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ORIGINAL RESEARCH

# Development and psychometrics measurement scales of factors affecting the establishment of teledermatology

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## Abstract

**Purpose:** Despite its vast benefits, the establishment of telemedicine, especially teledermatology, faces many problems due to several reasons. The present study was carried out with the purpose of psychometrics measurement of the factors affecting the establishment of teledermatology.
**Materials and Methods:** The present mixed-method (qualitative and quantitative) study was carried out through triangulation in 2018. The research population comprises experts and managers of the health system of Iran. Cronbach's alpha test was used to assess the internal consistency, and the external reliability was measured by the test-retest method. The significance level throughout the whole analysis was $P<0.05$.
**Results:** According to the scree plot, the eigenvalues were greater than 1 and the slope of the scree plot, 8 factors with the potential of predicting the 69.52% of the total changes of the factors of the establishment of the telemedicine were extracted and selected. Cronbach's alpha test was employed to determine the internal consistency of the questionnaire, which was approved with the amount of 0.941 (higher than 0.7).
**Conclusion:** The results indicated that the 58-article measurement scale for the factors influencing the establishment of teledermatology has good validity and reliability. According to factor analysis, it includes 8 subscales. Cronbach's alpha coefficient was calculated to be equal to 0.941.

**Keywords:** Telemedicine, Teledermatology, Dermatology, Questionnaire, Psychometrics

## Introduction

Teledermatology is a field of study in dermatology fellowship and one of the most common telemedicine methods. It is considered a modern development in dermatology. Dermatology is defined as the remote diagnosis of skin diseases using telecommunication technologies including voice, image, and data to exchange medical information such as examining the skin health status and its evaluation [1]. In this field of medicine, due to the visibility of skin diseases, especially with digital imaging, teledermatology facilitates the process of examining the patients' health and the diagnosis of skin conditions. Since skin diseases are mostly chronic disorders that require a great amount of time and appropriate treatment, teledermatology is a suitable method that offers medical services to these patients, which not only reduces the treatment costs but also can be practiced in different environments and circumstances [2]. This method enjoys other benefits such as improving access to specialized skin services, reducing the number of unnecessary clinical visits, reducing the number of travels, and increasing user satisfaction, improving the medical consultations and education. Due to dermatologists' unwillingness to work in the deprived areas and shortage of dermatologists, these areas could be covered using teledermatology, which is another advantage of using this method [3]. Using teledermatology changes the traditional physician-patient relationship and causes broad changes in using the health infrastructures and constructional equipment for providing the patients with clinical services. Also, in developing countries like Iran, by equipping health centers with the Internet in the remotest points in the country, the physicians can benefit from the required education, consultation and instructions in this regard [4].

Despite the wide range of benefits of teledermatology for human, organizational, and treatment aspects of telemedicine, the establishment and use of this approach face many problems for several reasons[5]. Safe access is a critical issue that should be taken into consideration. Other aspects include encryption, confidentiality, identification, validation, and integrity of data [5]. The other problems in the execution of teledermatology include hearing and visual impairment in patients, the psychological and social status and the impact of these factors on the patients' ability to understand the physician's or the consultant's remarks [6]. Providing the equipment and communicational infrastructure, their costs, policies of the involving health organizations and their inter-division cooperation are among the main factors affecting the establishment of teledermatology networks. Besides the patient's viewpoint, fixed and variable costs, work costs, and effectiveness, the economic considerations are an important dimension in planning and execution of a telemedia medical plan [7].

A wide range of studies was conducted regarding the usefulness of the telemedia method in the process of treatment of the patients. In most of the studies, the results revealed a variety of problems in carrying out the telemedicine, especially teledermatology [8, 9]. The research conducted by Jay Rajda et al. (2018) indicated that the potential of prevention plans by teledermatology to improve access and reduce the average wait time for skincare services from weeks to hours, however, the most important problem in performing the teledermatology was the quality of the plans [10]. Chung-mei et al. (2018) conducted a study, which demonstrated that this method improved the use of equipment in providing high-quality images and increasing the awareness and knowledge of the general practitioners during their interaction with the experts. This resulted in the improvement of the patients' satisfaction and reduction of the wait time between the primary and secondary care to one-third [11]. The study carried out by Howa Yeung et al. (2018), revealed that the official international teledermatology curriculum could improve the education with respect to the main competencies such as medical knowledge, interpersonal skills, communication, professionalism, and the interest in world health growth [12].

