

Development and Psychometric Assessment of Triage Nurses' Professional Capability Questionnaire in Emergency Department

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Abstract

Background: Evaluation of triage nurses' professional capability is integral to identifying areas of professional development and nurses' educational needs, thus the need for valid instruments for assessment of professional capability. The present study aims to develop and measure the reliability and validity of a triage nurses' professional capability questionnaire.

Methods: The present study is an exploratory work of research conducted in two stages: in the first stage (the qualitative phase), through conventional content analysis, the concept of professional capability in triage nurses was defined and the items of the questionnaire were developed. In the second stage (the quantitative phase), the psychometric properties of the questionnaire were assessed through analyses of its face validity, content validity, construct validity, internal homogeneity, and consistency.

Results: The primary item pool contained 90 items while the final scale consisted of 35 items. The S-CVI/Ave of the questionnaire was found to be 0.96. An exploratory factor analysis showed the factor loading of the items to be between 0.478 and 0.897, all of which values were significant, and the three dimensions introduced in the main instrument were verified with acceptable values. The overall interclass correlation of the instrument was found to be 0.90. The reliability of the instrument was assessed in terms of its internal homogeneity where the Cronbach's alpha of the entire instrument was found to be 0.89.

Conclusions: The results show that the questionnaire developed for assessment of triage nurses' professional capability is sufficiently reliable and valid and can be employed by nurse administrators toward evaluation of triage nurses' professional capability.

Introduction

In clinical care systems today, triage is an integral part of emergency management in hospitals and is regarded as an index in evaluations of emergency [1]. If, upon admittance, a patient is not triaged accurately and does not receive the necessary clinical care, even high-tech units and specialists' efforts may not prove effective in helping the patient's condition in the following hours or days [2]. The process of triage in hospitals is unpredictable and complicated [3]. Triage nurses are likely to encounter patients whose conditions are critical and quickly changing—obviously, in order to react properly to such quick changes, triage nurses should possess the necessary professional capability to assess patients' conditions rapidly, determine clinical priorities accurately, and make the right clinical decision [4]. Lack of the expected professional capability results in triage nurses' errors in prioritization of patients' needs, which, in turn, results in overcrowding in the triage unit, patients' dissatisfaction, and, in some cases, deterioration of patients' conditions [5]. An evaluation of nurses' professional capability is essential to identification of areas which need to be improved, pinpointing educational needs, ensuring the provision of optimum care, identifying the strengths and weaknesses of educational programs, and professional development [6]. An accurate identification of the areas where nurses need to improve their professional

performance and detecting nurses' educational needs necessitates an assessment of their professional capability using valid instruments [7]. Lack of standardized tests has always been an issue in evaluation of triage in hospitals [8]. A review and analysis of the results of studies in the field of professional capability confirms the inadequacy of knowledge with regard to evaluation of triage nurses' professional capability, which can be attributed to the fact that nurses' experiences and perceptions have not been addressed adequately enough [9]. Professional capability is a broad concept and can be defined variously according to context, individuals' characteristics, situation, and perspective [10]. Therefore, a comprehensive definition of triage nurses' professional capability, classification of the components of their professional capability, and identification of the indexes of it is the first step toward development of an instrument for evaluation of triage nurses' professional capability.

Experts on development of psychometric instruments believe that the content of an instrument must be extracted directly from the target population of the instrument [11]. Accordingly, there is need for a qualitative approach to establish the concept of professional capability and identify its dimensions and sub-dimensions: by clarifying concepts and providing definitions and items, qualitative studies contribute to the development of clinical questionnaires [12].

