

Factor Analysis and Reliability Evaluation of the Iranian Version of GHQ-12 Questionnaire

1st Mahtab Mehrabbeik¹, 2nd *Farnaz Ghassemi²

¹ Department of Biomedical Engineering, Amirkabir University of Technology, Tehran, Iran

² Department of Biomedical Engineering, Amirkabir University of Technology, Tehran, Iran

Ghassemi@aut.ac.ir

Abstract— One of the most potent tools in screening mental health conditions is the 12-item General Health Questionnaire (GHQ-12). This article aims to investigate the factor analysis and test the reliability of the Iranian version of GHQ-12. So, using the translated version of GHQ-12 (Iranian version) along with demographic questions, data were collected from 106 university students in Tehran and Semnan. Each questionnaire was scored using the C-GHQ method. The reliability of the GHQ-12 was tested by assessing Cronbach's alpha coefficient. Finally, to analyze the factor structure of the GHQ-12 questionnaire, the principal component analysis was performed using the varimax factor solution. The obtained data were analyzed by SPSS-26 software. The results show that the mean score of the GHQ-12 questionnaire is 3.5377, with a standard deviation of 3.4370. The reliability test of the questionnaire represents a satisfactory result, as Cronbach's alpha was obtained 0.872. The result of factor analysis shows a three-factor structure for GHQ-12, which contains 60.047% of the total variance. In conclusion, based on the results, the Iranian version of the GHQ-12 questionnaire is reliable and has good structural characteristics using the C-GHQ scoring method to measure general mental health quality.

Keywords— Factor Analysis, General Health Questionnaire, Iran, Reliability, University Students.

I. Introduction

As the World Health Organization (WHO) defines, mental health is one of the aspects of general health. Most people around the world are suffering from different types of mental health problems, and the statistics show the rising growth of these problems. It is necessary to utilize an appropriate tool to study mental health conditions [1]. General Health Questionnaire (GHQ) is one of the most powerful tools to study the general mental health condition. Goldberg designed the original version of the GHQ in 1972 in England. Today, shortened versions of GHQ, including 30-item GHQ (GHQ-30), 28-item GHQ (GHQ-28), 20-item GHQ (GHQ-20), and 12-item GHQ (GHQ-12), are available which can be used for different statistical societies [1, 2].

In recent years, GHQ-12 was taken into consideration due to its simplicity, brevity, and convenience of filling. Therefore, GHQ was translated into 20 different languages, such as Persian, Turkish, and Spanish. GHQ has been studied for different age categories, different illnesses, and also different occupations [3-6]. The last version of GHQ, which is called GHQ-12, has 12 items which represent the ability to concentrate, sleeplessness, feeling of being helpful, the capability of making decisions, being under pressure, inability to overcome the difficulties, enjoying the daily activities, ability to encounter the problems, feeling depressed and unhappy, losing the self-confidence, feeling unworthy, and feeling reasonable happiness during the last few weeks, respectively. Each item of the GHQ-12 is dedicated to four options. Also, GHQ-12 contains six positive and six negative questions that are independent of each other [7]. Different types of scoring methods are proposed for this questionnaire in the literature. One of the recommended methods is C-GHQ, which is proposed by Child and Jones to disambiguate the negative questions. The total score of GHQ-12 can be ranging from 0 to 12 by the mentioned scoring method [1].

Many studies have investigated the reliability and factor structure of the GHQ-12. The two-factor structure is the most popular factor structure for GHQ-12. For example, In 1994, Politi *et al.* (Cronbach's alpha=0.81) investigated the internal consistency, validity, and factor structure of GHQ-12 on 18-year-old Italian males [8]. They identified the two-factor structure in GHQ-12 named 'general dysphoria' and 'social dysfunction.' Also, In 2007, Hu *et al.* investigated whether the GHQ-12 can determine the positive mental health states [7]. The results represented a consistent and reproducible factor structure in the British Household Panel Survey (BHS) and the Health Survey for England (HSE) datasets. The two-factor structure corresponded to 'symptoms of mental disorder' and 'positive mental health' was found for GHQ-12. In the same year, Toyabe *et al.* studied the factor structure