Considering that the organizations involved in healthcare issues face many shared problems in most regions, investigating the factors affecting the establishment of teledermatology could be served as an invaluable guide in executing it in other regions. Taking into

account the various applications of telemedicine and distant documentation of medical reports, creating a proper platform and structure for offering health services in health organizations is necessary. This technology can guarantee the speed, precision, and quality of the health services presented to the patients. In the past decade, we have witnessed progress in the development of telemedicine technology supported by digital modern media communications. In most countries, the medical healthcare system is more accessible to patients. Telemedicine in countries such as Iran with poor transportation network, seems necessary. Therefore, this study aims at investigating the researches conducted in the field of telemedicine in Iran to provide the policymakers and executive managers with an objective view of telemedicine.

**Materials and Methods**

In the present mixed-method research, the qualitative-quantitative data were collected using a triangulation approach. This study was carried out in 2018. The research population comprises experts and managers of the health system of Iran. The number of samples amounted to 384 based on the purpose of the study and considering the Jersey table and Cochran formula. The statistical population included all Universities of Medical Sciences in Iran that were classified and the samples were selected using clustered selection. The stratified random sampling was carried out with proportional allocation. The determined population included 10 categories in accordance with the 10 Centers of Excellence of the Universities of Medical Sciences in Iran. Cochran formula was used to determine the maximum samples required. This formula was calculated based on willingness level of 50%, error rate of 5%, and the confidence interval of 95% (p=0.5, d=0.05). The Sample size was 384.

$$n = \frac{z^2pq}{d^2} = 384$$

The following formula was used to select the samples in each class according to the ratio of that class in the population. Accordingly, the number of samples for each university was 6, which was selected via simple random sampling from each class.

$$n_h = N_h\left(\frac{n}{N}\right)$$

The research population was selected from the Health System of Iran comprising two groups, information technology experts and executives, and dermatologists. The professional experts in this field were selected using documentations, organizational charts of the other organizations involved in the establishment of teledermatology including the Ministry of Health (Department of Health and Treatment, the policy-making council, Universities of Medical Sciences, faculty members), the Ministry of Cooperatives, Labor, and Social Affairs (Health Insurance Organization).

Research methodology was employed to develop and validate the questionnaire. In this method, instrument development, validity assessment, and instrument evaluation stages were carried out. Waltz 4-step method was employed for instrument development, as described below:

*The first stage (selecting the conceptual model for determining the dimensions of the subject of study):* In this stage, the dimensions of the subject of the study were determined by a systematic review using secondary sources. The inclusion criteria were selected considering the subject of the study, research articles, reviews, and meta-analysis published from 2000 up to the end of 2018 from Persian into English in the field of telemedicine dermatology and the factors influencing its establishment. Exclusion criteria were the articles presented in the conferences and educational articles, and lacking the full article in the database, report and short communication.

Therefore, in the first stage, the title and abstract of the article were searched in Persian databases such as Medlib, SID, Magiran, and Iranmedex and foreign databases such as ProQuest, Elsevier, Ovid, PubMed, CINAHL, Google Scholar, Science Direct, Web of Science, and Scopus using the following keywords, Telemedicine, Dermatology remote, Tele Dermatology, Telemedicine Dermatology. The keywords were searched solely at first and then together with other words. The references at the end of the article were investigated to find the articles including the above criteria, which could not be found in the previous searches. Finally, the Google

search engine was used to ascertain the search. Non-English articles were removed from the review. The articles that the researcher did not have access to their full texts plus the articles that discussed the attitude in non-health groups and students.

To assess the quality of the articles, each author searched the articles independently, and the extracted results were compared to each other. To extract the information, articles in Persian and English languages were collected. From each database Magiran, SID, Medlib, and Iranmedex, 4, 7, 3, and 5 articles with full text were downloaded, respectively, and from Pubmed, Ovid, Web of Science, ProQuest, Scholar, Science Direct, Scopus, and CINAHL, 18, 3, 14, 3, 11, 8, 8, and 2 articles were downloaded respectively. Some of the downloaded articles were the same. After removing the similar articles 49 files remained. After investigating the references of the articles and searching with Google, 2 more articles were found and the total number of articles reached 63. After a meticulous study and extracting the required information, the results were summarized in the data extraction table, then, analyzed manually. Diagrams were created using Excel 2007. Endnote X5, i.e. reference management software, was used to organize and study the titles and abstracts and detect repetitive cases.

*Second Stage (Determining Objectives of Instrument):* In this stage, the items of the questionnaire were designed based on the documents, articles, and questionnaires existing in Iran and other countries. The initial draft of the questionnaire included 73 items.

*Third Stage (Developing an Initial Plan):* After developing the items of the questionnaire, the items were investigated and their validity was assessed using face validity, content validity, and construct validity.