There are not any standard instruments for evaluation of triage nurses' professional capability in the emergency departments of hospitals, and the existing instruments only address triage nurses' knowledge. Professional capability is not limited to professional knowledge and includes a variety of domains. In order to fill the gap in the current body of theoretical and practical knowledge, the researcher set out to develop and assess the psychometric properties of an instrument for evaluation of triage nurses' professional capability. The present study uses an integrated research approach: a combination of qualitative and quantitative approaches can result in a better understanding of the subject in question, compensate for the shortcomings of an exclusively qualitative or an exclusively quantitative approach, increase the reliability and validity of the outcome of the study, and create new a outlook in science [13]. Also, an integrated approach enables the researcher to collect more comprehensive evidence for the research subject and, consequently, provide a practical answer to the research question [14].

On the other hand, as the objective of the present study is the development and assessment of the psychometric properties of an instrument for evaluation of triage nurses' professional capability, the most appropriate method to execute the project would be a sequential exploratory mixed methods design. Such a design can enable researchers to establish a theoretical framework for and identify the dimensions of complex and multi-dimensional concepts; it can also prove useful when the variables are unknown, there is not a framework or guiding theory, the researcher aims to extend the findings to different populations, or the objective of research is development of an instrument [15].

Methods

Study design

The present study relies on a sequential exploratory mixed methods design for development of an instrument. In a sequential exploratory design, the first step is to collect and analyze qualitative data; next, based on the results of the analysis of the qualitative data, the quantitative phase of the study where quantitative data are collected and analyzed begins; finally, the results of the qualitative and quantitative analyses are interpreted together [16]. According to Creswell (2012), one of the primary functions of a sequential research design is the development of instruments. The development of a new instrument for evaluation of a clinical concept necessitates a careful consideration of its complexity and various dimensions; thus, initially, the components of the concept in question should be identified and the structural dimensions of it should be clearly established [17]. In the qualitative stage, the conventional content analysis approach was used to determine triage nurses' perceptions of the concept of professional capability, identify relevant concepts, and develop items. Employed in many nursing studies, qualitative content analysis is a research method for mental analysis of the content of text data through the processes of systematic classification, assigning codes, and making themes or designing familiar models [18]. A definite advantage of conventional qualitative content analysis is the direct acquisition of clear data from the study free from the bias of previously-known subjects or theories [19]. In the present study, in addition to using a qualitative approach, the researcher conducted an extensive literature review to further verify the items. The validity of the questionnaire was measured in terms of face validity, content validity, and construct validity.

Sample and setting

In the first stage of the present study (the qualitative phase), data were collected using personal interviews, focus interviews, and observation. Accordingly, 24 in-depth, semi-structured interviews were conducted in which 20 nurses (18 triage nurses and 2 triage head nurses), 2 general practitioners, and 2 emergency medicine specialists were interviewed face-to-face. In addition, two focus interview sessions were held with a group of 5 triage nurses and the researcher carried out 48 hours of observation. The inclusion criteria for the nursing staff were having a bachelor's degree in nursing and at least one year of professional practice; the emergency doctors were required to be at least a G. P. and have 6 months' experience of work in triage. Both nurses and doctors were included only if they were willing to participate. For ethical considerations, The Institutional Review Board of the researchers' university has verified that the study complies with research ethics (decree code: IR.SUMS.REC.1396.S197). Before the interviews, the participants were informed about the objectives of the study, the voluntary nature of their participation, methods of data collection and why the interviews were to be recorded, the roles of the researcher and the participants, confidentiality of their information, and anonymity of the participants. Subsequently, they were asked to sign an informed consent form if they were willing to participate in the study. The participants were also informed that they were free to withdraw at any point of the research and the time of the interviews would be set by their agreement. In order for the observations to be ethical, the participants were observed with prior notice and in an overt manner.

Assessment of face and content validity

The qualitative face validity of the questionnaire was measured thus: 15 triage nurses and emergency specialists were interviewed face-to-face and the difficulty level (difficulty in understanding the statements and terms), relevance (relationship between the items and the different dimensions of the questionnaire) and ambiguity (possibility of misunderstanding the items or unclear terms) were assessed. After the faulty items had been revised, the quantitative method of item impact testing was employed to determine the quantitative face validity of the questionnaire and the significance of each item so that the unsuitable items could be identified and eliminated. Accordingly, 15 experts were asked to score each item on a 5-point Likert scale: 5 = Very important; 4 = Important; 3 = Fairly important; 2 = Not very important; 1 = Not important at all. Subsequently, the item impact score of each item was calculated.