of GHQ-12 on the Japanese people who have experienced the Niigata-Chuetsu earthquake in 2004 [9]. The results showed a two-factor structure of GHQ-12. In 2014, the factor structure of GHQ-12 was explored on university students of Tehran by Najarkolaei *et al.* [10]. Based on their report, a two-factor structure was found for GHQ-12. Moreover, Qin *et al.* (Cronbach's $\alpha=0.9$) and Pozo *et al.* (Cronbach's $\alpha=0.84$) studied the reliability and factor structure of GHQ-12 in 2018 and 2020 [11, 12]. They found the GHQ-12 a reliable instrument, and also, a two-factor structure was obtained for GHQ-12. Although the two-factor structure was the most prevalent factor structure for GHQ-12 in literature, the one, and three-factor structures have also been presented. For example, in 2010, Zulkefly and Baharudin (Cronbach's $\alpha = 0.7$) used GHQ-12 to evaluate Malaysian college students' mental health status [13]. They reported the three-factor structure of GHQ-12, namely 'psychological distress,' 'social and emotional dysfunction,' and 'cognitive disorders.' Moreover, in 2020, Pérez *et al.* investigated the factor structure of GHQ-12 on 16-year-old students of Madrid schools [14]. A one-factor structure was found for GHQ-12 using an optimized parallel analysis. Recently, in 2021, Lee and Kim (Cronbach's $\alpha = 0.86$) found a three-factor structure for GHQ-12 [15]. The studied population was Korean early childhood teachers. The validity and reliability of the Iranian version of the GHQ-12 have previously been studied by Ebadi *et al.* (Cronbach's $\alpha=0.87$), Montazeri *et al.* (Cronbach's $\alpha=0.87$), and Tagharrobi *et al.* (Cronbach's $\alpha=0.79$) in 2002, 2003, and 2015, respectively [1, 2]. It was confirmed that the Iranian version of GHQ-12 is consistent and reliable enough to be used in the general Iranian population. Moreover, according to their published results, the two-factor structure was found for GHQ-12 on different types of datasets.

Although the GHQ-12 has been highly recommended as a suitable screening instrument for measuring mental health conditions, a different factor structure has been reported for it, depending on the types of population. Hence, the goal of this study is to investigate the factor structure of the Iranian version of GHQ-12 on university students. Moreover, the reliability of the GHQ-12 was also studied in the collected database.

II. Materials and Method

A. Sampling and Sample Characteristics

In this study, GHQ-12 was used to collect the data. The data was collected from 106 university students in Tehran and Semnan through the convenience sampling method in a self-reporting way. After collecting the data, the C-GHQ scoring method was performed to score each questionnaire in a range of 0 to 12. It is worth mentioning that a higher score represents a worse mental health condition [1]. In the C-GHQ method, the two first options of each item of GHQ-12 receive 0, and the second two options receive one as the item's score. The total score was obtained by the summation of all the items' scores, which is a number in the range 0-12. Besides, the demographic information was collected from the participants, which include gender (female or male), grade (Bachelor, Master, or Doctorate), residency (Tehran or other), height (in centimeter), and weight (in kilogram). By using the height and weight of each individual, the Body Mass Index (BMI) was calculated. The data was analyzed through the SPSS-26 software.

B. Descriptive Analysis

Descriptive analysis was performed to determine the distribution of questionnaire scores of university students. The normality of the distributions was checked using the Kolmogorov-Smirnov test. An independent T-Test can be performed if the distribution of the score is normal. Otherwise, the Wilcoxon Rank-Sum Test can be performed to determine if the GHQ-12 scores vary across the two groups of females and males. Since the score distribution was not normal, the Wilcoxon Rank-Sum Test was performed to determine whether the GHQ score varies across the female and male groups.

