently consisting

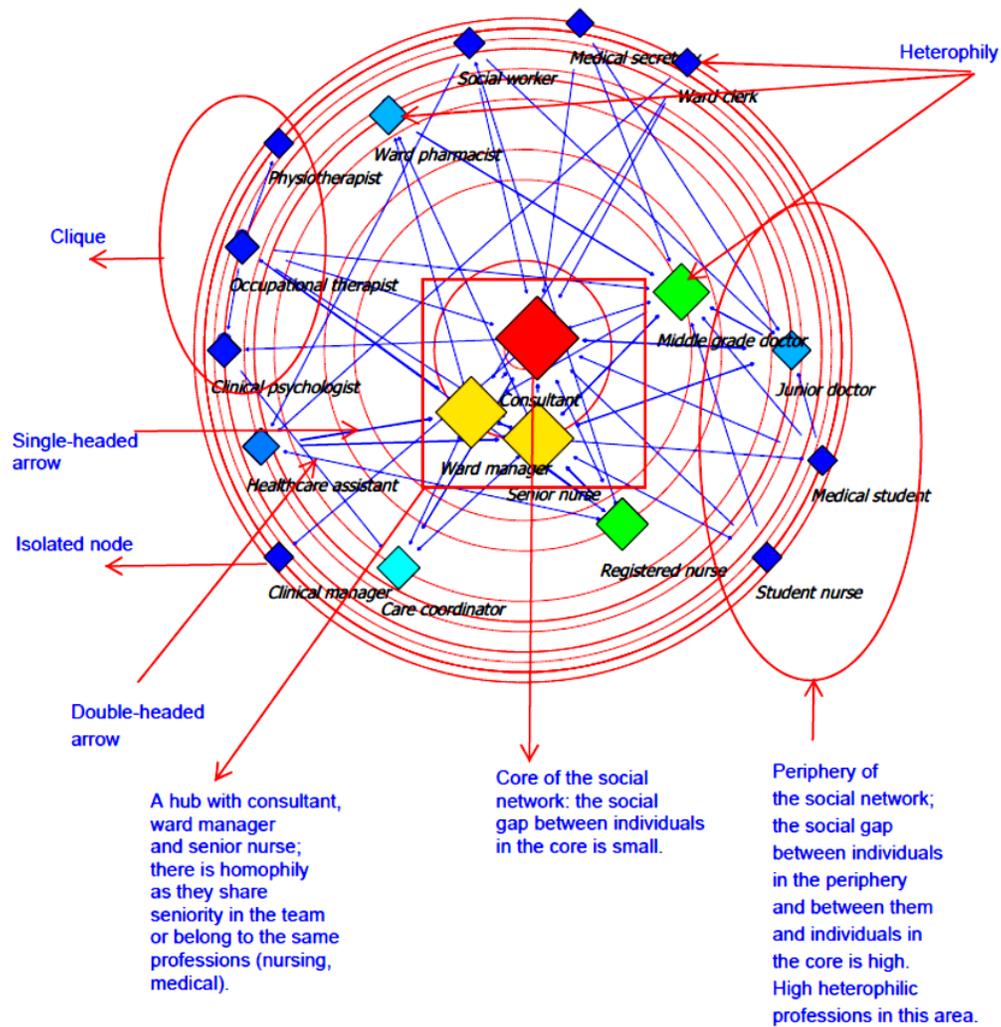


Fig. (1). The figure represents a social network with a core-periphery configuration. The more interconnected nodes usually occupy the core; they can also create a hub. Nodes with higher centrality also have a larger size. In the figure, the social gaps between core actors are small. There are more dispersed nodes of heterophilic individuals at the periphery with little connections with other actors in the network and between themselves. In the social network reported, the gap between individuals in the periphery and individuals in the core is significant. When present, single-headed arrows go from one node to another in a single direction. When reciprocity is instead present, the arrows become double-headed, connecting two nodes in a mutual relationship. (A higher resolution / colour version of this figure is available in the electronic copy of the article).

of actors creating small cliques or independent clusters [35]. Core-periphery configuration displays a central region with actors intensely tied between them and a periphery with dispersed nodes more frequently bound to core actors than themselves [23]. The concept of homophily was first created by McPherson, Smith-Lowin, and Cook (2001) to indicate that in social networks, individuals tend to select others based on similarities that can be economic, demographic, ethical, or attitudinal; occupying the same roles and positions within social networks can create the conditions for homophilic relationships [31]. Crossley *et al.* (2015, p. 15) further distinguish between ‘Status Homophily’ and ‘Value Homophily’ [23]. ‘Status Homophily’ is a trend within a network for actors to be highly linked to other actors who have one or more similar prominent characteristics [23]. ‘Value Homophily’ is a trend within a network for actors to be highly linked to other actors because they share some standards and or choices [23]. In sociology, the search for

others who are different from the self in some characteristics, heterophily, infers a risky venture, while homophily is more helpful in large social groups [45].

In social networks, a high level of reciprocal ties is indicated by the dominance of double-headed arrows between nodes [46]. Individuals in homophilic groups tend to interact and communicate within themselves more intensely or frequently than with other actors as in heterophilic groups [47]. Homophilic ties tend to be reinforced by the process of natural selection of other members with strong similarities [48].

Zones with high homophily tend to form ‘hubs,’ that is, areas of social networks with a high density of ties within individual nodes and a greater likelihood of getting new contacts within actors of the hub [33, 49]. Hubs are often occupied by more experienced people in the team, or ‘opinion leaders,’ that occupy the more central region of the so-

cial network and, in healthcare, are the most frequently contacted by their team when information, knowledge, and experience are needed in patient care [34]. Hence, actors with strong affiliations also tend to have more frequent reciprocal ties and form cliques or clusters of different sizes [25, 50].

However, extreme homophily might reduce the diffusion of information and knowledge within the social network and amongst other professionals [51, 52]. More extensively, the likelihood of medical practitioners adopting evidence-based medicine was positively associated with participation in heterophilic or multidisciplinary teams and negatively associated with homophilic groups [53]. Areas of a social network with few ties between members and a lower degree of partnership between them are called 'gaps'; they lead to the reduced effectiveness of the whole organization [36]. A gap can be interpreted as the social distance between individuals in the social network, both when closely associated (small gaps) (in this case sharing the same social characteristics such as job, working in the same environment, having the same goals), and when loosely associated (significant gaps) (not sharing the same collective characteristics) [37]. Hence, SNA provides both a graphic and sociometric account of how healthcare workers interact within interprofessional teams, while the presence of gaps helps provide the instruments for backing collaborative care and social development [54]. Network analysis might refer to this occurrence as 'structural holes,' indicating breaks between several areas of a social network [55]. These conglomerations or bonds between the actors of a social network are driven by different factors (e.g., professional backgrounds), giving rise to large or small sub-groups [56].

1.5. Applications of Social Network Analysis

Understanding social networks, inclusive of the dynamics of the interchange of information, knowledge management, and advice between different professional figures on interprofessional teams, is considered vital for patient safety and the quality of care [42]. SNA analysis captures the areas of interprofessional practice that need remedial actions to reduce gaps in patient care [43]. The application of SNA in healthcare research has found correlations between social networks and outcomes in patient care [44].

