

Correlation of Social Network Attributes with Individuals' Score on Bipolar Spectrum Diagnostic Scale

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Article info:

Received: 10 March 2012

First Revision: 15 April 2012

Accepted: 31 July 2012

Key Words:

Bipolar Spectrum Disorders,
Social Network,
Bonacich Power,
Centrality.

ABSTRACT

Introduction: Bipolar Spectrum Disorders include a variety of mood disorders from bipolar II disorder to conditions characterized by hyperthymic mood states. It has been suggested that psychosocial factors also play an important role in bipolar disorders, in this study we have used social network analysis in order to better understand the social positions of those affected by bipolar spectrum disorders.

Methods: In this cross sectional study 90 individuals within a bounded network were included and studied by using a standard questionnaire for bipolar spectrum disorder scale (BSDS) and a sociometric questionnaire for analyzing the social network of those individuals.

Results: This study showed that BSDS score is significantly correlated with the Bonacich power of the participants ($P=0.009$) as well as with their Outdegree Strength ($P=0.013$).

Discussion: The results of this study show that there is interplay between social attributes and Bipolar Spectrum Disorders. This emphasizes the need for understanding the role of social networks and performing further research into quantifying social aspects of psychiatric disorders.

1. Introduction

Bipolar Spectrum Disorders include a variety of mood disorders from bipolar II disorder to conditions characterized by hyperthymic mood states (Piver, Yatham, & Lam, 2002; Cassano et al., 1999; Akiskal, & Pinto, 1999; Cassano, Akiskal, Savino, Musetti, & Perugi, 1992). The prevalence of bipolar disorders has been reported as between 0.5% to 1.5% (Weissman et al., 1996). However, many conditions included in the bipolar spectrum disorders such as hypomania are usually underdiagnosed or are attributed to other problems and disorders (Piver, Yatham, & Lam, 2002). Bipolar spectrum disorder are caused by a variety of factors such as genes, neurobiology and social and psychological vulnerabilities. It has been suggested that psychosocial

factors play an important role in bipolar disorders and on the other hand, bipolar disorders have social implications for those affected as well, such as impaired work performance, family distress, relationship dysfunction and etc. (Milkowitz & Johnson, 2009; Goldberg, Harrow, & Grossman, 1995; Goldstein, Miklowitz, & Mullen, 2006; Miklowitz, & Cicchetti, 2006). However, there have been limited attempts at illuminating the correlation of bipolar disorders with social conditions of those affected, which necessitates further research in this area.

Social network analysis, allows understanding and quantifying of individuals and their social interactions. Social network methods identify egos in a network and study the relations between these egos. By using social network analysis, a researcher can understand social po-

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sitions, social interactions and functions of individuals in a society (Hanneman, & Riddle, 2005). Social network methods can be very useful in understanding the social factors affecting diseases, for example in a study by Christakis and Fowler it has been shown that obesity has a strong correlation with the social conditions of an individual. For example in that study, friends of an obese person were more likely to be obese than his/her siblings (Christakis, & Fowler, 2007).

However, there has been no study on the social position of those affected by bipolar disorders. In this study, we have applied for the first time social network analysis to understand the relation between social positions and bipolar spectrum disorders.

2. Methods

In this cross sectional study, a census of all students within the naturally occurring boundary of the faculty of health management was conducted. Naturally occurring boundaries are used in social networking methodology and refer to a social entity with a predefined boundary such as all the students of a class or all the members of an organization. The study was conducted between March 2010 and June 2010 in the Faculty of Health Management of the Isfahan University of Medical Sciences.

90 students were included in our study; it must be mentioned that in social network studies, sampling is not used and a census of target population should be made. Thus, Inclusion criteria consisted of any student within the bounded population and no exclusion criteria was used. However, all the social links which connected students to individuals outside the predefined boundary were excluded.

The social network analysis methodology which was utilized is known as full network methodology, which means all the nodes and relations within the target population group were defined and studied. The nodes and relations were identified by census using a sociometric questionnaire specifically designed for this study. The sociometric questionnaire aimed to measure friendships and their strength. After obtaining census and ensuring the participants of confidentiality, demographic data including the participant's identity were collected and participants were asked to name up to 20 of their friends and score three different aspects of their relationship with them using six questions. These aspects included: Trust, Consultation and Frequency of Interaction. They were asked to assign five of the questions with scores

of 1 to 10 and to give an approximation for the minutes they spent interacting with the named friend during a week. An aggregate score of between 1 to 10 was assigned to each named friend based on the answers the participant provided. The aggregate score was used as showing the strength of the relation.