To carry out qualitative face validity, 10 samples, including the provincial, state managers from the Management Center of Statistics and Information Technology of the Ministry of Health and province (3), dermatologists (2), professors from the field of Health Services Management and faculty members (3), faculty members from research centers (2), were asked to analyze the items of the questionnaire with respect to their simplicity, Persian language grammar, and clarity and express their opinion in this regard. Afterward, final analyses was carried out and the opinions were collected and recorded in two group discussions. After completion of each section of the group discussion and interview, in order to enhance the consistency and accuracy of the data, the interviews with the participants were controlled and finally, the data were analyzed through content analysis method. The item-impact method was employed for assessing the quantitative face validity. Thus, 10 experts were asked to check the items of the initial draft of the questionnaire in the 3-point Likert scale and choose one option. After calculating impact points of each item, the quantitative face validity of the questionnaire was assessed by the following formula. In case the impact point of each item is higher than 1.5 hat item is identified as acceptable for the subsequent analysis and will be saved.

Impact Point=importance*Frequency (%)

Next step in the third stage was the quantitative content validity assessment. In order to confirm the content validity, the content validity index and content validity ratio were calculated. In order to calculate the content validity ratio, Lawshe table and the opinions of 10 participants (0.62) were used and the content validity index was calculated with respect to three criteria including simplicity, relevance, and clarity of the items.

The exploratory factor analysis was employed to assess the construct validity, Thus, the questionnaire was distributed among 384 participants on the basis of the inclusion criteria of the research. The varimax rotation was employed to carry out exploratory factor analysis by the principal component analysis method. The minimum factor load was considered acceptable to retain the items in the exploratory factor analysis. For the purpose of scoring the final instrument, the minimum and maximum scores of each item were calculated and the minimum and maximum scores were determined on the basis of the number of the final questions. The following formula was employed in order to calculate the normalized distance scale:

$$\text{Scale distance} = \frac{\text{Maximum point of questionnaire} - \text{Minimum point of questionnaire}}{\text{Number of response classes to the questionnaire}}$$

*Fourth Stage (Construction of the Measure)* The construction of the measure is employing the processes, collection of items, and scoring rules. In this stage, reliability of the questions

is examined. The internal consistency of the questionnaire was assessed via Cronbach's alpha test. In order to determine the external reliability of the questionnaire, test-retest method was employed. Therefore, the questionnaire was handed over to 50 experts and professionals in two stages and with interval of one week, then, the data were collected. Then, the approved and final questionnaire will be given to the sample population. Considering the geographical distribution of the statistical population throughout the country, the questionnaires were sent to the participants as a web form and the completed questionnaires were sent back in the same manner. In case the participants' email addresses were available and the participants were willing to receive and fill out electronic questionnaires, these questionnaires were sent and the completed questionnaires were received via email. This process was followed up through three reminders, phone call, email or message.

Data were analyzed using SPSS, 21.0. Descriptive statistics were employed to calculate the Mean and the standard deviation. Determining the normality of the data was carried out by Kolmogorov–Smirnov tests. Cronbach's alpha test was used to check the internal consistency of the questionnaire. Exploratory factor analysis was used for data reduction via principal component analysis method through varimax rotation. The confirmatory factor analysis was carried out in order to examine the measure ratio. The minimum factor load was considered acceptable to retain the items in the exploratory factor analysis. Spearman's correlation coefficient was employed to investigate the relationship between the quantitative variables. The relationship between qualitative variables was determined by chi-squared test. T-Test was used for examining the mean difference of the meaning of life in the dichotomous variables. Checking the mean difference of the scores in the dichotomous variables was executed through one-way ANOVA test. Investigating the ranking of the effective factors was carried out by Friedman test.

**Results**

The results indicated that the mean age of the population was 42.2±6.9 (IQR=11) with group age of 26-57. Most of the participants with respect to the age variable were in age group of 36 to 40 (n=104, 27.1%), with respect to gender variable most of them were female (n=226, 58.9%), and considering the education variable half of the participants held Master's Degree (n=192, 50%). With regard to their employment records the maximum number of the participants had average length of employment of 10 to 15 years (n=161, 41.9%), and with respect to management experience (n=208, 54.2%) the average length was under 5. The average employment records equaled 14.6±8.7 years (ICR=8) that ranged between 3-26 years. The average employment experience equaled 4.6±8.3 years (ICR=7.5) that ranged between 2-15 years.