SNA is also an instrument for evaluating whether cooperation or divisions are apparent in providing care to shared patients and capturing areas of reinforcement [57]. Network cohesion has been linked to the continuity of care of patients with psychiatric pathologies [58]. The primary goal of SNA is to represent social events by measuring the organizational relationships of small groups of persons, organizations, or larger sets and by capturing their patterns of interactions [27]. SNA helps estimate the degree of centrality and prestige of the healthcare actors of a network by portraying their influence on the social network of reference; moreover, it can determine closeness and reciprocity and estimate the degree to which members of a social network form reciprocal ties [59]. Therefore, the primary objective of SNA is to capture the interactions between the actors of a social system [60]. The following paragraphs describe the research methodology for tackling the study hypothesis.

2. AIMS AND OBJECTIVES

2.1. Aim

The current study critically evaluates interprofessional collaboration in patient-centered practice in hospital and community psychiatry for PWA.

2.2. Justification of Aims

Currently, few studies are addressing interprofessional practice in dementia care [61]. Most research has focussed on the interprofessional practice between doctors and nurses [62]. Previous research from the authors suggests that integrated care of PWA more than other geriatric specialties can be implemented only when healthcare workers cooperate to address synchronously – all at the same time on a specific task as in inpatient settings – or asynchronously – different carers at different moments as in community settings – different aspects of PWA personhood [63]. Studies of interprofessional geriatric care suggest that collaboration is vital for chronic dementia and its requirements are integrated and holistic care provided and advanced only by working collaboratively and not in silos management [64]. Besides, collaborative care does not develop intuitively [65], while there is limited research on the practical configuration of interprofessional care in inpatient and outpatient geriatric settings for PWA [63]. More than any other medical setting, interprofessional care of PWAs is a pivotal action to promote their biological (e.g., reduction of risk choking), individual (e.g., communicating empathically), and sociologic (e.g., involving community meetings) personhood [66]. Without this coordinated action in geriatric care, there is a risk of reinforcing interprofessional barriers and endorse a 'Type A' setting with rigid divisions between professionals and missing information between more senior positions and other professionals also involved in the PWA care [67].

2.3. Objectives and Research Hypotheses

Objective 1 aims to use SNA to evaluate how different geriatric psychiatric professionals in PWA care collaborate and identify opinion leaders in their teams. SNA will assess their *Degrees of Prestige (DP)* when they are engaged in exchanging information and receiving and providing advice to colleagues. Study 1 will tackle Objective 1.

Objective 2 aims to identify the *Degree of Reciprocity r* in interprofessional teamwork in the geriatric psychiatric care of PWA. Study 2 will tackle Objective 2.

Research or Null Hypothesis H₀1 is that SNA shows no differences in DP in the teams assessed.

Research or Null Hypothesis H₀2 is that SNA shows no differences in *r* in the teams assessed.

3. POPULATION AND METHODS

3.1. Methodology

The current study is based on hypothesis testing and is a cross-sectional study with a mixed-method research approach. In SNA, the nodes represent psychiatric professionals who collaborate in patient care. The figurative illustration of their

interactions, the social network, describes the qualitative part of the research, showing in one preview how professionals collaborate. The network model of such collaboration illustrates ‘how’ people/nodes interact, cluster, isolate or collaborate within the social network *via* their ‘edges’ or ties (Fig. 1), representing the information and advice received or provided by each node [23]. All these data are not numerical but represent the qualitative/descriptive aspect of the network analysis of interactions between nodes. The data necessary to construct the network are extracted from the adjacency matrix (Table 3) that provides a nominal output where the column is the professional who is choosing, and the row is the professional that is chosen in the survey. In other words, the qualitative inquiry answers the question ‘which professional is chosen by whom?’ The numerical or quantitative analysis captures ‘how frequently’ people are central in the network; hence, it shows how many edges or ties (representing exchanged information and advice) each node/person has with other nodes [23]. The quantitative outcome is the *degree of prestige* and *reciprocity* of each professional figure within the own team [29].

3.2. Setting and Data Collection

The setting was represented by dementia psychiatric wards and community psychiatric teams treating PWA. The current study was initially piloted in several general psychiatric inpatient and outpatient services to improve the research instruments. The second stage involved the piloting of the action research into dementia psychiatric inpatient and outpatient services. In these teams, interprofessional collaboration is central for enhancing the quality of care and reducing PWA’s risk to self and others. Each member should coordinate with other colleagues with different roles to address complex needs and deliver integrated care. The population comprised people from age 60 above with a diagnosis of dementia and Alzheimer’s disease. The sample teams worked on a 24-hour shift and were active through constant exchanges of advice and information and knowledge in PWA care.

3.3. Selection Criteria: Inclusion and Exclusion Criteria

The data were collected online. The sample participated voluntarily and comprised anonymous responses to an online survey. The target population was psychiatric professionals working with PWA in the UK. The SNA survey was completed online by accessing a web platform. The criterion for inclusion was that the professional worked in the healthcare system in geriatric psychiatry in a public or private setting. The criterion for exclusion was healthcare professionals not involved in psychiatric teams. Those on leave could also access the survey.

3.4. Statistical Methods

3.4.1. Quantitative and Frequency Analysis

An online survey collected the data. The outcome of the quantitative research was the frequency or percentage of times an individual professional was consulted for advice and information in patient care and percentages in DP,

hence providing a numerical value for the social network. Confirmatory meta-analysis computing the coefficient of heterogeneity I^2 was used to accept or reject the null hypotheses. Open-Meta-analyst [68, 69] was the software of choice for such computation. A statistically significant I^2 indicated an unequal distribution in the outcome percentages; consequently, the null hypothesis H_0 , implying that percentages of the outcomes were equally distributed, could be rejected. The alpha or type one error was set at $p=.05$, accepting as statistically significant only values equal or less than alpha. The differences in percentages were also set by stating that the outcomes (percentages in the survey items answers) showed significant heterogeneity. The measure I^2 conveyed this degree of heterogeneity; it can span from 0% (zero) to 25% (small), 50% (modest) or 100% (significant), demonstrating that the percentages of the responses exhibited a non-random division [70]. Similarly, the probability p at meta-analysis for I^2 also established this non-random distribution in the numerical outcomes [71].

3.4.2. Qualitative and Quantitative Analysis

3.4.2.1. Study 1: Calculating the Degree of Prestige

The Software Social Network Visualizer 2.4 [29] generated the SNA graphs and computed the DP and r of each professional figure in the psychogeriatric teams. The qualitative research resulted in pictorial representations of how the professional figures in the social network collaborated; these graphs reported the centrality and isolation of specific professional roles. SNA utilized the percentage of degrees of prestige (%DP), where 0% represents no ties, and 100% corresponds to an actor having ties with every interprofessional team member. Ties can also be ‘interprofessional’ for team members sharing the same profession (e.g., two consultants) or ‘interprofessional’ for team members who do not share the same profession (e.g., the senior nurse and the consultant) [72]. The ties or edges within nodes or team members also have different weights or thickness measures in the graph according to the number of ties that link the team members [72]. In the network graphs, the size of a node is related to the centrality of the actor. SNA also has the advantage of capturing the number of ties that link the network’s members [30]. A related concept that emerged from the figurative analysis of the social networks of the current study, generating circular configurations, was that of the ‘core,’ where the links between the nodes are more intense than those at the ‘periphery,’ where individual nodes have fewer links with the other members of the network or none at all [73].