For studying the bipolar spectrum, we used the Persian version of the bipolar spectrum diagnostic scale (BSDS) which was developed by Ronald Pies and had been translated to Persian, revised and validated (Ghaemi et al., 2005; Shabani et al., 2009). It is a one page story in the first part – containing 19 positively valenced sentences as third person including some typical mood swing experiences – and one simple multiple choice question in the second part – to rate how well the story describes the individual. The score on the first part can range from 0 to 19, and on the second part from 0 to 6. Therefore, the total score of BSDS ranges from 0 to 25.

Both questionnaires were printed and distributed separately to the participants. All of the students within the target population (overall 90 students) agreed to participate in the study and filled out the questionnaires. The demographic and sociometric questionnaires were printed on three pages and on average took 10 minutes to fill out. The BSDS questionnaire was printed on a single page and on average took 5 minutes to fill out. Each person was assigned an ID number and after the questionnaires were collected they were matched based on the ID number assigned. Because all of the named friends were included in the target population, each had their assigned ID number and the names in the questionnaires were replaced by ID numbers before data was entered for analysis.

The data from sociometric questionnaires were entered into a UCINET (Ver 6.205) database (Borgatti, Everett, & Freeman, 2002). We used Netdraw (Borgatti, 2002) to visualize our social network and UCINET was used for extracting the network properties of the target population. The network attributes which were extracted included: network density, network cohesion and network diameter. Furthermore, network attributions of each of the participants were also extracted and included: Bonacich Power, Centrality (Betweenness), Indegree, Outdegree, Indegree Strength and Outdegree Strength.

Bonacich power is a measure of degree and centrality for each actor in a network, the higher Bonacich power of an actor means that not only he/she is well connected (has many ties) but also those actors to whom he/she is connected are well connected as well. Thus many con-

sider Bonacich power superior to other approaches such as Degree Centrality in showing the social power and position of a person. (Bonacich 1987)

Betweenness is a measure of centrality which identifies actors as having positional advantage, or power, to the extent that they fall on the shortest pathway between other pairs of actors. i.e. the higher Betweenness of a person means that more actors in that network are dependent on him/her for exchange of information (Hanneman, & Riddle, 2005).

Indegree and Outdegree, respectively refer to the incoming and outgoing relations of an individual, in our case, Indegree indicates the number of actors who considered the ego as their friend while outdegree shows the number of people whom our ego considered as friends. Strength is a value attributed to each outgoing or incoming relation. We calculated the Strength using our questionnaire with interval measures (Hanneman, & Riddle, 2005).

The data from demographic and BSDS questionnaires as well as the network attributes were inserted in a SPSS (ver. 17.0) database. Spearman Test was used to measure the correlation between the different variables.

For resolving any potential ethical problems, a consent form was handed to all participants, they were also ensured about preservation of confidentiality. The study was also approved by the University's Ethics Committee.

3. Results

There were 90 participants included in the study with average age of 22.5 (std= 1.32), the youngest and the oldest participants were 20 and 28 years old respectively. The study group consisted mostly of female students

(80% or 72 Individuals). 58 students were residents of Isfahan (64.4%) and the other 32 (35.6%) resided in the university's dormitory.

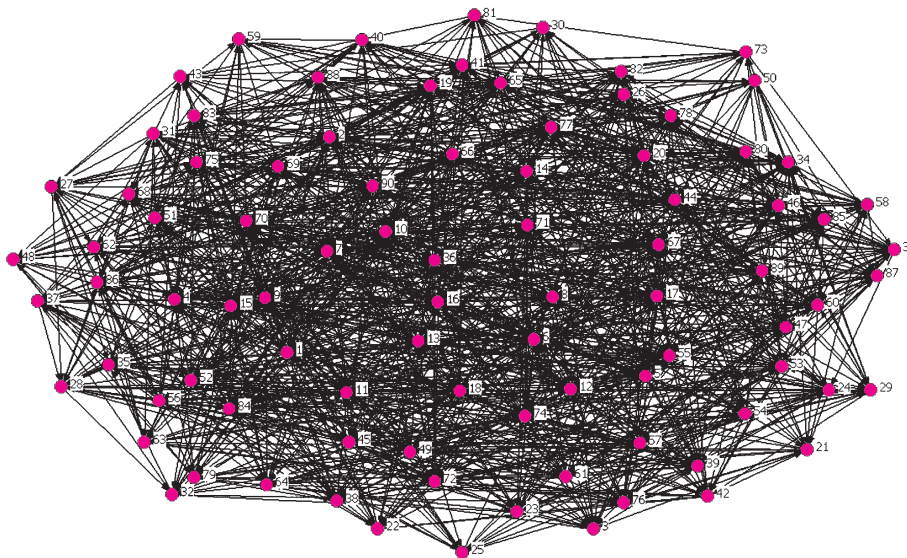
The density of the social network of the students was 0.167 and the average distance was 1.904. The network is mapped in Figure 1. The Average Bonacich power of the participants was 862.85 (std= 224.11), the average centrality (betweenness) of the nodes was 91.9 (std= 114.16). The average Indegree of the network was 15.11, i.e. on average the participants were considered as friends by 15.11 (std= 5.32) other participants. On the other hand the average Outdegree of the network was also 15.11 (std= 3.58). The strength of incoming friendship as calculated by our scale was on average 107.91 (std= 35.82). In other words, the average Indegree Strength was 107.91, and the average Outdegree Strength was also 107.91 (std= 27.23). The network properties are summarized in Table 1.