The items of the questionnaire were developed on the basis of the documents, articles, and questionnaires existing in Iran and other countries. The initial draft of the questionnaire included 73 items. In the face validity process, the results of calculation of the impact item index revealed that point impact of 64 items were more than 1.5; therefore, these items were considered appropriate items for examining the content validity. The identified factors from the previous stage (64 factors) were investigated by10 experts and professor of the health sector to confirm their content validity. In order to do so Lawshe technique and content validity ratio were employed, and the minimum acceptable amount in Lawshe table was 0.62 for 10. In accordance with the Lawshe table, among the identified factors, 60 factors were more than the determined acceptable amount. Thus, these factors were entered the main questionnaire for the subsequent stage. Taking into account that the minimum acceptable amount for CVI equals 0.8, items wit content validity index less than 0.8 were dropped. Accordingly, 58 items were confirmed from 60 questions (Table 1).

Table 1: The results of the content validity ration and content validity index of the initial draft of the questionnaire the factors affecting the establishment of telemedicine in dermatology

| | Cooperation of General Physicians and Specialist | CVR | CVI | Standardized Items | Cronbach's α |
|---|---|---|---|---|---|
| 2 | Helping increase the awareness and knowledge of the service providers | 0.8 | 82.0 | | |
| 3 | Increasing individual and professional skills of the service providers | 0.8 | 86.0 | | |
| 4 | Unequal geographical distribution and lack of specialists in remote areas | 1 | 91.0 | | |
| 5 | Stockholders' understanding of the results of using technology in service providing steps | 0.8 | 93.0 | | |
| 6 | Determining acceptable level of patient safety | 0.8 | 87.0 | | |
| 7 | Accuracy of Diagnosis | 0.8 | 96.0 | | |
| 8 | The need for distance medical education | 1 | 93.0 | | |
| 9 | Visit load | 0.8 | 87.0 | | |
| 10 | Patient satisfaction | 0.8 | 86.0 | | |
| 11 | Wait time between preventive care and treatment | 0.8 | 83.0 | | |
| 12 | Access | 0.8 | 81.0 | | |
| 13 | Interface-free communication of the users with system | 0.8 | 82.0 | | |
| 14 | Information Access using secure encryption | 0.8 | 86.0 | | |
| 15 | Expanding high quality medical services | 0.8 | 93.0 | | |
| 16 | Patient's direct access to their medical report (patient) | 0.8 | 93.0 | | |
| 17 | Adequate access to patient's history and medical records (Physician) | 0.8 | 91.0 | 840.0 | 0.941 |
| 18 | Service Quality | 0.8 | 95.0 | | |
| 19 | Continuous provision of care by the provider | 0.8 | 82.0 | | |
| 20 | Information security and preserving privacy | 1 | 96.0 | | |
| 21 | The role of Universities and determining the scope of authorities | 1 | 95.0 | | |
| 22 | Equipment distribution in various locations | 1 | 84.0 | | |
| 23 | International restrictions on sharing the information | 1 | 84.0 | | |
| 24 | Standard for agreeing on the course of treatment (lack of treatment guidelines in telemedicine) | 1 | 85.0 | | |
| 25 | Consistency of supply and validity | 0.8 | 89.0 | | |
| 26 | Computer system usability | 0.8 | 89.0 | | |
| 27 | Reliability of technology (responsibility and education) and computer system | 0.8 | 80.0 | | |
| 28 | User-friendliness of telemedicine | 0.8 | 81.0 | | |
| 29 | The communication of telemedicine network with governmental system for establishing the identity of the patients | 0.8 | 89.0 | | |
| 30 | Risk of equipment failure | 0.8 | 86.0 | | |
| 31 | Infrastructure | 0.8 | 93.0 | | |
| 32 | Integration of heterogeneous systems | 0.8 | 97.0 | | |
| 33 | Development of intelligent systems | 0.8 | 81.0 | | |
| 34 | Messaging standard | 1 | 81.0 | | |
| 35 | Less cost method with regard to financial, social, and environmental interactions | 1 | 89.0 | | |
| 36 | Method for reducing hospitalization costs | 1 | 84.0 | | |
| 37 | Medical equipment costs | 1 | 93.0 | | |
| 38 | Specialists' payroll | 1 | 94.0 | | |
| 39 | Threatening insuring organizations to payments insurance premium | 1 | 85.0 | | |
| 40 | Market forces and rivals | 0.8 | 82.0 | | |
| 41 | Budget constraints | 1 | 86.0 | | |
| 42 | Private insurance coverage | 0.8 | 93.0 | | |
| 43 | Determining a framework and issuing a third-party certificate for patients to access their medical records | 0.8 | 82.0 | | |
| 44 | Validation and instruction framework | 0.8 | 86.0 | | |
| 45 | Reliability and diversity of clinical guidelines and regulations | 0.8 | 93.0 | | |
| 46 | The role of the Ministry of Health and Medical Education in e-health | 1 | 93.0 | | |
| 47 | Emphasis on public health services | 1 | 89.0 | | |
| 48 | Insurance supervision | 1 | 80.0 | | |
| 49 | Required framework for creating rules and instructions | 1 | 81.0 | | |
| 50 | Protocols compatible with insurance responsibility | 1 | 89.0 | | |
| 51 | Creating care delivery guideline or instruction | 1 | 80.0 | | |
| 52 | The rules required for encrypting security information of patients | 1 | 81.0 | | |
| 53 | Documents presented in the clinical records for judicial barriers | 1 | 89.0 | | |
| 54 | Technology-based trust and cooperation between partners without knowing each other | 1 | 96.0 | | |
| 55 | Clarity and safety of all transactions, in general | 0.8 | 95.0 | | |
| 56 | Necessary instruments for interaction and execution | 0.8 | 84.0 | | |
| 57 | Degree of cooperation capacity and high scale in health system | 0.8 | 84.0 | | |
| 58 | Interaction between experts at the national and international levels | 0.8 | 87.0 | | |

