A METHODOLOGICAL APPROACH TO THE ANALYSIS OF EGOCENTRIC SOCIAL NETWORKS IN PUBLIC HEALTH RESEARCH: A PRACTICAL EXAMPLE

METODOLOŠKI PRISTOP K ANALIZI EGOCENTRIČNIH SOCIALNIH OMREŽIJ PRI RAZISKOVANJU V JAVNEM ZDRAVJU: PRIKAZ PRIMERA

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ABSTRACT

Keywords:
social network analysis, qualitative research, social environment, social support

Introduction. Research on social networks in public health focuses on how social structures and relationships influence health and health-related behaviour. While the sociocentric approach is used to study complete social networks, the egocentric approach is gaining popularity because of its focus on individuals, groups and communities.

Methods. One of the participants of the healthy lifestyle health education workshop 'I'm moving', included in the study of social support for exercise was randomly selected. The participant was denoted as the ego and members of her/his social network as the alteri. Data were collected by personal interviews using a self-made questionnaire. Numerical methods and computer programmes for the analysis of social networks were used for the demonstration of analysis.

Results. The size, composition and structure of the egocentric social network were obtained by a numerical analysis. The analysis of composition included homophily and homogeneity. Moreover, the analysis of the structure included the degree of the egocentric network, the strength of the ego-alter ties and the average strength of ties. Visualisation of the network was performed by three freely available computer programmes, namely: Egonet.QF, E-net and Pajek. The computer programmes were described and compared by their usefulness.

Conclusion. Both numerical analysis and visualisation have their benefits. The decision what approach to use is depending on the purpose of the social network analysis. While the numerical analysis can be used in large-scale population-based studies, visualisation of personal networks can help health professionals at creating, performing and evaluation of preventive programmes, especially if focused on behaviour change.

IZVLEČEK

Ključne besede:
analiza socialnih omrežij, kvalitativno raziskovanje, socialno okolje, socialna opora

Izhodišče. Analiza omrežij je raziskovalni pristop, ki je posebej primeren za opis, raziskovanje in razumevanje strukturnih in relacijskih vidikov zdravja. Analiza socialnih omrežij se v javnem zdravju uporablja med drugim za proučevanja vloge socialne opore in socialnega kapitala ter vpliva osebnih in širših socialnih omrežij na vedenje, povezano z zdravjem. Osebne povezave in omrežja, kot so družina ali prijatelji, so bistveni za socialno vključenost. Raziskave egocentričnih socialnih omrežij imajo dolgo zgodovino v sociologiji, v javnozdravstvenih raziskavah pa se uporabljajo redko.

Metode. V zdravstvenovzgojnih delavnicah Gibam se, ki potekajo v okviru Nacionalnega programa primarne preventive srčno-žilnih bolezni, vključenih v raziskavo o socialni opori za telesno dejavnost, je bil naključno izbran eden od udeležencev. Podatki so bili zbrani s pomočjo vprašalnika, oblikovanega za potrebe raziskave, in so primerni za izdelavo sociograma s podatki o opazovancu – egu in osebah, ki jih imenuje v svoje omrežje – alterjih. Intervjuje je v celotni skupini udeležencev osebno izvedel raziskovalec. Za analizo egocentričnega omrežja udeleženca so bile uporabljene numerične metode analize in računalniški programi za analizo socialnih omrežij.

Rezultati. Z numerično analizo so bili dobljeni podatki o velikosti, sestavi (homofilnost, homogenost) in strukturi (stopnja, jakost in povprečna jakost povezav) egocentričnega omrežja. Velikost omrežja predstavlja število imenovanih alterjev. Homofilnost in homogenost sta bili izračunani na osnovi podatkov o egu in alterju (spol, starost, odnos med egom in alterjem). Stopnja egocentričnega omrežja je izračunana kot razmerje med številom alterjev, ki so povezani z egom, in številom vseh navedenih alterjev. Jakost posamezne vezi je izračunana kot vsota jakosti posameznih komponent povezave ego-alter. Izračunana je bila tudi povprečna jakost vezi v omrežju. Opisani in ovrednoteni so trije programi za analizo socialnih omrežij. Programa Egonet.QF in E-net sta primarno namenjena analizi egocentričnih socialnih omrežij, medtem ko je program Pajek v osnovi namenjen analizi velikih, popolnih omrežij. Vsi trije programi imajo možnost slikovnega prikaza omrežja, razlikujejo pa se po obsegu informacij o akterjih v omrežju in njihovih povezah, ki so prikazane v sliki.