3.4.2.2. Study 2: Calculating the Degree of Reciprocity

SNA captured dyads of reciprocity r that determine the probability that the nodes of a network are mutually related, with values ranging from ‘0’ when there is no reciprocity in the network to ‘1’ when all actors have reciprocal connections [29]. The r can also be expressed as a percentage with a minimum value of 0%; a maximum of 100% expresses total reciprocated connections within a network (Fig. 2).

3.5. Sample

The sample population was represented by 50 psychogeriatric professionals working in dementia psychiatric

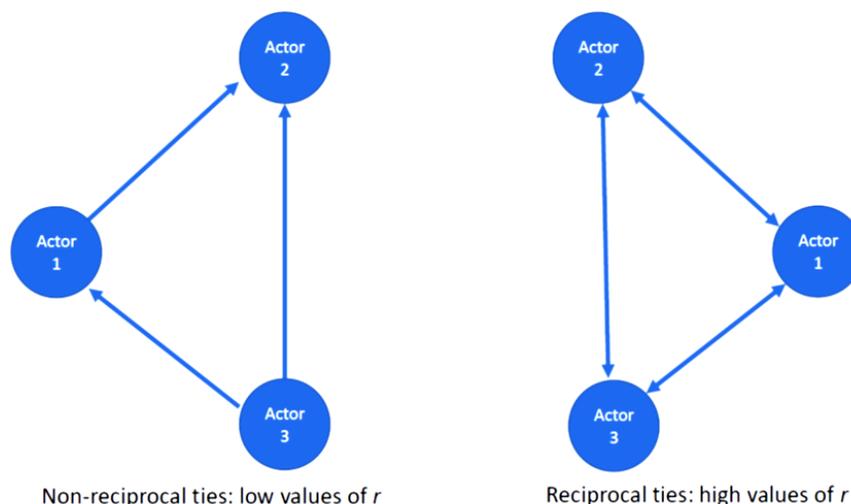


Fig. (2). Non-reciprocal and reciprocal ties. (A higher resolution / colour version of this figure is available in the electronic copy of the article).

wards and community dementia teams accessed by PWA. The minimal number of people required to generate a social network was one professional for each category. Hence, the model needed at least 18 different professions. In other words, the SNA network had at least 18 nodes (professionals) with 153 ties ($[18 \times 17] / 2$) [23]. The sampling was opportunistic, as respondents were invited by email or in-person to anonymously complete an online survey. Those who did not meet the cited categories were automatically excluded from the research. The number of choices/ties that generated the summative network graph was 415.

3.5.1. Demographic Characteristics

- Professional figures of the target population in psychogeriatric teams consisted of consultant, middle-grade doctor, specialist registrar or associate specialist, junior doctor or trainee doctor, ward manager, registered nurse, senior nurse or sister, ward manager, clinical leader, healthcare assistant, clinical psychologist, occupational therapist, art therapist, physiotherapist, ward clerk, medical secretary, care coordinator, social worker, hospital or ward pharmacist.
- Types of contracts with the hospital were permanent contract, fixed-term contract, part-time contract, locum agency contract, other forms of contracts.
- Length of experience in the profession was less than 1 year; from 1 to 5 years; from 5 to 10 years; more than 10 years.

3.5.2. Survey Questions

- “Which professional members of your team do you most frequently approach for advice on the care of PWA?” It is a multiple-choice question asking the respondents to select up to three professional figures they usually approach for receiving guidance during the care of a PWA.
- “Which professional member of your team do you most frequently approach to advise on the care of PWA?” It is a multiple-answer question asking the respondents to

select up to three professional figures they usually approach to guide the care of a PWA.

- “Which professional member of your team do you most frequently approach to get information on PWA?” It is a multiple-answer question asking the respondents to select up to three professional figures they usually approach for information during the care of a PWA.

4. RESULTS

4.1. Population

Table 2 shows that the most represented professional role was the staff or senior nurse (16%), with a permanent contract (76%) and with 5 to 10 years of experience (26%).

4.2. Summative Data

The data were condensed into Table 3 and Figs. (3 to 9). Table 3 is the adjacent matrix for the whole study, while Table 4 summarizes the whole study.

4.3. Study 1

The objective of study 1 was to use SNA to illustrate how different psychogeriatric professionals collaborate in their teams in terms of sharing information and receiving and providing advice in PWA care. Results are summarised in Table 4 and Figs. (3-5).

4.3.1. The Professional in the Team that is Approached Most Frequently to Receive Advice About Patient Care

The summative findings are provided in Table 4 and Fig. (3). The figurative, qualitative and quantitative analysis of the social network confirmed that some professionals occupied central positions with a high degree prestige (%DP), such as the consultant (DP = 21.37%), ward manager (DP = 16.55%), senior nurse (DP = 16.55%), speciality doctor (DP = 11%) (also called middle-grade doctor) and registered nurse (DP = 8.96%). The findings are not equally dispersed as data show high heterogeneity in the distribution of DP ($I^2 = 99.85\%$; $p < 0.001$).

Table 2. Biographical characteristics of the sample.

Role	Count (N) (total n=50)	Percentage (%)
<i>Professional role:</i>		
Consultant	4	8
Specialty doctor	2	4
Junior doctor	4	8
Medical student	1	2
Student nurse	2	4
Registered nurse	4	8
Staff or senior nurse	8	16
Ward manager or sister	2	4
Care coordinator	3	6
Healthcare assistant	5	10
Clinical psychologist	1	2
Occupational therapist	2	4
Hospital or ward pharmacist	4	8
Social worker	2	4
Ward clerk	1	2
Medical secretary	2	4
Other	3	6
<i>Form of contract:</i>		
Permanent	38	76
Fixed-term	1	2
Part-time	1	2
Locum agency	1	2
Other forms	2	4
<i>Years of experience in the service provision:</i>		
Less than one year	11	22
From one to five years	4	8
From five to ten years	13	26
More than ten years	18	36
No answer	4	8

Table 3. Adjacency matrix for the summative findings.

