

# Validity and reliability of the Persian version of greenspan social-emotional growth chart

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**Background:** The estimated prevalence of mental health disorders in children and adolescents is between 10% and 20%. Furthermore, a quarter of very premature infants exhibit socioemotional delays in infancy and childhood. The objective of this study was to determine the validity and reliability of Greenspan social-emotional growth chart (GSEGC) in Persian children aged 1–42 months. **Materials and Methods:** After translation procedures, the face validity, content validity, construct validity, test-retest reliability, and internal consistency of the GSEGC questionnaire were evaluated. The quality of translating items was obtained using the suggestions of the research group. The face validity of the GSEGC was performed by interviewing with 10 mothers in the target group. To evaluate content validity quantitatively, content validity ratio (CVR) and content validity index (CVI) were used after reviewing the face and content validity and pilot study, 264 parents of children aged 1–42 months completed the GSEGC questionnaire to assess the construct validity and internal consistency. In order to determine the test-retest reliability, after 2 weeks, 18 parents completed the questionnaire again. **Results:** Eleven questions were changed according to the interviews (questions 1–6, 9–11, and 15–16). The lowest CVR was related to items 30 and 20 (0.636), and other items had an acceptable CVR. The lowest CVI value was related to item 1 of clarity and simplicity (0.818), and other items had an acceptable CVI. Intra-class correlation coefficient was 0.988 for all items of questionnaire. Furthermore, Cronbach's alpha coefficient was 0.952 for all items. In factor analysis, two factors were extracted from the items in questionnaire. **Conclusion:** The Persian version of GSEGC questionnaire has acceptable face, content and, constructs validity, test-retest reliability and high internal consistency in the target population. Therefore, the Persian version of the GSEGC can be used as a tool to assess 1–42 months sensory processing and socio-emotional development.

**Key words:** Greenspan social-emotional growth chart, reliability, sensory processing, social-emotional development, validity

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## INTRODUCTION

Healthy socio-emotional development in children is important as a primary indicator of general health.<sup>[1]</sup> Children with a history of social-emotional development disorder without proper intervention have many problems in schools and older ages.<sup>[1,2]</sup> The estimated prevalence of mental health disorders in children and adolescents is between 10% and 20%.<sup>[3]</sup>

Children with a history of preterm birth, postpartum asphyxia, small for gestational age, autism spectrum disorders (ASD), Down syndrome, cerebral palsy, and language developmental disorders have socio-emotional developmental disorders in the early years of life compared to their peers. In a study of preterm infants, Johnson and Marlow found that during childhood, the risk of developing mental health disorders increased three to four times that of full-term infants.<sup>[4]</sup> A quarter of very premature infants exhibit socio-emotional delays in

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infancy and childhood. In addition, lower social competence at the age of two for premature infants compared to full-term born peers was identified.<sup>[5]</sup> The etiology of socio-emotional problems in very premature infants is not fully understood. However, there are some theories that these problems may be related to the impact of perinatal risk factors and social risk factors such as maternal mental health and educational level, and children cognitive and motor disorders.<sup>[6]</sup>

Children with socio-emotional problems are at greater risk for psychiatric disorders and less social development in later childhood. Therefore, early and accurate detection of young children with potential socio-emotional problems is important.<sup>[5]</sup> Although screening, a significant percentage of children at risk of socio-emotional problems can be identified and introduced for further investigation. However, accurate, usable, and cost-effective screening methods to detect social or emotional problems in young children are slowly emerging and difficult to develop. It is now clear that a significant number of very young children show psychological problems that arise during this period of development and problems during this period of growth often continue. Therefore, they need early identification and intervention.<sup>[7]</sup> On the other hand, premature infants may be at risk of sensory processing disorder due to the short nervous system growth in the uterus and because of experiencing severe stimuli during hospitalization in the neonatal intensive care unit which can alter development and function of the sensory system. All motor, behavioral, emotional, and attention responses are the result of how sensory information is processed. Sensory information processing serves as an important basis for adaptive behaviors such as self-control, learning, and the ability to organize.<sup>[8]</sup>