Zaključek. Predstavljeni sta numerična analiza in slikovni prikaz egocentričnih socialnih omrežij. Rezultati kažejo, da ima vsak od pristopov svoje prednosti, uporaba pa je odvisna od namena analize egocentričnega omrežja. Medtem ko je numerična analiza primerna predvsem za raziskave na populacijski ravni, lahko slikovni prikaz socialnih omrežij pomaga zdravstvenim delavcem pri razvijanju, izvajanju in vrednotenju preventivnih programov, zlasti če so ti usmerjeni v spreminjanje vedenja, povezanega z zdravjem.

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1 INTRODUCTION

Qualitative research is not a new paradigm in public health. It has been recognized decades ago that public health problems result from complex social, economic, political, genetic and environmental causes, and that there different methods that need to address them (1). Many of these methods evolved in social sciences and offer effective tools for dealing with health challenges that public health research is focused on (1-3). Disease prevention and health promotion is only one of the topics where more individually based and contextualized knowledge is required (3).

In Slovenia, the use of qualitative research in medicine increased significantly in the last years. Studies were performed either with qualitative methods only (4-9), or by means of an integrated approach, together with quantitative measures (9, 11).

The social network analysis (SNA) is defined as a set of methods used for mapping, measuring and analysing social relationships between people, groups and organisations (12). It is a research approach uniquely suited to describing, exploring and understanding structural and relational aspects of health (13, 14). It incorporates the social context to explain individual or group outcomes (15). Historically, the SNA has been used mainly in social sciences, but its use has grown rapidly in recent years into many other areas, including public health (12, 14). Research on social networks in public health focuses less on the transmission of specific tangible elements and more on how social structures and relationships influence health and health-related behaviours (16). Much of what is studied in public health is relational by itself. The SNA has been used primarily to study the transmission of diseases and information, diffusion of innovations, the role of social support and social capital, the influence of personal and social networks on health behaviours and the inter-organisational structure of health systems (13). There have been discussions whether the SNA is a quantitative or qualitative method. Authors describe the evolution from the qualitative approach in the early beginnings of the SNA, to the development of advanced mathematical methods and computer programs that led to a predominance of quantitative approaches, and finally, the mixed approach which combines both (17-19). Quantitative approaches map and measure networks by simplifying social relations into numerical data, where ties are either absent or present. Qualitative approaches, on the other hand, enable to consider issues relating to characteristics of social ties (19).

There are two types of social networks, namely: complete and egocentric social networks. Complete networks consist of a group of units (people, organisations, etc.) and relationships between them. In egocentric social networks (ESN), the person of interest is referred to as the ego. The people he/she is appointing to his/her network – relatives, friends, advisors, etc., are referred to as alteri (15, 20, 21). While the sociocentric approach is used to study complete social networks, the egocentric approach is gaining popularity because of its focus on individuals, groups and communities (15). Personal relationships and networks, like family relations, friendships, or neighbourhoodrelationships, are essential for social integration. Although the ESN studies have a long history in sociology, their use in health studies is rare (22).

With the present study, we aimed to contribute to the consolidation of the SNA in public health research. Our goal was to demonstrate the analysis and use of computer programmes for the ESN analysis on a practical example.

2 METHODS

The present study is part of a larger study on social networks and social support for exercise among participants of healthy lifestyle education workshops 'I'm moving', in the frame of the National Program of Primary Prevention of Cardiovascular Disease.

2.1 The Numerical Analysis of the ESN

The size (N) of a network is defined as the number of contacts – the alteri – the ego has.

The network's composition depends on the attributes of the alteri. In our case, those attributes include age, gender and one's relationship to the ego. Homo-/heterophily (the similarity or dissimilarity between the ego and alteri) and homo-/heterogeneity (the similarity or dissimilarity between alteri) of the network can be defined and calculated (23). Homophily of the ESN was calculated as the proportion of ego-to-alter ties sharing the same attribute among all ego-to-alter ties. Homogeneity of the ESN was calculated as the proportion of alteri sharing the same attribute among all alteri.