The Indegree and Indegree Strength of the participants showed significant correlation with the number of semesters participants had studied in the university ($P= 0.022$, $P= 0.023$ respectively). The age of the participants had significant correlation with Bonacich power ($P= 0.006$), Outdegree ($P= 0.006$) and Outdegree Strength ($P= 0.021$).

The average BSDS score of the participants was 9.78 (std= 6.57) with a minimum and maximum of 1 and 25 respectively. Spearman test showed that BSDS score was significantly and positively correlated with the Bonacich power of the participants ($P= 0.009$, Correlation Coefficient: 0.275) as well as with their Outdegree Strength ($P= 0.013$, Correlation Coefficient: 0.261). There is a strong positive correlation between Outdegree strength and Bonacich power of the participants. Multiple regression analysis, however, shows that mod-

Table 1. A summary of the network properties

Network Property	Mean Value	Minimum	Maximum	Standard Deviation
Network Density	0.167	N/A	N/A	N/A
Distance	1.904	N/A	N/A	N/A
Bonacich Power	862.85	419.09	1491.90	224.11
Centrality	91.9	14.68	516.69	114.16
Indegree	15.11	7	28	5.32
Outdegree	15.11	8	25	3.58
Indegree Strength	107.91	46	194	35.82
Outdegree Strength	107.91	52	187	27.23



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Figure 1. The map of the social network.

els that include Bonacich power are better predictors of the individual's BSDS score and removing Outdegree strength from the model does not affect its predictability power in a significant way.

There was no significant correlation between BSDS score and any of the other social or demographic parameters that were measured. In figures 2 and 3, the correlation of BSDS scale score with Bonacich power and Outdegree strength is plotted.

4. Discussion

Networks are composed of Nodes (or Actors) and Ties (or Relations). As a result, in order to study networks, the Actors and the Relations must be identified.

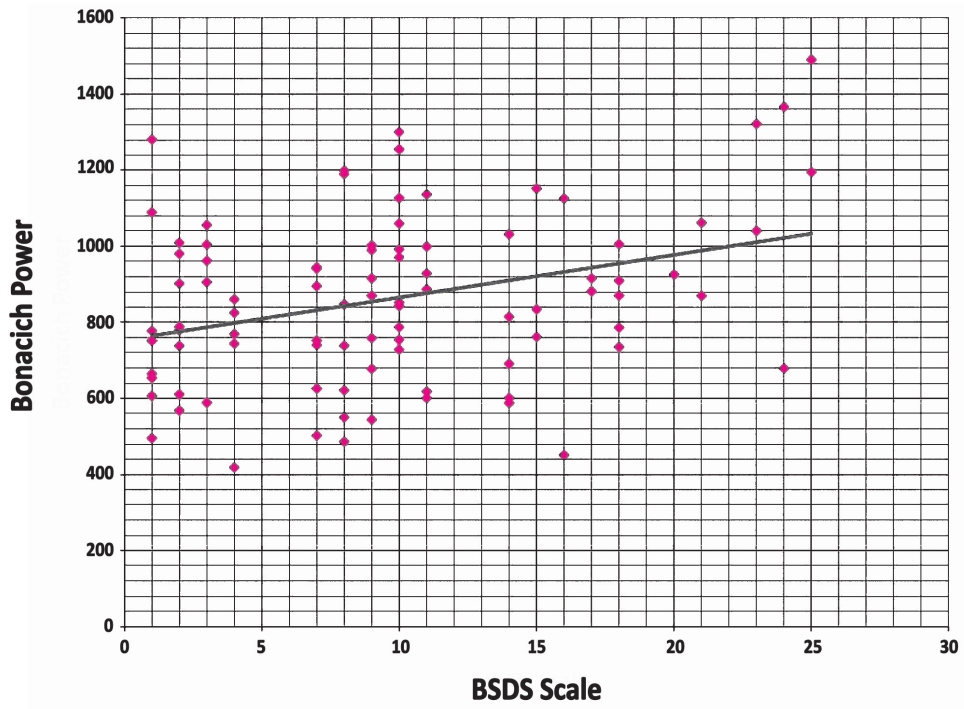
In social network studies the aim is to identify actors and the relations among them, not the attributes of the actor. This means that unlike conventional studies which rely on independent sampling, network studies should include all the actors within a network. In other words, actors cannot be sampled independently to be included as observations because if one actor is included, then we must also include all other actors to whom our ego is related. Thus, in social network studies the target population is studied by means of census, rather than by sample (Hanneman, & Riddle, 2005). To limit the target population we need to define boundaries that shape networks, some of these boundaries occur naturally, for example the network of the students of the health management faculty of the University is a naturally bounded population.