C. Reliability

The reliability of a questionnaire depends on the consistency of the questionnaire items. Cronbach's α is a type of internal reliability and consistency estimation that leads to assessing the consistency of an instrument or questionnaire [16]. The internal consistency of the GHQ-12 was assessed by Cronbach's α . In the literature, different thresholds were defined for Cronbach's α to be consistent. According to [2], the questionnaire is reliable if the assessed Cronbach's α is equal to or greater than 0.7. Also, as reported in [17], Cronbach's α between 0.5 and 0.7 is typically reliable. Moreover, as stated in [18], Cronbach's α greater than 0.4 could represent the good consistency of a questionnaire.

In addition to Cronbach's α , the Split-Half Coefficient Reliability test was also performed in the present study. Split-Half Reliability is also a statistical method used to measure the consistency of the scores of a questionnaire. In this method, the questionnaire would be split into halves, and the correlation of the scores of each half will be calculated. This test can represent the dependence of questionnaire responsibility on the number of questionnaire items. The Guttman Split-Half Reliability Coefficient is an adaptation of the Spearman-Brown Coefficient, which does not require equal variances between the two questionnaire halves [19].

D. Factor Analysis

Factor analysis is one of the data validation methods. This method can also be used to identify the small number of factors that explain the correlation patterns [13]. Bartlett's Test of Sphericity and the Kaiser-Meyer-Olkin (KMO) test were performed to check the possibility of factor analysis implementation. As stated in [13], Bartlett's Test's result shows the adequacy of the

data size to conduct the factor analysis. Moreover, the KMO test results indicate whether using the factor analysis is suitable to be performed on the data. Principal Component Analysis (PCA) with varimax rotation was accomplished to obtain the factor structure of the GHQ-12. Varimax rotation is a statistical technique that was used to clarify the relationship of the factors by maximizing the shared variance among the questionnaire items [20]. To specify the number of factors, the scree plot was represented. The factors with eigenvalues greater than 1.00 were determined. As declared in [21], the factors which have a contribution to the questionnaire items have a higher loading absolute value. The results of factor analysis with the PCA method and varimax rotation yield to factor loading values and variance percentage.

III. Results

A. Descriptive Findings

All 106 university students' data were used in this study. The descriptive findings and demographic information are shown in Table 1. Also, Table 2 expresses the descriptive information of each GHQ-12 question. In the studied population, 55.66% of the respondents were female. The mean of the total score was obtained at 3.5377, with a standard deviation of 3.437 using the C-GHQ method. The result of the Wilcoxon Rank-Sum Test was insignificant at alpha equals 0.05 (P -value=0.3616), which means that the two groups are not statistically different or, in other words, the GHQ score does not vary across the female and male groups of this sampling population significantly (P -Value>0.05).

B. Reliability

The obtained Cronbach's alpha for the whole sample was 0.872, which indicates satisfactory results. The measured Cronbach's alpha for the female and male groups were 0.889 0.848, respectively, which also indicates the acceptable results. Moreover, the results of the Split-Half Coefficient Reliability test are shown in Table 3.

Table I. Demographic information of the questionnaire

Demographic Index	Options	Number (percent)
Gender	Female	59 (55.66)
	Male	47 (44.34)
Grade	Bachelor	51 (48.11)
	Master	51 (48.11)
	Doctorate	4 (3.78)
Residency	Native	73 (68.87)
	Non-native	33 (31.13)

Table II. Descriptive information of each questionnaire item

GHQ-12 Items	Item's Score	
	Mean	Standard Deviation
1- Ability to concentrate	0.3019	0.4613
2- Sleeplessness	0.2642	0.4430
3- Feeling of being useful	0.2264	0.4205
4- Capability of making decisions	0.3491	0.4789
5- Being under pressure	0.2358	0.4265
6- Inability to overcome the difficulties	0.3491	0.4789
7- Enjoying the daily activities	0.2453	0.4323
8- Ability to encounter the problems	0.6132	0.4893
9- Feeling depressed and unhappy	0.2453	0.4323
10- Losing the self-confidence	0.3208	0.4690
11- Feeling unworthy	0.2453	0.4323
12- Feeling reasonable happiness	0.1415	0.3502
Total score	3.5377	3.4370