If the ego has ties with all of the named alteri homophily and homogeneity have the same value.

Structural attributes include measures like degree, strength, closeness, density, brokerage, etc. (23). In the present case, regarding the observed ties and the aim of the study, only degree, strength and average strength were considered.

Degree (D) of ESN is the number of nodes- alteri adjacent to the ego (20, 22). The degree is a count that ranges from a minimum of zero to the maximum number of adjacent alteri (n_a), if a given alter is adjacent to all alteri (20, 22). As the measure depends on the number of alteri,

a standardisation of the measure is proposed (20). The degree is the proportion of alteri that are adjacent to the ego (na) (Equation 1).

Equation 1.

$$D=n_a/N$$

Strength (s) of each ego-to-alter tie can either be named by the ego it self (based on the interview question and its scale) (22), or calculated, as in our case of the variable "overall support".

The measure average strength (S) has been introduced by the authors, as the separate elements of ties between ego and alteri can have different values of strength. It is calculated as the proportion of summary of separate strengths (Equation 2).

Equation 2.

$$S=s/n_a$$

2.2 The Visualisation of the ESN

Three computer programs for the SNA were analysed. The document analysis approach was used for the qualitative analysis of programs' characteristics. Document analysis is a qualitative approach where documents are interpreted by the researcher. Analysing documents, or in the present example, computer programs, incorporates the coding content into themes, similar to focus groups or interview analyses (24, 25).

The programs Egonet.QF (26) and E-net (27) were primary designed for the analysis of the ESN. The primary purpose of the tool Pajek (28) is the analysis of large social networks, but the analysis of the ESN is possible as well. The following themes, or in the present study, program characteristics, were used for the analysis: the availability of the program and manuals or instructions, preparation of input data, display of different strengths and elements of ties, calculation of numerical measures, and the export of network figures.

2.2.1 Egonet.QF

In Egonet.QF, no preparation of data is needed, as the data about the ego and alteri are entered into the program directly in order to create a network card. A network card is created by adding alteri to the ego. First, the number of circles is selected. The circles represent the closeness of alteri to the ego. In our example, we

used the circles as a measure for the strength of ties. In the analysis of the overall support, the closest circle means the highest value of strength - 4. In the analysis of separate ties, where the value is only 0 and 1, we used only one circle. As it is not possible to show different elements of ties in one network card, we created five different cards: four for each different element and one for the overall support. Different sectors of the network card can be selected. The sectors can be specified by different means. In our example, we divided the sectors according to the ties of alteri to the ego (family, relatives, friends, workshop members or others). The nodes – alteri– are placed manually into the specified sector and circle. Additionally, information about alteri can be added: the ID, label, role and sex. As a result, the ego is presented as the centre of the network card with its alteri in different circles and sectors. All attributes of the ego and alteri can be seen in a separate window. Figures of the networks can be exported as digital image files (JPEG).

2.2.2 E-net

In the program E-net, data can be imported in two formats, row-wise as a single text in a raster image file (VNA) format, or column-wise as an Excell sheet. According to the way we organised our data, the row-wise format has been more convenient. The rows represent the collected egos and alteri, while the columns represent their attributes. The VNA file can be created by copying-and-pasting Excell matrices into a text editor and saving the document in the VNA format. In the VNA file, two kinds of data must be identified by an asterisk and matrix title (*ego data and *alter data) (Figure 1). After importing the VNA file in E-net, the data about ego and alteri are shown in a table. The visualisation of the network shows the ego in the centre, connected with the alteri. The lines between the ego and alteri do not convey any information about the type or strength of the connection. Information about each alter (age, sex, relationship, strength of all different elements) is shown by clicking on the respective alter in the network. Figures of the networks cannot be exported.

Figure 1. Data on the ego and alteri organized for entering social network analysis in the program E-net.