In a study in which socio-emotional screening tools for young children were systematically reviewed, ten tools in this area met the inclusion criteria. Through these assessment tools, excellent internal consistency (Cronbach's alpha = 0.95) was reported for the Greenspan social-emotional growth chart (GSEGC), and it is mentioned that the GSEGC is unique in terms of showing the child's problems and skills. In addition, GSEGC has been used in a variety of studies with ethnically diverse children with very similar coefficients to the designer. The GSEGC is also standardized in the US population. This questionnaire shows a balanced level of sensitivity (86.6), specificity (90.2), and reliability (0.94–0.83) at all ages depending on the age range and has a reliability of 0.83 in the sensory processing sector.<sup>[9,10]</sup>

Considering the increasing prevalence of socio-emotional disorders and prematurity rate,<sup>[11]</sup> there is no available comprehensive Persian scale to examine the socio-emotional development in infancy and young children, and in

particular a tool to measure sensory processing in premature infants. In this study, we decided in the first stage to prepare a standard Persian version of GSEGC and in the next step to determine the validity and reliability of this version.

## MATERIALS AND METHODS

This was a psychometric study of the GSEGC for 1–42 months children in Tehran, the capital city of Iran. The method was descriptive-analytic. The Persian version of GSEGC was developed through precise translation and back-translation. GSEGC was translated into Persian according to the International Quality of Life Assessment Protocol.<sup>[12]</sup> First, two independent translators who were fluent in Persian and English and were familiar with socio-emotional development of children translated the original version of the GSEGC from English into Persian. Then, two translated versions were reviewed in research group and first Persian version obtained. First version was back-translated into English by two English language translators and translated version was compared to the original version by research group and the second version was obtained. The second version was presented to 11 experts to familiar with socio-emotional development of children determine the face and content validity. Using comments from these experts, cultural and language adaptations were performed. Then, in order to study the face validity 10 mothers of children aged 1–42 months were interviewed qualitatively and their point of view was included in the items with the confirmation of the research team and final version was obtained. Factor analysis method was used to investigate construct validity. To determine the reliability of the GSEGC test-retest, and to detect internal consistency, Cronbach's alpha was estimated. Considering that in the validity and reliability studies, no specific formula is used to estimate the sample size and the most important determining factor is the sample size of the statistical models used in the data analysis; and in accordance with other studies that used factor analysis and the Comrey sample size criterion;<sup>[13]</sup> the sample size was determined to be 200 child, and overall 264 children 1–42 months old included in the study.

### Instrument

The GSEGC is a screening questionnaire based on six functional developmental milestones and demonstrates the possibility of showing children's socio-emotional milestones from birth to 42 months as part of the Bayley III scale. This questionnaire is also offered as a separate diagnostic tool in the United States.<sup>[14,15]</sup> The GSEGC is divided into eight age groups. It comprise of 35 items and each item is graded by a 6-point Likert scale from 0 (cannot tell) to 6 (all of the time). The final score is age corrected [Table 1]. The first 8 items are included of sensory processing and are not age

**Table 1: Greenspan developmental milestones by age groups**

Functional emotional milestones	Age group (months)	Items to complete	Maximal score for age group
Stage 1 - Exhibits growing self-regulation and interest in the world	0-3	1-11	55
Stage 2 - Engages in relationships	4-5	1-13	65
Stage 3 - Uses emotions in interactive purposeful manner	6-9	1-15	75
Stage 4a - Uses series of interactive emotional signals or gestures to communicate	10-14	1-17	85
Stage 4b - Uses series of interactive emotional signals or gestures to solve problems	15-18	1-21	105
Stage 5a - Uses symbols or ideas to convey intentions or feelings	19-24	1-24	120
Stage 5b - Uses symbols or ideas to express more than basic needs	25-30	1-28	140
Stage 6 - Creates logical bridges between emotions and ideas	31-42	1-35	175

dependent with a maximal score of 40. The child was placed into: (1) Full mastery-the child has demonstrated mastery of needed skills. (2) Emerging mastery-the child requires further practice. (3) Possible challenges-the child may require further evaluation (4). The validity of the GSEGC questionnaire has been evaluated in the United States. In terms of psychometric properties, an internal consistency of 0.90 was reported for social emotional items and an average of 0.83 for the sensory processing items.<sup>[16]</sup> No test-retest reliability of original test was reported.

The advantages of GSEGC are as follows: Completion of the questionnaire by parents or caregivers in <10 min, easy to administer and score by any professional, and the necessary guidance to intervene. The most important advantage of GSEGC is the fact that this test allows screening, which is based on a step-by-step and functional developmental pattern from normal social emotional and cognitive development rather than on behaviors or symptoms.