		PROFESSIONAL SELECTED																			
		Consultant	Middle-grade or senior doctor	Junior doctor	Medical student	Student nurse	Registered nurse	Staff or senior nurse	Ward manager or sister	Care coordinator	Clinical manager	Healthcare assistant	Clinical psychologist	Occupational therapist	Physiotherapist	Hospital or ward pharmacist	Social worker	Medical secretary	Ward clerk	Patient	Other
PROFESSIONAL SELECTING	Consultant	5	2	2	0	0	3	1	1	4	2	1	1	0	0	0	1	0	0	0	1
	Middle-grade or senior doctor	4	1	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0
	Junior doctor	7	5	2	1	0	2	9	1	0	0	3	0	0	0	0	0	0	0	0	1
	Medical student	3	2	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Student nurse	1	2	0	0	1	2	5	1	0	0	1	0	0	0	0	1	0	0	0	0
	Registered nurse	7	3	0	0	1	7	10	4	1	0	3	0	0	0	0	3	0	0	1	0
	Staff or senior nurse	18	4	3	1	1	3	13	14	5	0	0	0	0	0	2	0	0	0	2	1
	Ward manager or sister	2	0	0	0	0	1	3	2	5	0	1	0	0	0	4	0	0	0	1	0
	Care coordinator	8	2	2	1	1	4	6	7	3	0	1	0	0	0	0	3	0	0	1	0
	Clinical manager	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Healthcare assistant	0	0	0	0	0	8	12	10	0	0	3	0	0	0	0	0	0	0	1	0
	Clinical psychologist	0	0	0	0	0	0	0	1	3	0	0	2	0	0	0	0	0	0	0	0
	Occupational therapist	4	3	0	0	2	7	6	4	0	0	0	1	6	4	0	0	0	0	0	0
	Physiotherapist	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hospital or ward pharmacist	8	9	2	0	0	2	8	6	0	0	0	0	0	0	0	0	0	0	1	0
	Social worker	5	0	1	0	0	6	0	0	2	0	3	0	0	0	0	2	0	0	0	0
	Medical secretary	6	6	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ward clerk	2	0	0	0	0	0	0	2	0	1	1	0	0	0	0	0	0	1	0	0	

Table 4. Summary of study 1 and 2.

-	Provided Advice About PWA Care		Received Advice on PWA Care		Provided Information About PWA		Summative Data	Degree of Reciprocity
	%Answers	%DP	%Answers	%DP	%Answers	%DP	%DP	<i>r</i>
<i>Professional (Sample N=50)</i>								
Consultant	68%	21.37%	46%	16.40%	52%	14.44%	19.27%	0.07
Speciality doctor	32%	11.03%	24%	9.37%	22%	7.09%	9.39%	0.12
Junior doctor	12%	4.13%	16%	6.25%	10%	3.54%	4.57%	0.11
Medical student	2%	0.69%	4%	0.78%	0%	0.00%	0.72%	0.00
Student nurse	2%	0.69%	6%	2.34%	2%	0.00%	1.68%	0.14
Registered nurse	26%	8.96%	30%	11.71%	42%	14.89%	12.28%	0.09
Senior nurse	48%	16.55%	48%	18.75%	54%	18.44%	19.27%	0.08
Ward manager	44%	16.55%	32%	12.50%	40%	15.60%	13.01%	0.09
Care coordinator	16%	5.51%	12%	4.68%	20%	7.09%	5.78%	0.10
Clinical manager	4%	0.69%	2%	0.78%	4%	1.41%	0.72%	0.00
Healthcare assistant	10%	3.44%	12%	4.68%	12%	3.54%	3.61%	0.14
Clinical psychologist	6%	2.06%	2%	0.78%	0%	0.00%	0.96%	0.33
Occupational therapist	6%	2.06%	4%	1.56%	4%	1.41%	1.44%	0.20
Physiotherapist	2%	0.69%	4%	1.56%	2%	0.00%	0.96%	0.00
Ward pharmacist	6%	4.13%	6%	2.34%	0%	1.41%	1.44%	0.00
Social worker	4%	1.37%	8%	3.12%	8%	1.41%	2.65%	0.18
Medical secretary	0%	0.00%	0	0.00%	2%	0.00%	0.00%	0.00
Ward clerk	0%	0.00%	0	0.00%	0%	0.70%	0.00%	0.00
Patient	-	-			14%	4.96%	1.44%	0.00
Others	-	-	2% ^a		-		0.72%	0.00
<i>I</i> ²	96.36%	99.85%	94.01%	99.85%	95.83%	99.84%	99.83%	89.23%
<i>P</i> -value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
<i>Tau</i> ²	0.008	0.000	0.005	0.00	0.04	0.00	0.00	0.001
<i>Q</i>	467.42	114.57	314.93	109.72	432.166	109.23	112.53	178.02

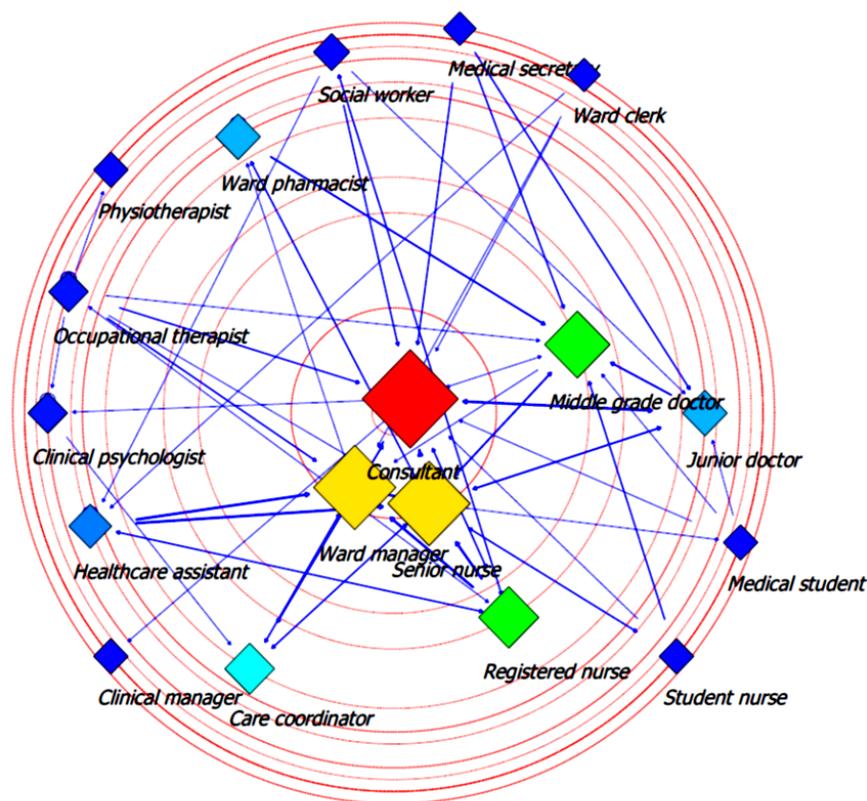


Fig. (3). Social network graph of psychiatric professionals most frequently approached for asking advice on the care of PWA. (A higher resolution / colour version of this figure is available in the electronic copy of the article).

4.3.2. The Professional who is Approached Most Frequently to Provide Advice on Patient Care

The summative findings are provided in Table 4 and Fig. (4). The figurative, qualitative and quantitative analysis of the social network confirmed that some professionals occupy central positions with a high degree of prestige %DP, including the senior nurse (DP = 18.75%), consultant (DP = 16.40%), ward manager (DP = 12.50%), registered nurse (DP = 11.71%) and speciality doctor (DP = 9.37%). All other professional figures have more peripheral positions with lower %DP. The findings are not equally dispersed as data show high heterogeneity in the distribution of DP ($I^2 = 99.85\%$; $p < 0.001$).