2.2.3 Pajek

The program Pajek works with specific plain text files, called Pajek files. They can be created from text files by using the program txt2Pajek (29). For demonstration, we used only the connection 'overall support'. Figure 2 shows how data are entered into a text file. The label 'from' presents the ego, the label 'to' different alteri, and the label 'weight' the strength of the tie, in our case the variable 'overall support'. In the next step, the text file is imported in txt2Pajek. The Pajek file is created and saved automatically in the same folder as the text file. By choosing the option 'drawing network', the network is shown with the ego and its connections to alteri. The strength of the connections is demonstrated by different sizes of the lines. Figures of the networks can be exported as JPEG files.

```
from     to        weight
1        1_01      4
1        1_02      4
1        1_03      3
1        1_04      4
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Figure 2. Data on the egocentric social network, organized in a text file for entering the transformation in the program Text2pajek.

2.3 The Sample for Demonstration

One of the participants of the healthy lifestyle health education workshop 'I'm moving' was randomly selected. The participant was denoted as the ego and members of her/his social network as alteri.

2.4 Input Data

Data were collected by personal interviews, using a questionnaire, which is self-made, based on the 'Social support for exercise survey' (30). The interview was performed in the entire workshop group by the researcher giving the participants detailed oral instructions and individual support for filling in the questionnaire, which was designed with the purpose to create a sociogram (20). Data about the ego included the ID, age, gender, and fitness status.

As a name generator of alteri (21), the following instruction, given orally and in the written form, was used: *'Please think about people who are very close to you. These are the people who mean a lot to you, whom you are asking for advice on important matters, and with whom you are in most frequent contact. Please consider family members, other relatives, friends, neighbours, co-workers, workshop members, etc.'*

Data about alteri included basic data (age, gender and one's relation to the ego) and answers to the following questions to explore elements of social support for exercise, namely: 1. Does the person exercise or do sports with you? 2. Does the person support or encourage you to be physically active? 3. Does the person hinder you in any way at being physically active? 4. Does the person support or encourage you at attending the workshop 'I'm moving'?

2.5 The Preparation of the Data for the Analysis

Each of the elements of the tie has the value 0 or 1, considering the answer to the question. In questions 1, 2 and 4, the answer 'yes' has the value 1 and the answer 'no' has the value 0. In question 3, the answer 'no' has the value 1 and the answer 'yes' has the value 0. Each of the four elements can be analysed and visualized separately. For an overall view on the strength of social support, the variable 'overall support' was created, being a summary of separate elements' values, and had values from 0 to 4. Figure 3 shows how to properly organize data on the ego and alteri for entering the SNA.

ego data								
ID	age	gender						
1	48	female						

alter data								
from	to	age	gender	relation	exercise	sup.exe	bar.exe	sup.ws	overall.sup
1	1_01	43	male	family	1	1	1	1	4
1	1_02	12	male	family	1	1	1	1	4
1	1_03	36	female	family	0	1	1	1	3
1	1_04	53	female	friend	1	1	1	1	4

Figure 3. Data on the ego and alteri organized for entering the social network analysis.

3 RESULTS

3.1 Numerical Analysis Results

3.1.1 The Size

The size of the demonstrated ESN was 4.