The limitations of GSEGC include: The elimination of children who did not speak English, children who had a developmental risk factor based on social, socioeconomic status, or parental education level from the standard study.<sup>[14]</sup>

**Validity and reliability**

To evaluate content validity quantitatively, content validity ratio (CVR) and content validity index (CVI) were used.<sup>[17]</sup> After collecting the survey questionnaires, the submitted comments were reviewed and statistically analyzed by determining the CVR and CVI and based on the results, the necessary changes to delete, add or edit. The Lawshe method was used to evaluate the content validity of the questionnaire. The approved Persian version was given to 11 experts including: Psychologist, pediatrician, occupational therapist, and psychiatrist, who had sufficient experience in socio-emotional development, asked to comment on the importance and necessity of each questionnaire items based on the following classification including: It is necessary, useful but not necessary, and not necessary. Experts were also asked to review each of the

items of the questionnaire, taking into account the clarity, simplicity and relevance.

Based on the number of experts who evaluated the questions, the minimum acceptable CVR value was determined. Items that the amount of CVR calculated for them is less than the desired amount according to the number of experts evaluating the question, should be excluded from the test.

CVI was provided by Waltz and Bausell.<sup>[18]</sup> To calculate the CVI, experts are asked to rate the clarity, simplicity, and relevance of each item to a four-part range. The number of experts who have selected the first and second options is divided by the total number of experts. If the value is <0.7, the item is rejected. If it is between 0.7 and 0.79, a review should be performed, and if it is >0.79, it is acceptable.

In this study, the face validity of the Persian version of the GSEGC was performed by interviewing the examiner with 10 mothers in the target group. In this regard, after explaining the purpose of the research, the examiner asked the mother to read the question and then retell it in her own language, and then the parent was asked questions including the following:

- Is the general meaning of the question understandable?
- If there is a problem in understanding the question, which word or phrase is problematic and what is the suggestion?
- Does the question in accordance with Persian culture and language?

The results of these ten interviews were presented in the research group, and finally changes were made in the second Persian version, and the third Persian version was obtained.

Pilot study was performed to determine the response time and to help improve the GSEGC Persian version and check the coding of variables and their suitability for analysis. At this stage, a GSEGC was given to ten parents of children who were similar to the target group.

Factor analysis method was used to investigate construct validity. The internal consistency and test-retest reliability was used to investigate the reliability.

### Participants and procedure

Children were recruited from health care centers of Tehran, Iran in 2020–2021. The inclusion criteria were: Age range 1–42 months; apparently normal development and lacking any developmental disorders. Exclusion criteria were: Non Persian speaking parents, children with sensory deficits (hearing/vision), genetic or congenital anomalies, neurological (e.g. epilepsy) or other systemic disorders (e.g. Attention Deficit and Hyper Activity, ASD, Mental deficiency) and use of rehabilitation.

A number of health care centers in the north, east, south and west of Tehran were randomly selected. The participants were selected from health care centers using convenient sampling. After the health centers confirmation, the informed parents' consent was obtained to participate in the study, and explanations about the steps of completing the questionnaire were provided to them by health care workers. Then Parents completed a demographic and the GSEGC questionnaire. The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki, as reflected by *a priori* approval by the institution's human research committee. Approval was obtained from the Ethics Committee of the University of Social Welfare and Rehabilitation (USWR) Sciences IR.USWR.REC.1399.170.

### Statistical analysis

For the examination of the reliability, the internal consistency (Cronbach's alpha coefficient) was employed on the GSEGC variables.

Factor analysis method was used to investigate construct validity. From the implementation of factor analysis, it is necessary to study two issues: (1) Adequacy of sampling (2) ensuring that the correlation matrix underlying factor analysis in society is not zero. Thus, first Kaiser–Mayer–Olkin (KMO) of sample adequacy values was calculated. Then Bartlett's test of sphericity was done and Chi square was calculated.

Factor analysis was done using the Principal Components Analysis method. In order to determine that test components are saturated by how many significant factors, three determinants were considered: Eigen value; the percentage of variance explained by each factor; and Chart of Eigen value or scree plot.

Descriptive statistical methods were used to describe the participants. The level of significance was defined as

$P < 0.01$ . SPSS version 16 (Chicago, IL, USA) was used for data and Factor analysis.