4.3.3 The Professional that is Approached Most Frequently for Receiving Information About a Patient

The summative findings are provided in Table 4 and Fig. (5). The figurative, qualitative and quantitative analysis of the social network confirmed that some professionals occupy central positions with a high degree of prestige %DP, including the senior nurse (DP = 18.44%), ward manager (DP = 15.60%), consultant (DP = 14.44%), registered nurse (DP = 14.89%) and speciality doctor (DP = 7.09%). All other professional figures (who are also involved in patient care) have, instead, more peripheral positions with lower %DP. The findings are not equally dispersed as data show high heterogeneity in the distribution of DP ($I^2 = 99.84\%$; $p < 0.001$).

4.3.4. Summative Findings and the Global SNA Model

The cumulative results showed that the number of total ties was 415. The roles with the maximum degree of prestige were consultant (DP = 19.27%), senior nurse (DP = 19.27%), ward manager (DP = 13.01%), registered nurse (DP = 12.28%) and speciality doctor (DP = 9.39%) (Table 4 and Fig. 6). The findings reject the Null Hypothesis H_0 1 as data are not equally dispersed while showing high heterogeneity in the distribution of DP for all professionals ($I^2 = 99.83\%$; $p < 0.001$) (Table 4 and Fig. 7).

4.3.5. Visual Analysis of Social Networks

Social networks (Figs. 6 and 7) show a characteristic core-periphery layout. The core forms a hub with psychogeriatric professionals with highly intense ties. These professionals show status homophily (being in the nursing and medical professions, years of professional seniority, performing clinical tasks) and value homophily (having highly intense contacts with PWA). The periphery is occupied by psychogeriatric professionals showing status heterophily (having different professional roles) and value heterophily (having less frequent contacts with PWA). The professionals at the core of the network have homophilic ties and tend to interact with other core professionals with the same roles (*i.e.*, a senior nurse with a ward manager or a consultant with a middle-grade doctor). The professionals at the periphery of the network are more dispersed and have heterophilic ties with professionals in the core, *e.g.*, the care

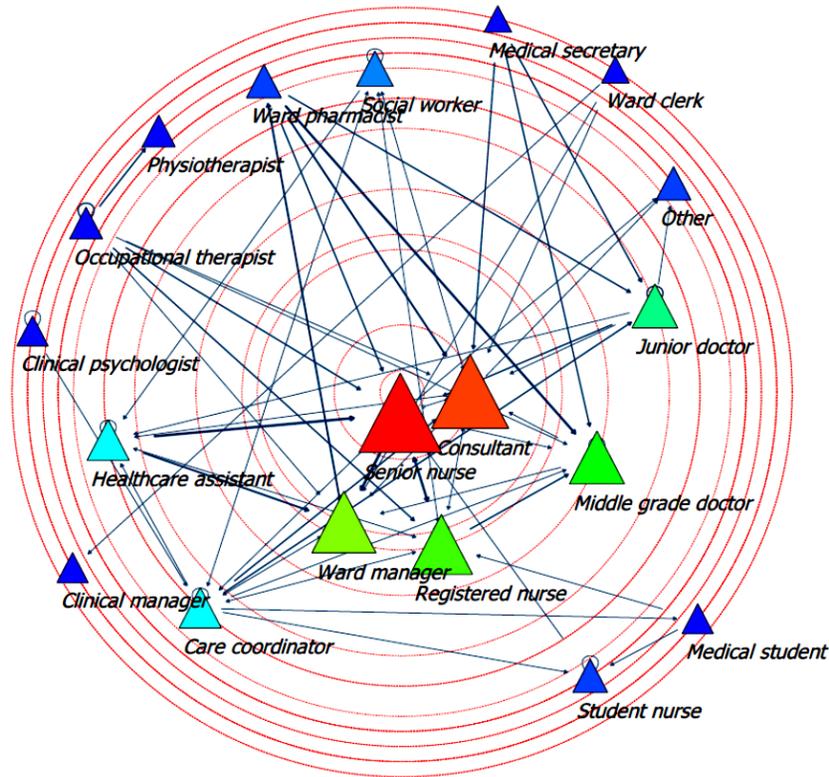


Fig. (4). Social network graph of psychiatric professionals most frequently approached for providing advice on the care of PWA. (A higher resolution / colour version of this figure is available in the electronic copy of the article).

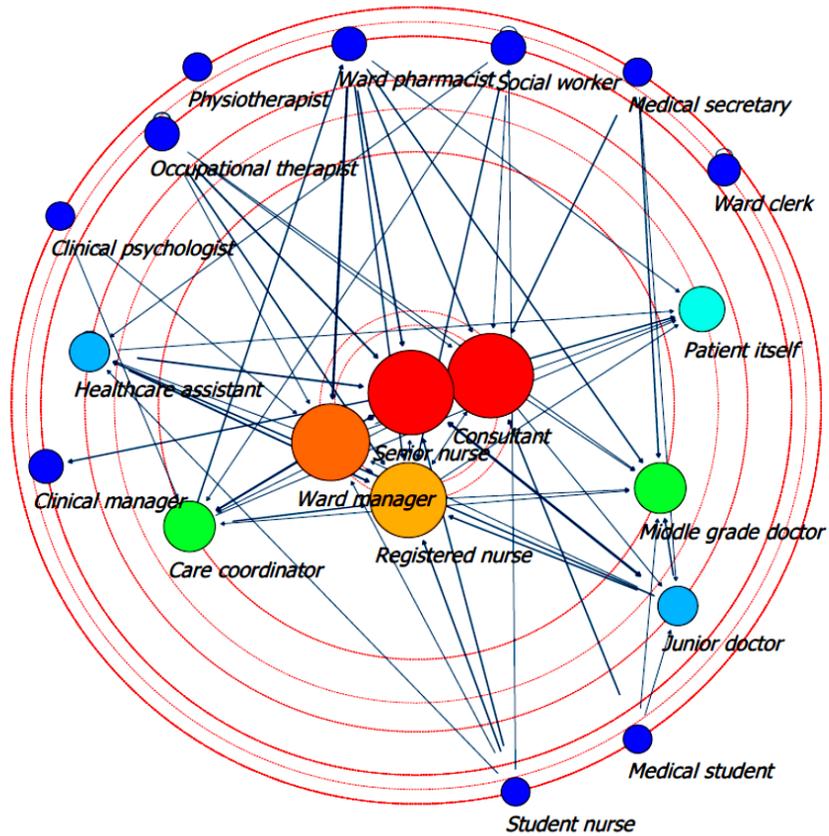


Fig. (5). Social network graph of professionals most frequently approached to receive information about PWA care. (A higher resolution / colour version of this figure is available in the electronic copy of the article).