On the basis of the results, all items obtained the minimum point required for carrying out the construct validity; therefore, all 58 items were used for executing construct validity through exploratory factor analysis. The results of the exploratory factor analysis contained Initial eigenvalues, extraction sums of squared loadings, and rotation sums of loadings. As seen in the above table, 8 principle factors were identified from the questionnaire by carrying out exploratory factor analysis. These 8 factors have eigenvalues greater than 1 that includes the 69.52% of the variance of the factors, which is the acceptable amount (Table 2).

Table 2: Variance results, initial sharing and extraction of the exploratory factor analysis the final draft of the questionnaire factors affecting the establishment of telemedicine dermatology in construct validity

| Eigenvalues | | | Sum of unrotated factor loadings | | | Sum of rotated factor loadings | | | Factor |
|---|---|---|---|---|---|---|---|---|---|
| Amount | Percentage | Cumulative sum | Amount | Percentage | Cumulative sum | Amount | Percentage | Cumulative sum | |
| 22.079 | 38.067 | 38.067 | 22.079 | 38.067 | 38.067 | 8.635 | 14.889 | 14.889 | 1 |
| 5.798 | 9.996 | 48.063 | 5.798 | 9.996 | 48.063 | 6.539 | 11.274 | 26.163 | 2 |
| 3.198 | 5.513 | 53.576 | 3.198 | 5.513 | 53.576 | 5.211 | 8.984 | 35.147 | 3 |
| 2.503 | 4.315 | 57.891 | 2.503 | 4.315 | 57.891 | 4.482 | 7.727 | 42.874 | 4 |
| 2.052 | 3.538 | 61.429 | 2.052 | 3.538 | 61.429 | 4.284 | 7.387 | 50.261 | 5 |
| 1.865 | 3.216 | 64.645 | 1.865 | 3.216 | 64.645 | 4.237 | 7.305 | 57.565 | 6 |
| 1.650 | 2.845 | 67.490 | 1.650 | 2.845 | 67.490 | 3.726 | 6.424 | 63.989 | 7 |
| 1.182 | 2.038 | 69.528 | 1.182 | 2.038 | 69.528 | 3.213 | 5.539 | 69.528 | 8 |

As demonstrated on the scree plot, this study considered eigenvalues to be greater than 1 and the slope of scree plot, 8 factors with the potential of predicting the 69.52% of the total changes of the factors of establishment of the telemedicine were extracted and selected (Diagram 1).

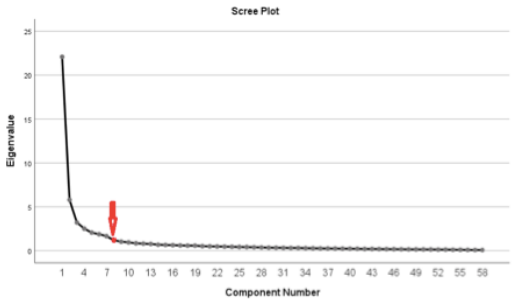


Diagram 1: The scree plot eigenvalues questionnaire factors affecting the establishment of telemedicine dermatology in construct validity

In accordance with the results of the execution of factor analysis by varimax rotation, 58 questions were extracted from the questionnaire with allocation of the required factor loading by 8 factors, first factor with 8 items as service provider, service recipient with 11 questions, technology factor with 9 questions, economic factor with 8 items, structural factor with 6 items, policy making factor with 5 questions, cultural factor with 5 items, and legal factor with 6 questions (Table 3).