Content validity was measured both quantitatively and qualitatively. In the qualitative stage, 15 experts who were familiar with development of instruments and nursing were asked to examine the questionnaire in terms of syntax, use of proper vocabulary, necessity, significance, placement of the items, and scoring. The quantitative assessment of the content validity addressed content validity ratio (CVR), content validity index (CVI), and scale-level content validity index S-CVI/Ave. To measure CVR, the experts ranked each item on a 3-point Likert scale: Necessary, Useful but not necessary, Unnecessary. According to Lawshé's table, items whose numerical value of CVR is above 0.49 are kept [20].

Evaluation of CVI was conducted according to Waltz and Bausell's index: the relevancy, clarity, and simplicity of each item were ranked on a 4-point Likert scale by 15 experts [21]. The S-CVI/Ave of the questionnaire was calculated based on the mean of the CVI scores of all the items. According to Polit and Beck (2006), a score of 0.90 or above is acceptable for S-CVI/Ave [22]. Item analysis was performed prior to factor analysis. The object of item analysis was to determine the Cronbach's alpha and initial reliability and identify the items that affected the reliability of the questionnaire. Item analysis is also intended to examine the relationship between the correlation coefficient of items: if an item does not have a correlation coefficient of at least 0.2–0.3 with at least another item, it is eliminated [23]; also, if the correlation coefficient of an item with another item is above 0.7, either one of them is eliminated or they are merged. Items whose total correlation coefficient score is below 0.3 can be omitted [24]. Most studies suggest a sample size of 30 to 50 subjects for the purpose of item analysis [25]—in the present study, sample size was set at 40 subjects. An evaluation of the reliability of the questionnaire based on item analysis yielded a Cronbach's alpha of 0.79.

Assessment of construct and divergent validity

Construct validity was determined using factor analysis. The recommended sample size for factor analysis is 5 to 10 subjects per item of an instrument. Some authorities consider 3 subjects per item as adequate provided that percent variance is reported and factor loading is above 0.80 [26]. In the present

study, the number of selected participants was 10 times the number of the items of the questionnaire (350 nurses). The construct validity of the questionnaire was measured using exploratory factor analysis, Kaiser-Meyer-Olkin(KMO) index test, Bartlett's test of sphericity, analysis of the major indexes, and Vorimax rotation. After the calculation of the correlation matrix between the variables, factors were extracted. The factor loading of every item in factor matrix and rotation matrix must be at least 0.4 [27]. In the present study, a factor loading of 0.4 was taken as the least acceptable degree of correlation between each item and the extracted factors. Evaluation of divergent construct validity was conducted using not only the developed triage nurses' professional capability questionnaire, but Liu's Competency Inventory for Registered Nurses (2007) [28]. Both questionnaires were distributed simultaneously among 100 triage nurses; subsequently, the correlation between the scores was analyzed.

Assessment of reliability

The reliability of the questionnaire was assessed in terms of internal homogeneity and consistency. The internal homogeneity of the instrument was measured by calculation of its Cronbach's alpha. In the present study data collected from 350 triage nurses. A Cronbach's alpha of 0.7 to 0.8 indicates satisfactory and adequate internal homogeneity for an instrument [29]. The consistency of the instrument was tested using the test-retest method for each factor and the entire questionnaire. Grove et al. (2014) suggest an interval of 2 weeks to 1 month between the two tests [30]. In the present study, the interval was 20 days and the subjects' scores from the two tests were compared using intraclass correlation coefficient (ICC) test. If the ICC index of an instrument is above 0.80, its consistency is considered as satisfactory [31]. The sample used to determine the consistency of the questionnaire consisted of 50 triage nurses who completed the questionnaire twice with a 20-day interval.