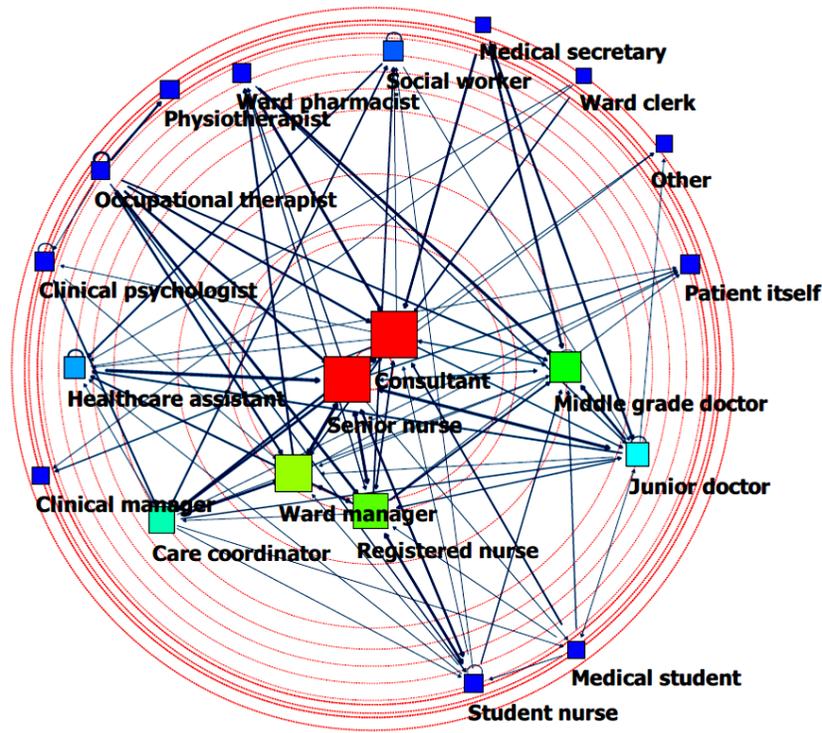


Fig. (6). Summative SNA for the degree of prestige. (A higher resolution / colour version of this figure is available in the electronic copy of the article).

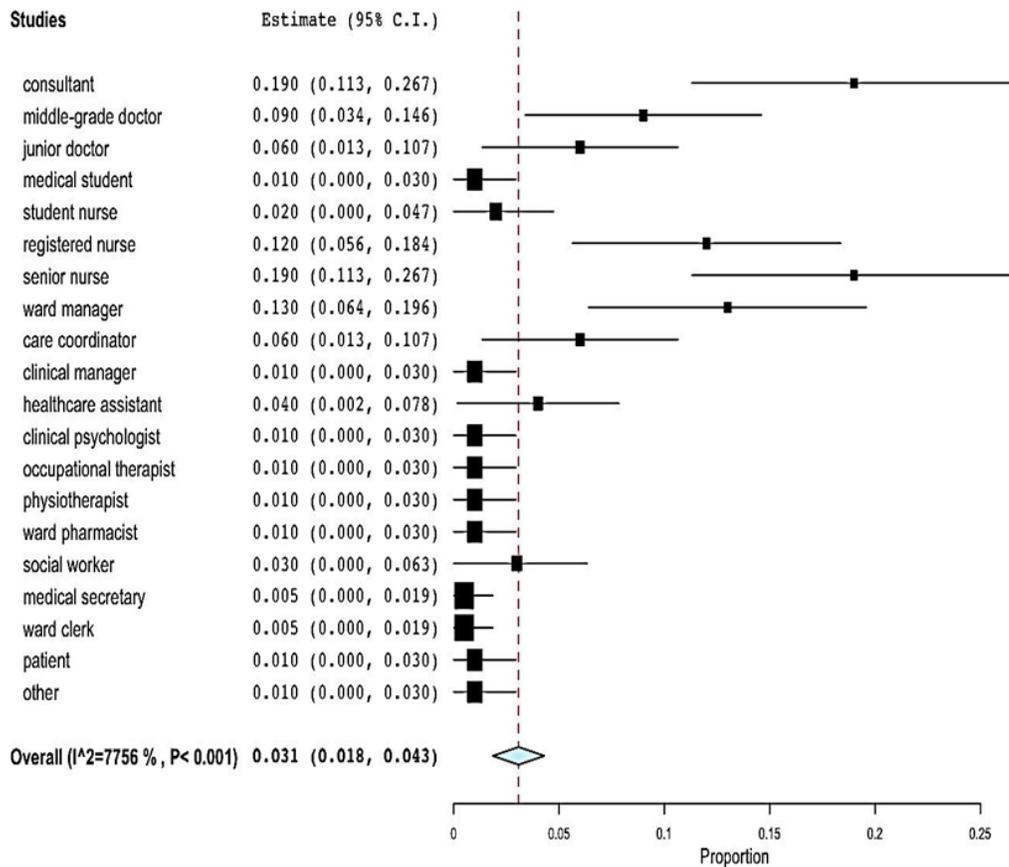


Fig. (7). Forest-plot for summative SNA of the degree of prestige. (A higher resolution / colour version of this figure is available in the electronic copy of the article).

coordinator with the consultant. The professionals at the periphery tend not to have ties between them. There are network gaps between core and peripheral professionals. Consultants, senior nurses, ward managers, registered nurses, and middle-grade doctors frequently occupy the core. Medical students, junior doctors, student nurses, social workers, ward clerks, ward pharmacists, medical secretaries, physiotherapists, occupational therapists, healthcare assistants, clinical psychologists, and clinical managers frequently occupy the periphery. The care coordinator appears to form a hub with central psychiatric professionals.

4.4. Study 2

The objective of Study 2 was to assess the degree of reciprocity r of all professionals in psychogeriatric teams by using SNA. The computation of the reciprocity factor r indicates how the actors in the network form dyads and have reciprocal ties [41]. This last parameter provides more evidence of interprofessional teamwork than unilateral ties or outbound arrows from one actor to another. In this case, the results showed that of all the pairs of actors examined in the network, only 13% had reciprocal connections and relationships. The findings show that the clinical psychologist had slightly more symmetric ties with other professionals ($r = 0.33$), followed by the occupational therapist ($r = 0.20$), the social worker ($r = 0.18$), the student nurse ($r = 0.14$), the healthcare assistant ($r = 0.14$), the middle-grade doctor ($r = 0.12$) and the junior doctor ($r = 0.11$) (Table 4). The findings reject the null hypothesis H_0 that reciprocity is uniformly distributed as data show high heterogeneity in the reciprocity factor r ($I^2 = 89.23\%$; $p < 0.001$) (Table 4; Fig. 9). The figurative analysis of the social network (Fig. 8) confirms that the professional figures with more reciprocal ties are different from those with more prestige than previous networks; in the figures of the social network, professionals with higher r occupy the centre.

5. DISCUSSION

5.1. SNA and the Configuration of Social Networks

Objective 1 of the current study evaluated how different professionals collaborate and identify opinion leaders in psychiatric teams by SNA. The data and configuration of the social networks emerging in the current research provide theoretical support of a core-periphery layout with homophilic professions occupying the core of the network and heterophilic professions more dispersed at the periphery. The findings are in keeping with the theory that suggests that the presence of homophily leads to the creation of a core-periphery social network [74]. The current research data also support other theories suggesting that where there is a flow of knowledge and information, social networks conform to a core-periphery layout [35]. The current study's findings also indicate that the core is occupied by those professionals that more frequently provide the whole interprofessional team with information and advice in patient care, such as consultants and senior nurses, followed by the ward managers, middle-grade doctors, and registered nurses. They also have higher degrees of prestige compared to other professionals. All other psychiatric professionals, such as clinical leaders, healthcare assistants, clinical psychologists,

occupational therapists, art therapists, physiotherapists, ward clerks, medical secretaries, care coordinators, social workers, and ward pharmacists, occupy more peripheral regions. As suggested by other authors, elite actors tend to occupy the network's core and have more dense connections within themselves [75].