Table 3: The results of the rotated factor matrix with the principal component analysis approach and varimax rotation of the final draft of the questionnaire, factors affecting the establishment of telemedicine dermatology in construct validity

| Extracted factors | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Service recipient factors | Economic factors | Service providing factors | Technology factors | Structural factors | Legal factors | Policy-making factors | Cultural factors | Questions |
| | 748 | | | | | | | EQ1 |
| | 745 | | | | | | | EQ2 |
| | 811 | | | | | | | EQ3 |
| | 778 | | | | | | | EQ4 |
| | 714 | | | | | | | EQ5 |
| | 804 | | | | | | | EQ6 |
| | 815 | | | | | | | EQ7 |
| | 804 | | | | | | | EQ8 |
| | | 654 | | | | | | ER1 |
| | | 635 | | | | | | ER2 |
| | | 714 | | | | | | ER3 |
| | | 561 | | | | | | ER4 |
| | | 565 | | | | | | ER5 |
| | | 692 | | | | | | ER6 |
| | | 669 | | | | | | ER7 |
| | | 759 | | | | | | ER8 |
| | | | 475 | | | | | FA1 |
| | | | 523 | | | | | FA2 |
| | | | 631 | | | | | FA3 |
| | | | 740 | | | | | FA4 |
| | | | 661 | | | | | FA5 |
| | | | 681 | | | | | FA6 |
| | | | 642 | | | | | FA7 |
| | | | 448 | | | | | FA8 |
| | | | 550 | | | | | FA9 |
| | | | | | | | 698 | FR1 |
| | | | | | | | 681 | FR2 |
| | | | | | | | 656 | FR3 |
| | | | | | | | 482 | FR4 |
| | | | | | | | 802 | FR5 |
| | | | | | 617 | | | GA1 |
| | | | | | 679 | | | GA2 |
| | | | | | 699 | | | GA3 |
| | | | | | 636 | | | GA4 |
| | | | | | 758 | | | GA5 |
| | | | | | 668 | | | GA6 |
| 838 | | | | | | | | GI1 |

| Extracted factors | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Service recipient factors | Economic factors | Service providing factors | Technology factors | Structural factors | Legal factors | Policy-making factors | Cultural factors | Questions |
| 821 | | | | | | | | GI2 |
| 794 | | | | | | | | GI3 |
| 815 | | | | | | | | GI4 |
| 849 | | | | | | | | GI5 |
| 844 | | | | | | | | GI6 |
| 872 | | | | | | | | GI7 |
| 822 | | | | | | | | GI8 |
| 803 | | | | | | | | GI9 |
| 862 | | | | | | | | GI10 |
| 846 | | | | | | | | GI11 |
| | | | | 562 | | | | SA1 |
| | | | | 704 | | | | SA2 |
| | | | | 755 | | | | SA3 |
| | | | | 761 | | | | SA4 |
| | | | | 661 | | | | SA5 |
| | | | | 727 | | | | SA6 |
| | | | | | | 669 | | SI1 |
| | | | | | | 736 | | SI2 |
| | | | | | | 705 | | SI3 |
| | | | | | | 699 | | SI4 |
| | | | | | | 759 | | SI5 |

As seen in the diagram No. 2, the result of standardized path coefficients of the confirmatory factor analysis of the final draft of the questionnaire of the factors affecting the establishment of telemedicine dermatology in construct validity indicates that the data is in harmony with a specified factor structure that is mentioned in the hypothesis and the required alignment exists between the indexes (questions).

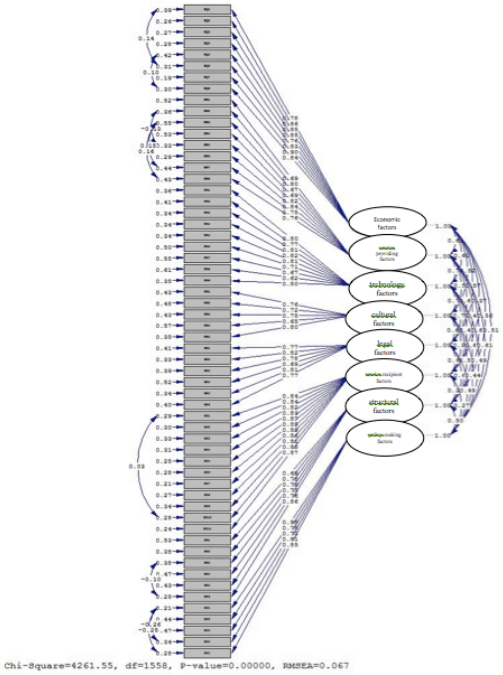


Diagram 2-4: The standardized path coefficient the confirmatory factor analysis the final draft of the questionnaire the factors affecting the establishment of telemedicine dermatology in construct validity