3.1.2 The Composition

The ESN had homophily value 0.75 for the ego's relationships to alteri, value 0.5 for gender, and value 0.5 for age (two alteri were ofthe same age as the ego, +/- 5 years).

As the ego had ties with all alteri, homogeneity showed the same values.

3.1.3 Structure

The degree of the network was 4, as the ego was connected to all 4 alteri, regardless of the element of the tie.

Three connections had strength values 4 and one connection had the value 3.

The average strength of the network was 3.75.

3.2 Visualisation Results

All three computer programs for the SNA had the option to visualize the ESN.

3.2.1 Egonet.QF

The ESN figure visualized in Egonet.QF in Figure 4 shows the overall support, while Figure 5 shows different network cards for each different element of the tie.
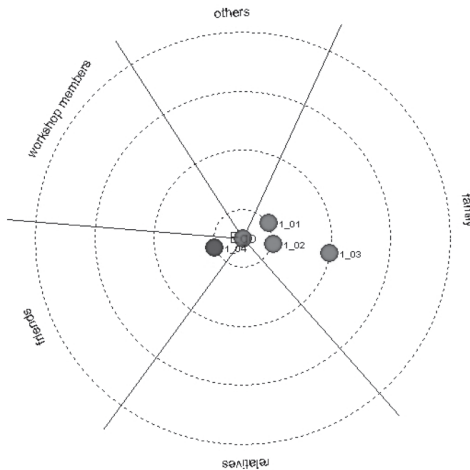

Figure 4. The ESN visualized in the program Egonet QF, showing the overall support.
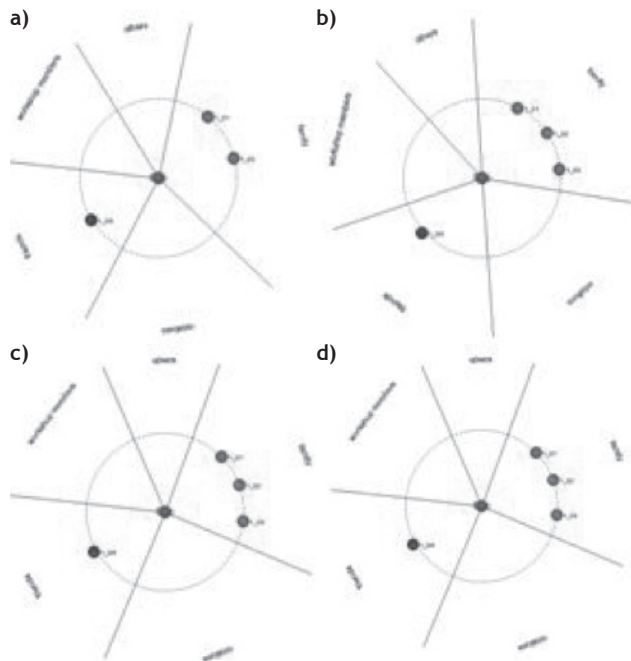

Figure 5. The egocentric social network visualized in the program Egonet QF, showing the following separate elements of the tie: a) exercise with the ego, b) support exercise, c) barrier exercise and d) support attending the workshop.

3.2.1 E-net

Figure 6 shows the ESN figure visualized in E-net. It presents the ties between ego and alteri, with information about the respective alter and the ego-to-alter tie displayed in the window left in the figure.
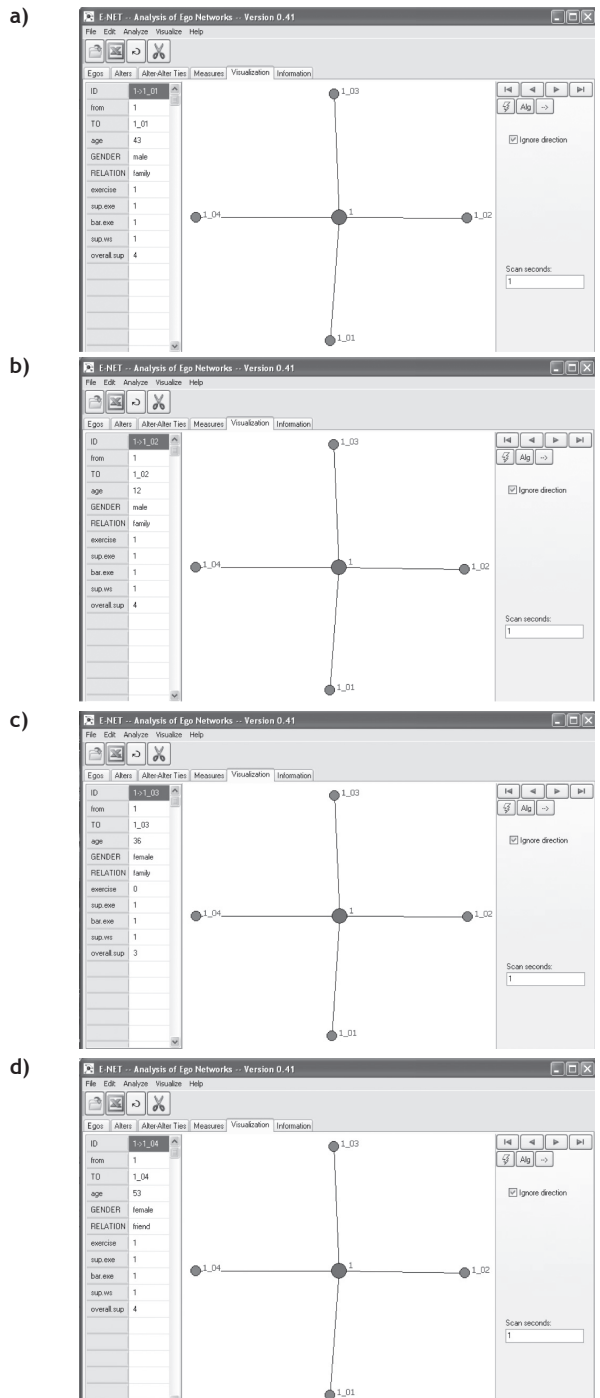

Figure 6. The egocentric social network visualized in the program E-net, displaying information about the alteri and alter-to-ego relationships: a) alter 1_01, b) alter 1_02, c) alter 1_03 and d) alter 1_04.

3.2.1 Pajek

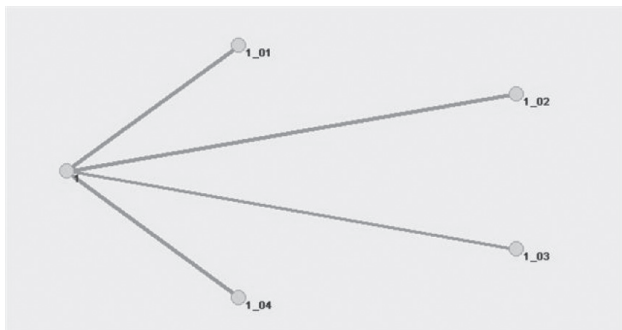Figure 7 shows the ESN visualized in the program Pajek.

Figure 7. The egocentric social network visualized in the program Pajek.

3.3 The Qualitative Analysis of Programs for the Analysis of Egocentric Social Networks

Table 1 shows the main characteristics of the demonstrated tools.

4 DISCUSSION

Results of the numerical analysis of the ESN give an insight into the network's main characteristics regarding the structure and content. We are able to obtain quantitative and qualitative data about the ESN's size, composition and structure (23). Degree is a measure very easy to compute, but informative in many applications (20). It gives the first overview of the individual's social network. Regardless of the element or strength of the ties, it shows how many people are connected to the ego, or in our example, how many people support the individual. The average strength of ties has an added value because it summarizes information on the strength of separate ties. The 'gap' between the degree and average strength is valuable information, especially in exploring social support. Together with the strength of separate ties, it shows the eventual potential for increasing the support in a very detailed way. The network's composition shows the characteristics of people within the ESN. It tells what are the preferences or possibilities of the individual at choosing persons into her/his network.

The program Egonet.QF is suitable for creating network diagrams, which make use of concentric circles (26). The use of circles is an excellent tool to present the strength of ego-to-alter ties. We used different sectors of the network to present different relationships between the ego and alteri. The division based on other attributes is possible too, so users can choose the option that is best suited to the purpose of their study. The visualization with

Table 1. The main characteristics of the demonstrated tools for the visualization of egocentric social networks.

Characteristics	Tools		
	Egonet.QF	E-net	Pajek
Availability	Free download	Free download	Free download