In order to study relations between the actors in the network, firstly the nature of the relation must be defined, in this case we chose Friendship as representing the relations between our actors and we designed a questionnaire with interval measures for measuring the strength of the relation.

We used a full network approach for studying the target population, i.e. all the actors within the target population were included in the study and all the defined relations (in this case friendships) between the pairs of actors were identified. By analyzing the resulting network we extracted network attributes such as Bonacich power, Centrality (Betweenness), Indegree and Outdegree for each actor. All these attributes were previously explained in the methods and materials section.

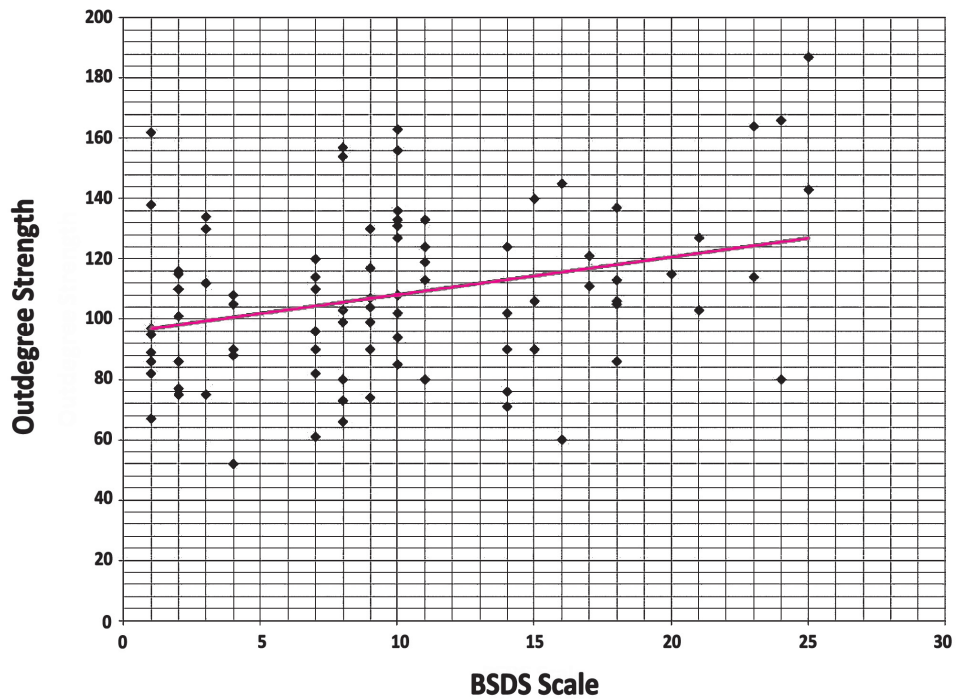
The results of our study suggest that the longer a person has been a member of the network (as shown by the number of semesters studied), the Indegree of that person will be higher. The older an actor is, the more powerful (as measured by Bonacich power) position he/she assumes in the network, in addition age also determines how many people the ego considers as friends and how much he/she values his/her friendships, i.e. the Outdegree and Outdegree Strength of the ego increases with age.

Interestingly, our study showed that the more social power an ego possess in the network the more likely that person is to score highly on the Bipolar spectrum which shows that people with high scores in the BSDS scale, are either more connected or are located in social



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Figure 2. The correlation of BSDS scale score with Bonacich power.



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Figure 3. The correlation of BSDS scale score with Outdegree strength.

neighborhoods with dense connections. Another finding was that those individuals, who had high scores on the BSDS scale, valued their friendships more, as shown by the higher Outdegree Strength of these individuals.

The results of multiple regression analysis show that in this study the single most significant social attribute that has a positive correlation with BSDS score is Bonacich power and we suggest that this attribute be further explored in understanding the social characteristics associated with psychiatric disorders.

As our study was unique and there has been no similar studies performed, any reader must consider the fact that these results were found in our target network, and may not be reproducible in another network. Further networks with similar demographic attributes should be studied before one can definitively correlate the score of individuals on a bipolar spectrum with the social position of those individuals.

In conclusion, the results of our study support our speculation that there is a relation between social position of a person and his/her bipolar spectrum score, while we acknowledge the fact that more studies are needed for clearly defining this relation.

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