The internal consistency of the questionnaire was assessed via Cronbach's alpha test. Therefore, the questionnaire was given to 50 experts and professionals in two stages and with interval of one week with the amount of 0.941 (higher than 0.7) confirmed (Table 1). As indicated in table No. 4, Cronbach's alpha coefficient of all extracted factors is higher that 0.7, which is acceptable. Furthermore, Cronbach's alpha coefficient of the total questionnaire with 58 items and 384 samples is in optimum level and calculated as 0.97.

Table 4: The results of Cronbach's alpha coefficient of the final draft of the questionnaire of the factors affecting the establishment of telemedicine dermatology in construct validity after carrying out exploratory factor analysis

| Extracted factors | Number of Items | Variance Percentage | Cronbach's Alpha |
|---|---|---|---|
| Economic factors | 8 | 14.88 | 0.949 |
| Service providing factors | 8 | 11.27 | 0.915 |
| Technology factors | 9 | 8.98 | 0.921 |
| Legal factors | 6 | 7.38 | 0.899 |
| Cultural factors | 5 | 7.72 | 0.851 |
| Service recipient factors | 11 | 7.30 | 0.965 |
| Structural factors | 6 | 6.42 | 0.892 |
| Policy-making factors | 5 | 5.53 | 0.876 |

The final confirmed instruments included 58 items. Each item on the basis of 5 point Likert scale includes (5) Strongly agree, (4) Agree, (3) Neither agree nor disagree, (2) Disagree,

(1) Strongly disagree. Final score of the deigned instrument calculated between 58-290. The higher the obtained number, the more the dependency of the telemedicine to the various factors; therefore, there is a low possibility of its establishment. In addition, in each of instrument subscales, the score is calculated on the basis of the number of each item. In accordance with table No. 5, the confirmed final instrument based on the 5-point Likert scale and the formula for determining the normalized distance, includes 5 classes from low dependency to absolute dependency. The higher the obtained score in the instrument, the more the dependency of establishment of telemedicine to the respective factors.

Table 5: The results of determining the normalized distance of the final version of the questionnaire, factors affecting the establishment of telemedicine dermatology and determined subscales in factor analysis in validation based on the 5 point Likert scale

| Stratum | Minimum Score | Maximum Score |
|---|---|---|
| Totally Low Dependence | 58 | 104 |
| Low Dependence | 105 | 151 |
| Moderate Dependence | 152 | 197 |
| High Dependence | 198 | 244 |
| Absolute Dependence | 245 | 290 |

**Discussion**

This is an innovatory study in Iran due to development of a questionnaire of factors affecting the establishment of telemedicine teledermatology based on the 5-point Likert scale, with points ranging from 1 to 5. All other questionnaire in Iran and other countries [10, 13, 14] investigated the determined component in this instrument separately. No specialized instrument were developed for investigating the factors affecting the establishment of telemedicine teledermatology that could simultaneously cover all 8 fields such as economic factors, service providing factors, technology factors, cultural factors, service recipient factors, structural factors, and policy-making factors. The questionnaire developed in this research, not only aims at fixing the deficiencies in other questionnaires, but also enjoys the good reliability and validity. The study carried out by Tensen et al. (2016) revealed that considering the efficient dimensions of teledermatology, the personal, and transportation costs of the service recipients are of the important aspects of this instrument [15]. Coates et al. (2015) stressed the network information as the most important field in teledermatology establishment [9]. Taking into account that in the various instruments the emphasis was placed on the specific categories and factors in teledermatology establishment, creating a specific instrument that covers most of the factors is one of the innovations of the present study. The wide range of the confirmed items in this instrument is an indication of the impact of various factors that could be considered as the factors affecting the establishment of teledermatology. The study conducted by Moghaddasi et al. (2015) suggested the major role of teledermatology establishment in' health of the individuals and expressed a variety of factors in its establishment [16].