## RESULTS

The frequency distribution and percentage of the sample group based on demographic information ( $n = 264$ ) and the stages of socio-emotional development of the GSEGC are shown in Table 2.

### Validity

To check the face validity, the examiner was interviewed with 10 mothers of the target group. The results of interviews were made changes in 11 questions (questions 1–6, 9–11, and 15–16).

The lowest CVR was related to items 30 and 20 (0.636), which was higher than the minimum acceptable value (0.59), and all items had an acceptable CVR.

The lowest CVI value was related to item 1 of clarity and simplicity (0.818), which was more than the minimum possible value (0.79), and all items had an acceptable CVI value.

The response time to the GSEGC was estimated to be about 10–12 min. Variables were encoded. The performed coding was suitable for analysis.

**Table 2: Demographic characteristics of children and parents in the study ( $n=264$ )**

Characteristics	$n$ (%)
Gender	
Boys	125 (47.3)
Girls	139 (52.7)
Age groups (months)	
Sensory processing (0-42)	264 (100)
Stage 1 (0-3)	13 (4.92)
Stage 2 (4-5)	17 (6.44)
Stage 3 (6-9)	39 (14.77)
Stage 4a (10-14)	42 (15.9)
Stage 4b (15-18)	41 (15.53)
Stage 5a (19-24)	36 (13.64)
Stage 5b (25-30)	34 (12.88)
Stage 6 (31-42)	42 (15.9)
Mother educational level*	
Low	123 (46.6)
Moderate	124 (47)
High	17 (6.4)
Father educational level*	
Low	133 (50.5)
Moderate	98 (37)
High	33 (12.5)

\*"Low educational level" refers to special education, primary school, or prevocational secondary education (<12 years); "medium educational level" refers to senior general secondary education, preuniversity education, or secondary vocational education (13-16 years); "high educational level" refers to higher professional education or university (17+ years)



### Construct validity

The size of the KMO (0.911) and the result of performing the Bartlett correlation test, ( $P = 0.0001$ ) indicated sample adequacy for performing factor analysis. Cerny and Kaiser believe that when the value of KMO is more than 0.6, factor analysis can be easily performed, and the higher the value, the greater the appropriateness and adequacy of sampling.

Considering that in performing factor analysis, the aim is to extract one factor from the set of questions, the Eigen value and the percentage of variance explained by the first two factors; calculated 13.666 and 39.044 for first factor and 6.152 and 17.576 for second factor.

At the GSEGC, the percentage of variance explained by the first factor was 39.044. On the other hand, in the continuation of factor analysis, it was found that a number of questions do not have the desired factor load with this factor and there is a high correlation with the second factor in this questionnaire. Thus, the research group decided to extract the two factors including: (1) sensory processing and interaction with environment and (2) social development from the set of items.

In addition, in the scree plot of the GSEGC shown in Figure 1, it can be inferred that the share of the first and second factors in the GSEGC in the total variance of the questions are significant and different from the share of other factors.

According to the above conditions, two factors were extracted from the set of GSEGC questions.

It should be noted that in order to investigate the nature of the relationship between the questionnaire items and achieve the definitions of factors, it was assumed that coefficients  $>0.3$  have a significant share in the definition of factors and therefore coefficients less than this value as a factor were considered random. The correlation of items with extracted factors (factor loading) is presented in Table 3.

### Reliability

In this study, in order to measure the test-retest reliability, the calculation of the Intraclass Correlation Coefficient (ICC) with a confidence interval of 95% was used in two assessments with an interval of 2 weeks. ICC was 0.988 for total 35 items, 0.944 for first interacted factor, and 0.990 for second interacted factor. The correlations  $<0.40$ ,  $0.40-0.75$  and more than  $0.75$  were considered weak, moderate, and good, retrospectively.<sup>[19]</sup> Thus, a good correlation was calculated in the sensory processing section and the total score.