Preparation of input data	No preparation of specific file formats needed	Depending on the desired format, transformation into VNA file is needed.	First, the creation of a text file, then the transformation into the Pajek file.
Display of different strengths of ties	Different strengths can be demonstrated by using circles with different distances to the ego.	Strengths of ties are not shown in the network picture, but are displayed in a separate window.	Different strengths of ties are shown in the network picture by different sizes of the lines between the ego and alteri.
Display of different elements of ties	Different elements can be demonstrated by using different sectors in the network.	Elements of ties are not shown in the network picture, but are displayed in a separate window.	Different elements of ties are not shown in the network picture.
Export of the figure	Export as JPEG file	No export of figures	Export as JPEG file
Calculation of numerical measures	No	Homophily and homogeneity	No
Manual freely available on-line	Yes	Yes	Yes

different circles and sectors is attractive and gives a good overview on the ties between the egos and different alters. E-net is a program designed specifically for the analysis of personal networks (27). The VNA file needed for the import of data is easy to create and allows importing data of more than one ego and her/his alters in one file. This is useful when analysing more ESNs. The visualization is very basic and shows only the ego, alteri and connection

between them. Attributes of the actors are shown in the window beside the picture, by clicking on the respective node. The attributes, in our case, included strengths of separate elements of support by every alter, therefore this option gives a good overview of the source of support for the individual. The attributes can be displayed only separately for each actor. Pajek is a program for analysis and visualization of large social networks (28). Despite that, a visualisation of an ESN is possible too. Two steps are required in the preparation of data, including the use of an additional program for the transformation of data (29). The visualization is very basic and shows only the ego, alteri and connections between them. The only information about the ties is their strength, shown in different sizes of the lines. The analysis of ESNs could be performed in Pajek as well, but only if the ESN is analysed within an analysis of a complete social network.

Despite offering a selection of numerical analysis tools, none of the programs calculates the degree or average strength of the network, and only E-net calculates homophily and homogeneity. This is not considered as an important disadvantage, as the numerical analysis of the ESN is easily performed in other widely accessible programmes, such as Excell.

The analysis of the ESN provides a feasible way of obtaining network information, but it has several limitations. Demonstration of one single case limits representativeness. Relying on a single case is considered acceptable for a study as ours, as the purpose was to demonstrate the use of a particular methodology (17). Another limitation is related to the bias of recall. Respondents are often asked to recall behaviours that took place over a broad period of time. Recent contacts are more likely reported into the network, and forgetting to name people is another potentially significant problem (14, 15). In the analysis of the ESN, the example relies on the accuracy of reports from the focal actor, the ego. As we do not observe the status of relationships from the perspective of alteri, the perceptions of alteri could be different (17, 22). In our study, we focused only on ties between the ego and alteri, and did not explore the ties between alteri. Those ties can potentially affect the ego. As the purpose of our study is to demonstrate the use of the ESN analysis with social support, we limited our example only on ego-to-alter relationships.