5.2. SNA and Interprofessional Teamwork

Objective 2 of the study was to identify the degree of reciprocity in interprofessional teamwork in psychogeriatric care by using SNA. The findings of the current study indicate that although there are intense ties between the network professionals, only a low percentage of these connections satisfy the condition of reciprocity. Hence, very few nodes are linked to adjacent ones by a bilateral connection where each actor is both a source and recipient of the knowledge in patient care [23, 28]. Consequently, knowledge management is not equally distributed.

As previously mentioned, the presence of central hubs occupied by those who have more seniority might decrease the flow of knowledge to the periphery, hence reducing the likelihood that the whole network can quickly react to potential crises [76] in patient care. As other authors advise, for effective interprofessional practice, relationships between different professional roles are more important than relationships with professionals sharing the same areas of expertise [77]. However, this hypothetical configuration appears to be under-represented in the networks captured in the current study.

5.3. How Interprofessionalism Improves Care?

In a recent survey, core trainees in psychiatry expressed gaps in their training and areas of reinforcement in learning collaborative work (also including patients), shared decision making, and joint care planning [78]. A systematic review of 141 studies indicated that collaborative team-based care practice had been found to have a positive impact on patients' care, although limited evidence exists for positive outcomes when involving opinion leaders and specialists [79]. The findings of the current study indicate a centralization of prestige (decision-making and advice-giving) in the most senior geriatric figures, suggesting policies to reinforce collaborative care, information sharing, and interprofessionalism while avoiding silos management in the care of PWA. Besides, the current study also captured a small number of reciprocal ties/edges between all healthcare professionals in geriatric care and the creation of centralized cliques (senior psychogeriatric professionals) to the detriment of decentralization and peer-support and knowledge sharing. In the United States, a report commissioned by The National Academy found that the bulk of healthcare errors are not the result of human irresponsibility but rather are the result of flawed programs, procedures, and circumstances that cause individuals to make errors or neglect to avoid them [80]. Despite evidence-based policies that support interprofessional cooperation and treatment, human factors often impede successful implementation; policy aspects of interprofessional collaboration include providing a voice to all team participants and promoting discussion based on diverse

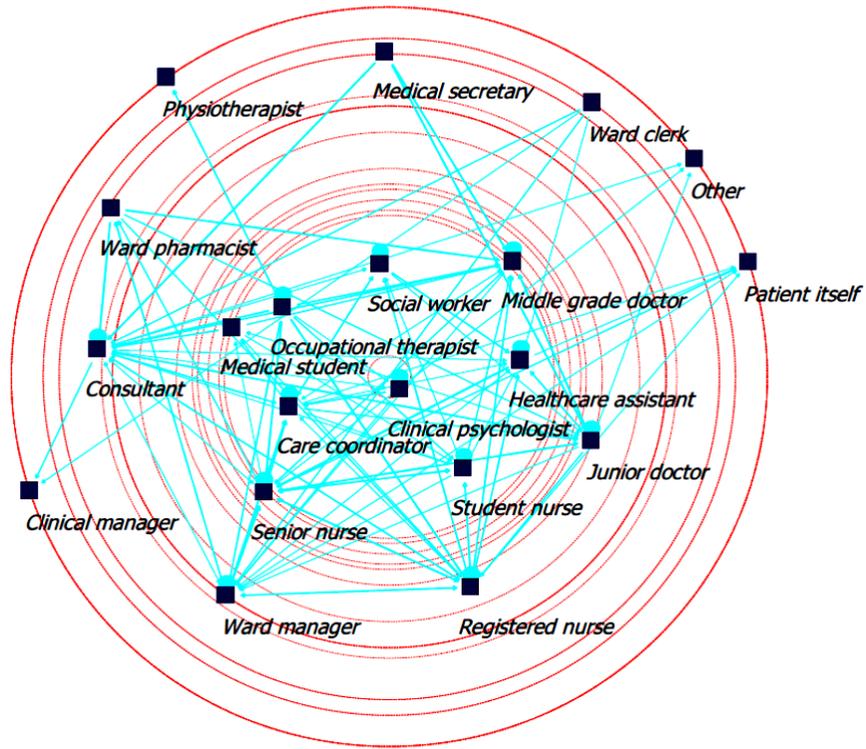


Fig. (8). SNA for the degree of reciprocity. (A higher resolution / colour version of this figure is available in the electronic copy of the article).

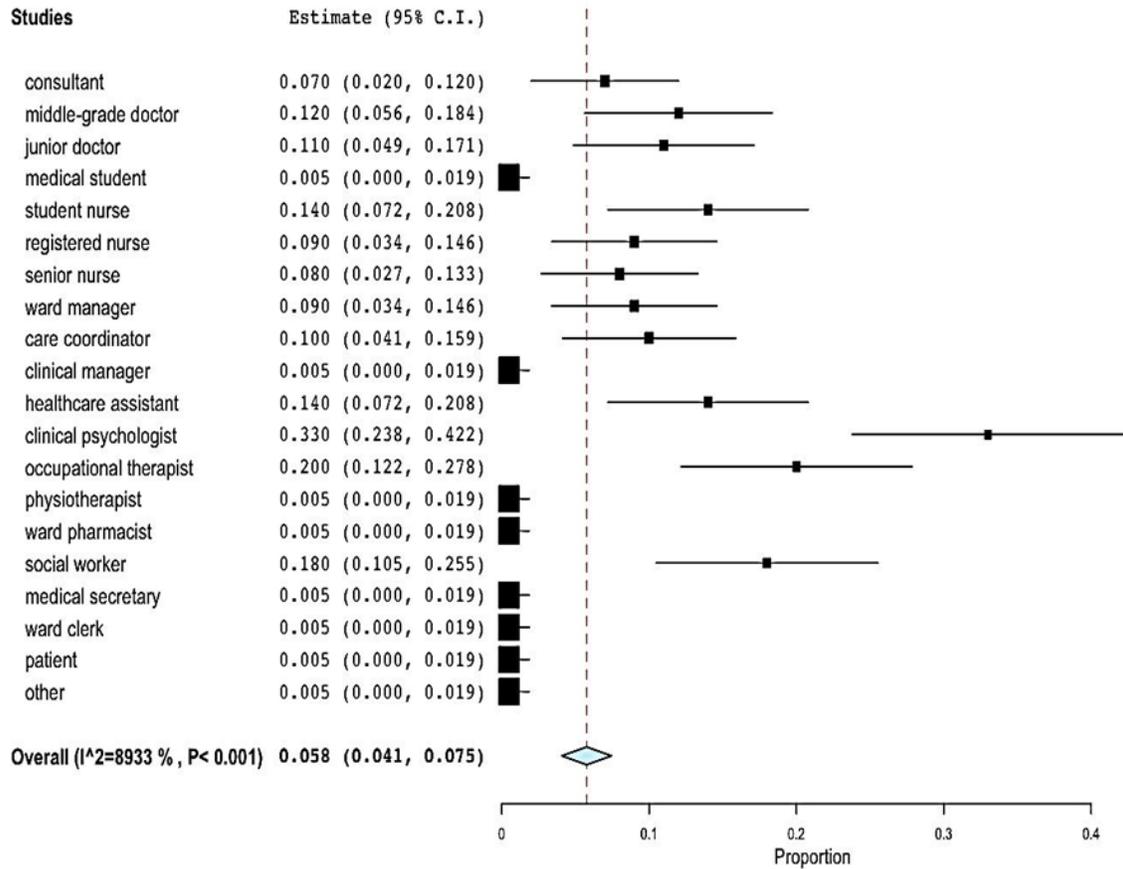


Fig. (9). Forest plot for SNA of the degree of reciprocity. (A higher resolution / colour version of this figure is available in the electronic copy of the article).