Results

In the first stage of the study, the concept of professional capability in nurses was defined according to data collected from unstructured and focus interviews with triage nurses and emergency room doctors as well as a review of literature. According to the definition thus obtained, a capable triage nurse should not only possess clinical competenc, but have psychological capabilities and be committed to his/her professional duties. Initially, the questionnaire consisted of 85 items which were increased to 90 items following the review of literature. After several meetings and based on the comments of experts, the research team eliminated or merged certain items and the number of the items was reduced to 43. Each item could be scored on a 5-point Likert scale: Very important; Important; Moderately important; Not very important; Not important at all. In the quantitative evaluation of the content validity of the questionnaire, two items were found to have impact values of below 1.5 and were, therefore, eliminated; thus, the number of the items shrank to 41. In the qualitative evaluation of the content validity of the questionnaire, 6 items were merged and 38 items remained. The S-CVI/Ave of the questionnaire was found to be 0.96. The results of item analysis showed 6 items to have correlation coefficients of 0.75 to 0.92—the research team merged those items and eventually 35 items were kept for factor analysis. In the present study, for

the purpose of an exploratory analysis of the construct validity of the questionnaire, 10 subjects per item (350 subjects) were selected. In the first stage, the adequacy of the sample was tested using the Kaiser-Meyer-Olkin (KMO) method: the result was 0.91, which was adequate and very satisfactory. In the next stage, Bartlett's test of sphericity was used—this test shows whether performing a factor analysis based on the matrix under study is justified and appropriate. The results of the test showed the Chi-square to have an approximate value of 14223.013 and degree of freedom of 595 and be significant at $p < 0.001$. (Tabel –1).

Based on the scree plot, three factors were confirmed for the questionnaire (Figure–1). The factor analysis yielded 3 factors for the triage nurses' professional capability questionnaire which could account for 59.96 percent variance. In the present study, the factors of the questionnaire were established using exploratory factor analysis with initial eigenvalues of above 1 and a minimum factor loading of 0.4; in this stage, none of the items was eliminated and all the 35 remaining items were kept. At the end of this stage, the research team labeled the three factors according to the content of the items.

The results of the exploratory factor analysis showed the factor loading values of the items to be between 0.468 and 0.897, all of which were significant, and the three major dimensions introduced in the main instrument were verified with acceptable values.

The first factor, labeled clinical competence, concerns professional knowledge, clinical skill, and clinical judgment and consists of 20 items (items 1 through 20). The second factor, labeled psychological empowerment, concerns resiliency, emotional stability, and self-confidence and consists of 6 items (items 21 through 26). The third factor, labeled professional commitment, concerns personal development, adherence to ethical principles, and interaction and consists of 9 items (items 27 through 35). Table 2 shows the factor loading of each dimension after varimax rotation.

Analysis of divergent construct validity showed the correlation ($r = 0.14$) between the scores obtained by triage nurses' professional capability questionnaire and Liu's Competency Inventory for Registered Nurses (2007) to be insignificant, which indicates that the two questionnaires measure different constructs. Thus, divergent validity was confirmed. To determine the internal homogeneity of the questionnaire, the researchers measured its Cronbach's alpha coefficient—the coefficient was calculated for each of the factors (subscales) and the entire questionnaire with a sample consisting of 350 subjects. A Cronbach's alpha of above 0.7 was taken as satisfactory. The results showed that the present questionnaire had a Cronbach's alpha of 0.89 and possessed a very high reliability. The Cronbach's alpha values of the dimensions of clinical competence, psychological empowerment, and professional commitment were found to be 0.92, 0.87, and 0.89 respectively. The consistency of the present questionnaire was tested using the test-retest method. The results showed the interclass correlation (ICC) coefficient of the entire instrument to be 0.90 and significant at $p < 0.05$. The interclass correlation coefficients of the dimensions of clinical competence, psychological empowerment, and professional commitment were found to be 0.89, 0.88, and 0.93 respectively (Table - 3).