In order to determine the reliability of the instrument of factors affecting the establishment of teledermatology the internal reliability method through Cronbach's alpha was employed and the optimum results were obtained. Considering that Cronbach's alpha coefficient in this study was 0.941, therefore, the questionnaire enjoys the required reliability. On the other hand, each field has a medium relationship with other areas, which indicates that fields do not overlap and the questions are discriminant. Santos et al. (1999) expressed that development of instrument scale for collection of the predicting variables to be used in objective models that results in increase of the reliability, the performance of the scales to be designed, and expands the predicting scale. One of the most popular reliable statistics is Cronbach's Alpha that in order to assess its reliability, internal or medium consistency determines the factors of an instrument [17]. Gurupur et al. (2017) in their study suggested the Cronbach's alpha to be 0.79 in the developed instrument and argued that there is a positive attitude regarding the use of telemedicine in North Louisiana that could be assessed on the basis of the instrument of the study [18]. For assessing the internal compatibility of the questionnaire, Cronbach's alpha was used. Consequently, in case of increase in the internal compatibility of the questionnaire, alpha coefficient will be increased as well, i.e. If the items have more relationship with the subject of the study, this coefficient will become larger. Cronbach's alpha is also used for determining the relationship between the items and the latent variable, Meaning that the items with higher coefficient could be the indication of a latent variable. Consequently, by calculating the total points, the amount of latent variable can be calculated. Taking into

account the method of calculation of this coefficient, the minimum amount is 0 and the maximum amount equals to 1. I.e. If the items are independent or their covariance equals 0, the numerator of the fraction of the Cronbach's alpha will be 0 that is an indication of dissimilarity of the items for assessing the target variable [19].

The results of exploratory factor analysis contained initial eigenvalues, extraction sums of squared loadings, and rotation sums of loadings. In accordance with the result of the exploratory factor analysis, the standardized factor load for the questions, includes the variables higher than 0.4 and considering that the t-value among the items with the respective latent variables were calculated as greater that 1.96, construct validity of the measurement of the respective variables is approved is a significant level, i.e. 0.05. After carrying out the exploratory factor analysis, 8 principle factors were identified from the questionnaire. These 8 factors have eigenvalues greater than 1, which explains 69.52 percent of the variance of the factors, which is acceptable. Through carrying out the confirmatory factor analysis, the construct validity is approves to a great extent. Maher et al. (2016) conducted a study using factor analysis method in which 10 subscales were identified as the factors affecting the establishment of teledermatology. The study conducted by Alami et al. (2017) revealed 3 factor for each subject, some factors and challenges in difference levels of health care. Rahman et al. (2018) suggested 7 effective factors in telemedicine establishment in Bangladesh [22].

The result of principle component analysis with varimax rotation indicated that 58 questions of the questionnaire with allocation of the required factor loading, 8 factors with potential of predicting the 69.52% of the total changes of the factors of establishment of the telemedicine, first factor with 8 items as service provider, service recipient with 11 questions, technology factor with 9 questions, economic factor with 8 items, structural factor with 6 items, policy-making factor with 5 questions, cultural factor with 5 items, and legal factor with 6 questions were all extracted. The results revealed that the designed instrument have good validity and reliability for assessment. The study carried out by Maher et al. (2016) identified factors such as financial infrastructures, technical, human resources, rules and regulations, budget, data collection, equipment, human resources education and media representation as factors affecting telemedicine [20]. The study conducted by Alami et al. (2017) indicated factors such as governance and strategy, professional and organizational dimensions, economic and financial dimensions for each subject with the factors and challenges that they face in difference levels of health care. Sendín et al. (2019) conducted a study that demonstrated the presence of three principal subscales in a model including advanced use of information and communication technologies, moderate use of information and communication technologies, and scarce use of information and communication technologies [23].

Investigating and determining the normalized distance and the mean of the effective factors in telemedicine Establishment in dermatology of the population revealed a high dependence level between the factors affecting the establishment of telemedicine dermatology. The study conducted by Saliba et al. (2012) demonstrated that the dependency of the telemedicine establishment to four groups of factors such as legal factors, reliability factors, cultural factors, and background factors can prevent its execution. Rho et al. (2015) carried out a study which revealed that facilitating factors impact the behavioral intention model for using the distance services through performance expectancy [25].

Taking into account that in this study a variety of infrastructure factors were identified as the elements affecting the establishment of telemedicine that are categorized in various classes through factor analysis. The dependency of the execution of telemedicine on these factors is expected and as demonstrated in the investigation of the predicting factors each of these factors were could affect the establishment. On the other hand, it should be noted that most of the factors such as the lack of providing low-price and high-quality services, lack of the appropriate culture for using Internet, lack an organization for administering telemedicine and legal and structural infrastructures do not

enjoy a proper execution condition, supplying and Establishment of telemedicine is completely influenced by these factors. The findings indicated that the scale of 58 factors of assessing the effective factors in teledermatology establishment have good validity and reliability. According to factor analysis, it includes 8 subscales. The obtained Cronbach's alpha coefficient amounts to 0.941.

**Conflict of interest**

Authors declare no conflict of interest.

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