experiences and opinions [80]. Reduced interprofessional practice jeopardizes evidence-based medicine where each professional's action is instead guided by reciprocal sharing of knowledge with colleagues; this process will accrue the personal and collective bank of information about patients and deliver holistic and coordinated care [81]. Besides, integrated interprofessional team practice reduces medical and pharmacological errors by improving shared information, reducing gaps in actions and collateral support, and increasing responsiveness and accountability in multidisciplinary teams [82].

5.4. How Does SNA Inform Clinical Outcomes?

The promotion of PWA personhood and cognitive stimulation and activation requires the participation of diverse experts (*e.g.*, nurses, doctors, psychologists, physiotherapists, healthcare assistants, and other healthcare professionals), each one with the know-how necessary to attend to the multifaceted aspects of Alzheimer's disease [20, 83]. Social networks configuration emerging in the current study provide some hint that centralized geriatric care, although based on pivotal senior and expert figures, might not provide rapid response in clinical conditions of novelty, emergence, and rapid deterioration of PWA [66] where in these last conditions (centralized knowledge management), and immediate consultation and information might not be available, for instance, in decentralized geriatric units, night shifts, community work and for 'peripheral workers', PWA are at risk for safety and health [66]. Instead, these findings should match the National Institute for Health and Care Excellence plan to implement interprofessional trust and shared help provision to support patient-centred care [84]. SNA can help reconfigure teamwork in PWA's psychogeriatric care while capturing when silos leadership inclines to a centralized *vs.* collaborative care to PWA. For instance, a systematic review found that one strategy to promote collaborative care is to increase multidisciplinary meetings which promote increasing internal audits and improve patient care [85]. Nonetheless, owing to the variety of activities required for the activation of cognitive and social skills in PWA, dementia health carers can reorganize their resources when shaping diverse acts for patient promotion in an environment of reciprocal recognition, self-reflection, change, and the quest for innovative alternatives in patient care [17]. This reconfiguration of the sociograms capturable by SNA was also found to increase each member of staff's job satisfaction by encouraging feelings of coalition and support from peers during complex tasks on patients [86].

5.6. How do Social Networks and Diffusion of Knowledge in PWA Differ from other Geropsychiatric Units at other Institutes?

Interprofessional practice in psychogeriatric inpatient sees the same professional as promoting different aspects of PWA personhood, or on the contrary, different professionals advancing the same aspect of PWA personhood independently from their professional specification [63]. If collaborative care is vital for addressing PWA with multiple needs, the model proposed cannot always be replicated in other specialties and healthcare sectors where more specific divi-

sions of the tasks and skills are required to complete a task. Other times, the capitalization of knowledge moves its steps also according to scientific development where technologically advanced students use know-how and collaboration within several individuals from various fields (*e.g.*, architecture, industry, and health care) to collaborate as an interdisciplinary team to apply creative ideas to a task also as creative hubs [87]. Research conducted in a teaching hospital in the Netherlands confirms that team members differ in the interpretation of care planning. At the same time, physicians reported a central and pivotal role in medical decisions [88]. Due to the complexity of PWA needs, SNA findings showed the high DP of senior figures, although more peripheral figures could equally provide valuable inputs to the whole team when consulted. From our experience, independently from seniority in the team, many professionals, also those who occupy more peripheral areas of the social network, undergo specialized training in specific areas of PWA care. If their capital of knowledge is not shared with colleagues in interprofessional teams, there is a risk of loss of vital information for the care of PWA. The current study confirms that centralized cliques are still active in PWA psychogeriatric care, and it can be hypothesized the risk of loss of capital knowledge with small reciprocity of ties. Instead, diffuse interprofessional care would suggest more reciprocal ties/edges in information and consultation sharing where each professional is guided by and can guide others in a coordinated PWA care.

5.3. Limitations of the Current Study

The findings of the current study can only be applied to psychogeriatric teams working with the adult population with dementia and Alzheimer's disease. Besides, the application of the findings is restricted due to the limited number of professionals who completed the survey. The groups of participants were not randomly selected, hence reducing the generalisability of the study. Furthermore, no control group from non-psychiatric wards was used for a comparison of collaborative care. Therefore, it is predictable that distinctive social networks exist in other teams, although the current analysis did not capture these dynamics. The findings are linked to the teams explored here and can only be hypothetically generalised to similar teams. Therefore, the current research has some degree of contextual limitation. Another limitation derives from the nature of consultation and information sharing within the healthcare system, where much can occur on a digital platform independently from face-to-face approaches. Hence, the SNA can be both a natural and virtual network of exchanges inclusive of face-to-face encounters or distance communication. The current study did not explore such differences. Besides, the configurations of the social networks did not provide any information about their effectiveness in PWA care; this last has only been assumed based on similar studies.

CONCLUSION

SNA offered a snapshot of psychogeriatric teams in terms of professional figures who are more central in disseminating knowledge to the whole team and the degree of reciprocity in interprofessional relations. The current re-

search findings have practical applications in the implementation of collaborative practice as recommended by national and international guidelines in interprofessional care. Hence, the current study results can help policymakers understand team dynamics within psychogeriatric teams and advocate targeted interprofessional training and knowledge management for such teams. The initial findings appear encouraging in identifying SNA as a reliable and valid instrument to study interprofessional practice in healthcare settings and old-age psychiatry. The current study could be continued by involving other psychiatric teams that were hard to reach during the current stage of assessment. This opportunity would explore other dynamics in interprofessional care in psychiatry and other areas of reinforcement.

LIST OF ABBREVIATIONS

DP	=	Degree of Prestige
SNA	=	Social Network Analysis
PWA	=	Persons with Alzheimer's Disease

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Participation to the current research was anonymous, voluntary and online. According to the Medical Research Council and NHS Health Research Authority requirements, the current research did not need national clearance in the UK. The research project was approved by the University of Derby ethical committee.

HUMAN AND ANIMAL RIGHTS

No Animals/Humans were used for studies that the base of this research.

CONSENT FOR PUBLICATION

Local managers and participants gave their verbal consensus to publication at the condition that no identifiable data was disclosed.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of the article are available in the current study only. Therefore, researchers, hospitals, and users interested in the data will be provided with the link to access the present article or access it via search engines.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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Declared none.

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