The present study, final version of triage nurses' professional capability questionnaire including 35 items. The score range is between 35 and 175. Answers are scored on a 5-point Likert scale, ranging from 1 (Not important at all) to 5 (Very important). (Table- 4).

Discussion

The objective of the present study was to develop and subsequently evaluate the psychometric properties of a triage nurses' professional capability questionnaire. The questionnaire addresses a wide range of triage nurses' professional capabilities in the three domains of clinical competence (20 items), psychological empowerment (6 items), and professional commitment (9 items). An evaluation of the psychometric properties of the questionnaire proved it to possess satisfactory face, content and construct validity and reliability for measuring professional capability in triage nurses.

An extensive review of the available literature did not yield any instruments specifically designed for assessment of triage nurses' professional capability. Thus, the researchers reviewed studies of triage nurses which were relatively similar to the present study. In their study, Javadi et al. (2016) employ a researcher-made questionnaire to assess the professional knowledge and performance of triage nurses in Iran. The questionnaire consists of 15 4-point items for measuring knowledge and 10 4-point items for measuring performance. The reliability of the instrument is verified with a Cronbach's alpha of 0.87. The findings show that triage nurses' professional knowledge and performance are less than satisfactory [32].

Similarly, Haghig et al. (2017) use a researcher-made questionnaire to assess the knowledge of triage nurses in Iran. The content validity of the questionnaire is verified by 10 nursing professors. A Cronbach's alpha of 0.70 confirms the reliability of the questionnaire. The results of the study show that triage nurses knowledge is unsatisfactory [33]. Dadashzadeh et al. (2011) use a researcher-made questionnaire to study the factors which affect triage from the perspective of the emergency department personnel in a hospital in Iran. The questionnaire consists of 20 4-point items. The content validity of the instrument was confirmed by 10 nurses from the emergency department. Using the test-retest method, the researchers had 10 nurses complete the questionnaire with a one-week interval and reported a Cronbach's alpha of 0.75. The results of the study show that the most influential personal factors in the triage of patients are clinical experience and professional skills [34].

In their study, Aloyec et al. (2014) employ a researcher-made instrument to assess the professional knowledge and performance of triage nurses in a hospital in Tanzania. The skills section consists of 35 and the knowledge section consists of 30 4-point items. The reliability of the instrument is tested using the retest approach and verified with a Cronbach's alpha of 0.78. The findings show the professional knowledge and performance of triage nurses to be unsatisfactory [35].

Fathoni et al. (2010) use a researcher-made questionnaire to measure the professional knowledge and skills of nurses in triaging patients. The skills section consists of 37 and the knowledge section consists of 15 items. The content validity of the questionnaire is confirmed by 3 experts. The reliability of the instrument is tested using the retest method and verified with a Cronbach's alpha of 0.95. The study

reports the knowledge and skills of triage nurses to be unsatisfactory. Moreover, at the end of the study, the researchers mention that there is need for more thorough research to develop a standard instrument for evaluation of triage nurses' capabilities [36].

The above-mentioned instruments address only the knowledge and skills of triage nurses and do not measure the various dimensions of their professional capabilities. Furthermore, the items in those instruments have been developed based on library research and do not reflect triage nurses' perceptions. None of the above-mentioned instruments have been assessed in terms of face or construct validity.

Conclusion

As hospital triage nurses work in a complicated and unpredictable environment, they are expected to enhance their professional capabilities and nurse administrators are expected to conduct regular evaluations of nurses' capabilities using standard instruments. The present questionnaire is a valid and reliable instrument for assessment of the various aspects of triage nurses' professional capabilities. Nurse administrators can employ the present instrument to measure triage nurses' professional capabilities and, by identifying weaknesses, take measures to enhance their professional capabilities and, in turn, improve the quality and effectiveness of triage.

Declarations

Ethics approval and consent to participate

This article was supported by the Vice Chancellor for Research, Shiraz, University of Medical Sciences, Shiraz, Iran (ethical code: IR.SUMS.REC.1396.S197). Informed consent was obtained in writing through voluntary completion of the survey by respondents.