With the analysis of different methodological approaches to the analysis of ESNs, we contributed significantly to public health research. We pointed out or introduced measures most suitable for the analysis of the ESN related to public health issues. The approaches are applicable to a wide range of ESN types and questions related to ESN research, including personal networks and social support, professional networks atthe personal level or networks between organizations.

Using the ESN analysis helps us learn about how individuals correspond with their social networks (31). Data obtained from the numerical network analysis, at the population level, can give an overview of social networks and social support in populations of interest. Data can serve for the monitoring and evaluation of programs, where social networks and social support present important components for program success. Especially health promotion or health education programs, where the focus lies on behaviour change, depend highly on the social support of participants. It is important to keep in mind that individuals are involved in a social environment and in a series of social relationships. Improvement and maintenance of health is influenced not only by the individual's behaviour, but also by the behaviours of others in the network (16). The methodological approaches demonstrated in the present study can be used for assessing for any kind of behaviour change. Public health experts working in those programs can benefit from information on their participants' social networks. A network card obtained with one of the visualization tools can not only serve as a presentation of results, but can also help the individual as cognitive support in network exploration, to help keeping the overview of relationships (32). The existing and potential sources of support or barriers can be identified, and can help maintaining or improving social support. Besides social support, many other relations can be explored at the individual level, such as seeking advice or information from a professional. Studies on the ESN can be performed autonomously, when the focus is on a small sample or specific environment. When gathering personal network information on large scale, ESN studies can be embedded within population surveys to enable population-representative data (22). When performing the ESN analysis at the population level, the numerical analysis is preferred, as it is more suitable for handling large amounts of units, and as the data can be further analysed by using statistical methods (eg. a comparison between egos or ego-alter relations, time dynamics, etc.).

5 CONCLUSION

We demonstrated the analysis of ESNs, including measures and visualization, and compared three different computer programs for the analysis of ESNs. Results show that both numerical analysis and visualization have their benefits. The decision as to which approach to use is dependent on the purpose of the ESN analysis. While the numerical analysis can be used in large scale population-based studies, visualization of personal networks can help health professionals at creating, performing and evaluating preventive programs, especially if focused on behaviour

change. The analysis of social networks, including ESNs, is used widely in the area of public health, and there is an enormous potential in the use of it.

CONFLICTS OF INTEREST

The authors declare that no conflicts of interest exist.

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ETHICAL APPROVAL

Ethical approval has been received by the Committee of the Republic of Slovenia for medical ethics on April 11, 2011.

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