Table III. Descriptive information of each questionnaire item

Cronbach's Alpha	Part 1	Value	0.762
		N of Items	6 ^a
	Part 2	Value	0.794
		N of Items	6 ^b
	Total of Items		12
Correlation Between Forms			0.754
Spearman-Brown Coefficient	Equal Length		0.860
	Unequal Length		0.860
Guttman Split-Half Coefficient			0.860

^a. The items are: Q1, Q2, Q3, Q4, Q5, Q6

^b. The items are: Q7, Q8, Q9, Q10, Q11, Q12

C. Factor Structure

The results of Bartlett's Test of Sphericity and Kaiser-Meyer-Olkin (KMO) Test are shown in Table 4. Bartlett's Test of Sphericity results in a significant P-value<0.001, and Chi-Squared was 470.8. The value of KMO was 0.877. Therefore, it was concluded that the GHQ-12 is factorable.

The PCA with varimax rotation solution was performed, and three underlying factors were found for GHQ-12. After the varimax rotation, the three factors with eigenvalues of 2.992, 2.885, and 1.329, which respectively accounted for 24.930%, 24.039%, and 11.078% of the total variance, were selected. Figure 1 (a) shows the Scree plot, which helped to select the number of mentioned factors. These three factors were identified as 'psychological distress,' 'social and emotional dysfunction,' and 'cognitive disorders,' which together accounted for 60.047% of the variance. Factors' loading for each GHQ-12 item is represented in Table 5. As illustrated in Fig 1 (b), each item of the questionnaire has a load in each factor. However, these loads are not equal, and the loads below 0.5 can be ignored. Moreover, Fig. 2 shows the maximum factor loadings for each item of the GHQ-12, which indicates the aspect of the mental health assessment of each question. Therefore, the questionnaire items can be easily categorized into three factors with different importance.

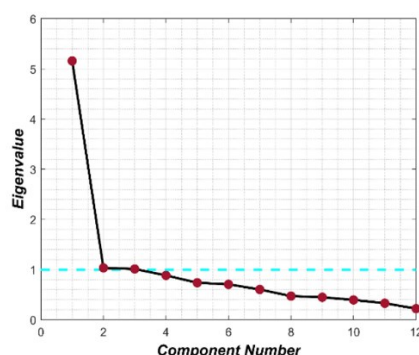
The first factor includes the ability to concentrate, sleeplessness, feeling of being useful, being under pressure, feeling unworthy, feeling reasonable happiness. This factor represents the psychological problems that a person would confront and is named psychological distress. The second factor represents the social and emotional disability of a person in his/her life. This factor includes the capability of making decisions, inability to overcome difficulties, ability to encounter problems, feeling depressed and unhappy, and losing self-confidence. Therefore, it was named social and emotional dysfunction. The third factor represents the cognitive feelings of a person about the normal things in his or her life. This factor includes enjoying daily activities and is named cognitive disorders.

Table IV. KMO and Bartlett's test results.

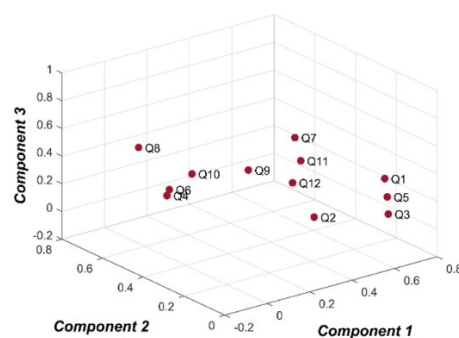
Kaiser-Meyer-Olkin measure of Sampling Adequacy		0.877
Bartlett's Test of Sphericity	Approx. Chi-Squared	470.776
	df	66
	P-Value	<0.000

Table V. Loading factors after varimax rotation

GHQ-12 Items	Factor I	Factor II	Factor III
1- Ability to concentrate	0.630	-	-
2- Sleeplessness	0.568	-	-
3- Feeling of being useful	0.715	-	-
4- Capability of making decisions	-	0.700	-
5- Being under pressure	0.783	-	-
6- Inability to overcome the difficulties	-	0.733	-
7- Enjoying the daily activities	-	-	0.887
8- Ability to encounter the problems	-	0.608	-
9- Feeling depressed and unhappy	-	0.557	-
10- Losing the self-confidence	-	0.715	-
11- Feeling unworthy	0.640	-	-
12- Feeling reasonable happiness	0.547	-	-



(a)



(b)

Fig. 1. (a) The Scree plot of the data (including eigenvalues and the principal components) and (b) Loadings of each component in the rotated space.