Consent to publish

Not applicable.

Availability of data and materials

The datasets used and /or analysed during the current study are available from the corresponding author on reasonable request. availability of data and materials.

Competing interests

The authors declare that they have no competing interests.

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Authors' Contributions

All authors (MB, MR, MF, and CT) have participated in the conception and design of the study. MB contributed the data collection and prepared the first draft of the manuscript. MB, MR and CT, Critically revised and checked closely the proposal, the analysis and interpretation of the data and design the article. All authors read and approved the final manuscript

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Tables

Table 1 - The results of factor analysis of questionnaire (KMO and Bartlett's Test)

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.91
Bartlett's Test of Sphericity Approx. Chi-Square	14223.013
Df	595
Sig	p<0.001

Table - 2 ; Rotated Component Matrix of items

Items	Factors		
	1	2	3
q1	0.897		
q2	0.591		
q3	0.758		
q4	0.527		
q5	0.478		
q6	0.654		
q7	0.537		
q8	0.547		
q9	0.642		
q10	0.730		
q11	0.657		
q12	0.628		
q13	0.534		
q14	0.639		
q15	0.554		
q16	0.627		
q17	0.531		
q18	0.621	0.642	
q19	0.547	0.657	
q20	0.523	0.597	
q21		0.468	
q22		0.559	
q23		0.544	
q24			
q25			
q26			
q27			0.698
q28			0.754
q29			0.637
q30			0.587
q31			0.567
q32			0.651
q33			0.797
q34			0.641
q35			0.593

Table - 3: The score and the intraclass correlation coefficient (ICC) values of triage nurses' professional capability Scale dimensions.

Pvalue	confidence interval:	ICC	Mean (Standard Deviation)	Dimensions	Factor
p<0.05	0.789 - 0.898	0.89	77.96± 3.81	clinical competence	1
p<0.05	0.854 - 0.943	0.98	23.92±10.90	psychological empowerment	2
p<0.05	0.840 - 0.927	0.93	36.68±2.95	professional commitment	3
p<0.05	0.824 - 0.922	0.90	138.56±8.63	Total	

Tabel - 4 : The final version of triage nurses' professional capability questionnaire (35 items)

Item	Very important	Important	Moderately important	Not very important	Not important at all
1. Having the ability to quickly and accurately prioritize patients' needs based on the ESI triage algorithm					
2. Being knowledgeable in the field of physiopathology					
3. Having the ability to quickly and accurately measure vital signs					
4. Being knowledgeable in the field of CPR					
5. Being skilled at CPR					
6. Being knowledgeable about the usage and side effects of emergency box medicines					
7. Having the ability to take nursing measures in high-risk cases					
8. Being skilled at air way management					
9. Being skilled at interviewing patients about their status and performing physical examination					
10. Being skilled at using medical equipment correctly					
11. Cooperating with the other members of the medical team in providing care					
12. Respecting the opinions of the other members of the medical team					
13. Being skilled at management and leadership (organizing resources, inter-unit coordination, and guiding the personnel) in teamwork					
14. Prioritizing and performing tasks (time management)					
15. Reflecting upon the outcome of previous clinical measures					
16. Having the ability to predict potential hazards to patients by analyzing visual and mental data					
17. Having the ability to judge and make decisions about patients' conditions by analyzing clinical data based on one's academic knowledge					
18. Having the ability to notice incompatibilities between medical signs and test results					
19. Having the ability to predict potential complications in patients'					

conditions instinctively (based on clinical intuition) .					
20. Making clinical judgment based on clinical guidelines, research literature, and the knowledge and experience of one's colleagues					
21. Having the ability to deal with difficulties in critical conditions					
22. Making an effort to maintain one's own physical and mental health					
23. Being aware of one's own emotions and feelings					
24. Having the ability to manage and control one's anger					
25. Having the ability to defend logical decisions with resolution					
26. Having the ability to perform tasks with self-confidence					
27. Observing punctuality at work					
28. Having a neat appearance at work					
29. Feeling responsible about one's professional performance					
30. Active participation in continuing education programs, academic nursing associations, and clinical research					
31. Introducing oneself (name and professional status) to patients and their companions					
32. Listening to patients' and their companions' questions patiently and providing honest answers					
33. Respecting patients' privacy and maintaining confidentiality					
34. Respecting patients' and their companions' dignity					
35. Performing triage regardless of patients' financial and social status or nationality (justice)					

Figures

Scree Plot

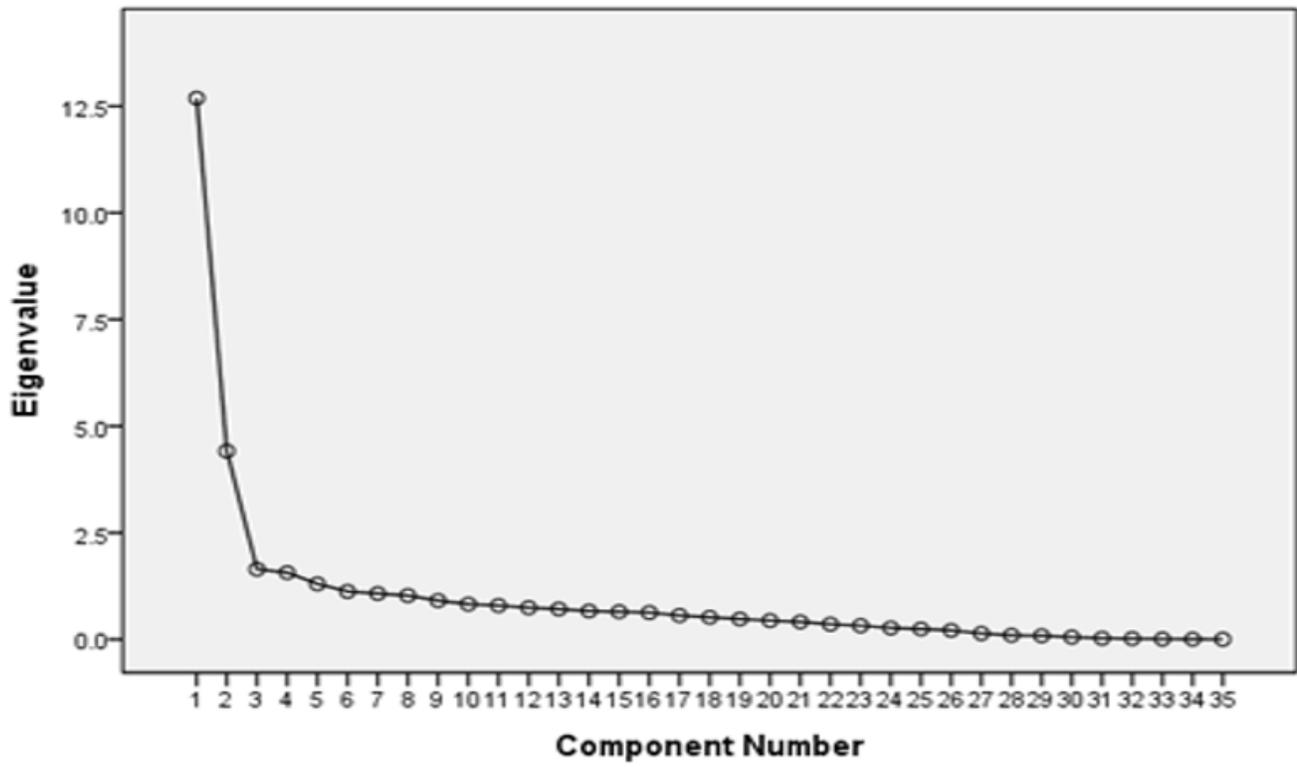


Figure 1

The factor analysis scree plot