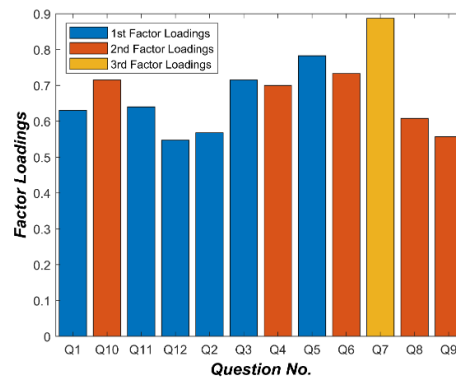


Fig. 2. Maximum factor loadings of GHQ-12 items.

IV. Discussion

The 12-item General Health Questionnaire (GHQ-12) is a powerful tool for measuring mental health status, which has been translated into different languages. It should also be mentioned that GHQ-12 is not a tool for the diagnosis of a specific mental disease and only measures minor mental health conditions, not the severity of mental health disease.

In this study, the data was collected from Iranian university students who are studying in Tehran city. The results are promising enough to compare with similar results around the world. This paper aims to determine the reliability and factor structure of the Iranian version of GHQ-12.

According to the result of The Kolmogorov–Smirnov Test, the GHQ-12 total score distribution was not normal. Therefore, the Wilcoxon Rank-Sum Test was performed, and the results show that the total score of GHQ-12 does not vary across the female and male groups ($P\text{-Value} > 0.05$).

The obtained results indicate that the GHQ-12 is a reliable tool for measuring the psychological health of Iranian university students as the Cronbach's alpha was obtained 0.872, which means that the scale of the GHQ-12 is reliable to be used for the mentioned population. This result is consistent with the findings of Ebadi *et al.* [3], Montazeri *et al.* [2], and Najarkolaei *et al.* [10]. Any differences in obtaining Cronbach's alpha with other similar previous studies can be due to the version of the employed GHQ-12 and also the sampling population. Moreover, GHQ-12 shows a good factor structure as the results of Bartlett's Test of Sphericity ($\text{Chi-squared} = 470.776$ and $P\text{-value} < 0.001$) and Kaiser-Meyer-Olkin (KMO) Test ($\text{KMO} = 0.877$) indicate the great factorability potential of GHQ-12. Using the factor analysis with the PCA method and varimax rotation, three factors with eigenvalues greater than 1.00 were detected. Therefore, it can be concluded that there are three underlying factors in GHQ-12, which are 'psychological distress,' 'social and emotional dysfunction,' and 'cognitive disorders.' These three factors together accounted for 60.047% of the total variance. Each of the mentioned three factors can represent one principal aspect of the mental health condition. Therefore, GHQ-12 can also be used for screening minor psychological conditions.

C-GHQ was the chosen scoring method for scoring the GHQ-12, as Tagharrobi *et al.* declared in 2015 [1]. However, there are other scoring methods expressed in the literature. For example, Likert is one of the famous scoring methods recommended in the literature for such questionnaires [14].

The findings of this work are almost in line with the results reported by Zulkefly *et al.* in 2010 [13]. They also found the three-factor structure for GHQ-12, namely 'psychological distress,' 'social and emotional dysfunction,' and 'cognitive disorder,' which is almost the same as our findings. It is worth mentioning that the scoring method used in their study was Likert, which can explain the existing differences. Furthermore, there are some other researches, which have identified a three-factor structure for GHQ-12. For an illustration, Daradkeh *et al.* found a three-factor structure for the Arabic version of GHQ-12 on university students in 2001 and introduced them as 'general dysphoria,' 'lack of enjoyment,' and 'social dysfunction' [22]. Two years later, in 2003, Doi *et al.* also found a three-factor structure for GHQ-12 on Japanese adult men and named them as 'psychological distress,' 'social dysfunction,' and 'happiness' [23]. There are also one-factor and two-factor structures of GHQ-12 recommended in the literature [12, 14]. For instance, in 2000, Werneke *et al.* declared that the GHQ-12 consists of only two factors, namely 'depression' and 'social dysfunction' [24]. Besides, Najarkolaei *et al.* announced a two-factor structure, namely, 'social dysfunction' and 'psychological distress' [10]. The difference in the number of structural factors can also be due to the sampling population, i.e., the number of samples and the type of statistical society. According to the literature review, it seems that the three-factor structure can be a typical factor structure determined for GHQ-12 on university students' population.

The GHQ-30, GHQ-28, and GHQ-20 can represent more accurate aspects of the mental health condition. Due to a large number of questions and limited student response time, GHQ-12 was used as the sampling tool for collecting the data. The study

was limited to university students of Tehran and Semnan, and the sampling method was convenient. This can make the result unexpandable to the whole student's society.

V. Conclusion

The present study revealed that the Iranian version of GHQ is reliable and has a suitable factor structure to be used as a tool for measuring the psychological health condition of university students of Tehran and Semnan.

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تحلیل عاملی و ارزیابی پایایی نسخه ایرانی پرسش‌نامه GHQ-12

مهتاب مهربابیک^۱ و فرناز قاسمی^{۲*}

^۱ دانشکده مهندسی پزشکی، دانشگاه صنعتی امیرکبیر، تهران، ایران

^۲ دانشکده مهندسی پزشکی، دانشگاه صنعتی امیرکبیر، تهران، ایران

Ghassemi@aut.ac.ir

چکیده: یکی از قدرتمندترین ابزارها در غربال‌گری وضعیت سلامت روان، پرسش‌نامه سلامت عمومی ۱۲ سوالی (GHQ-12) است. هدف این مقاله بررسی تحلیل عاملی و آزمون پایایی نسخه ایرانی GHQ-12 است. از این‌رو، با استفاده از نسخه ترجمه شده GHQ-12 (نسخه ایرانی) به همراه سوالات دموگرافیک، اطلاعات ۱۰۶ دانشجوی دانشگاه‌های تهران و سمنان جمع‌آوری گشت. هر پرسش‌نامه با استفاده از روش C-GHQ امتیازدهی شده و پایایی پرسش‌نامه GHQ-12 با ارزیابی ضریب آلفای کرونباخ مورد آزمایش قرار گرفت. در نهایت، جهت تحلیل ساختار عاملی پرسش‌نامه GHQ-12، تحلیل مؤلفه‌های اصلی با استفاده از روش عامل واریماکس صورت گرفت. داده‌های به دست‌آمده با استفاده از نرم افزار SPSS-26 مورد تجزیه و تحلیل قرار گرفته است. نتایج نشان می‌دهد که میانگین نمره پرسش‌نامه GHQ-12 برابر با $3/5377$ با انحراف معیار $3/4370$ است. آزمون پایایی پرسش‌نامه نتیجه رضایت‌بخشی را نشان می‌دهد، زیرا آلفای کرونباخ به دست‌آمده برابر $0/872$ می‌باشد. نتایج تحلیل عاملی، ساختاری سه عاملی را برای GHQ-12 نشان می‌دهد که شامل $60/047\%$ از واریانس کل است. در نتیجه، بر اساس نتایج، نسخه ایرانی پرسش‌نامه GHQ-12 پایا و دارای ویژگی‌های ساختاری خوبی با استفاده از روش امتیازدهی C-GHQ برای سنجش کیفیت کلی سلامت روان است.

کلید واژگان: تحلیل عاملی، پرسش‌نامه سلامت عمومی، ایران، پایایی، دانشجویان دانشگاه.