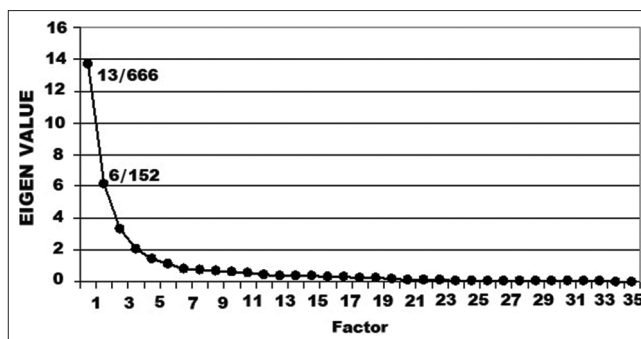


Figure 1: Scree plot of the social-emotional scale questionnaire

Table 3: Factor loading of Greenspan social-emotional growth chart Factor 1 (sensory processing and interaction with environment) and Factor 2 (social development)

Question	Factor loading	F2-social development
	F1-sensory processing and interaction with environment	
1	0.560	
2	0.585	
3	0.627	
4	0.584	
5	0.447	
6	0.602	
7	0.463	
8	0.648	
9	0.552	
10	0.605	
11	0.544	
12	0.516	
13	0.550	
14		0.596
15		0.583
16		0.730
17		0.743
18		0.828
19		0.824
20		0.807
21		0.851
22		0.818
23		0.840
24		0.835
25		0.805
26		0.822
27		0.817
28		0.807
29		0.673
30		0.684
31		0.749
32		0.734
33		0.700
34		0.663
35		0.682

Internal consistency is an indicator that shows the homogeneity between the changes in subscales scores

among individuals in a sample over a period of time. Cronbach's alpha coefficient is the most common indicator used in such studies to assess internal consistency. This coefficient is between zero to one variable and the closer it is to one, indicates that the studied instrument has a higher internal consistency. Cronbach's alpha coefficient is often considered to be more than 0.70.<sup>[20,21]</sup> This coefficient was obtained 0.952 for 35 items, and 0.935 for first interacted factor and 0.959 for second interacted factor.

## DISCUSSION

In our study, two factors were extracted by performing the factor analysis. The first factor includes sensory processing and the first and second stages of Functional Emotional Milestones (items 1–13), and the second factor was third to sixth stages (items 14–35) of the Greenspan's emotional functional growth. According to the content of the questions, we consider the first factor as sensory processing and interaction with the environment and the second factor, as social development. Furthermore, in this study, ICC and Cronbach's alpha coefficient were 0.954 and 0.952 for all items of questionnaire and 0.988 and 0.930 for sensory processing retrospectively.

Socio-emotional screening tools for use in child care services should have scientific evidence to show children need for further evaluation or follow-up. Properties derived from this include (1) internal consistency, (2) short-term and long-term correlation of test-retest or stability to construction and child age, (3) relationship to diagnostic indicators, and need for service, and (4) accumulated credit in groups and situations. Screening tools sensitive to common psychosocial problems among children will be most helpful. Screening should use children's reporting if possible, provide strength-based information, and support risk and resilience theories. Finally, screening identifies children who need services despite subclinical-level problems, and their problems may appear in areas of functional disorders such as peer-to-peer relationships and family.<sup>[9,22]</sup> In a study, socio-emotional screening tools for young children were systematically reviewed. In this study, ten instruments had the inclusion criteria. Among these, excellent internal consistency ( $\alpha = 0.95$ ) has been reported for GSEGC and it has been mentioned that this questionnaire is unique in terms of showing the child's problems as well as his skills. The GSEGC has been used in a variety of studies with ethnically diverse children with very similar design coefficients to the designer. The GSEGC is also standardized in the US population. For very young children, this scale shows a balanced level of sensitivity (86.6) and specificity (90.2) and reliability (94–83) at all ages depending on the age range and has a reliability of 0.83 in the sensory processing sector.<sup>[9,10]</sup>

Tede *et al.*<sup>[5]</sup> in their study of the results of exploratory factor analysis with a small sample size grouped 35 items of the GSEGC questionnaire into five factors that were consistent with different aspects of the structure. However, the results of their study were inconsistent with the results of our study due to the grouping of questions. They grouped questions 1–8 into sensory processing (like the questionnaire designer) and questions 9–13 (the first and second stages of Greenspan's socio-emotional development) as responses to the environment. However, in our study, the sum of sensory processing questions and responses to the study environment of Tede *et al.* were extracted as the first factor, and we named them as the factor of sensory processing and interaction with the environment. Furthermore, in the present study, we grouped questions 14–34 as the second factor or social development. These questions appear to assess age-related socio-emotional development, which in Tede *et al.* study were named separately in three factors: Nonverbal communication, language, and imagination.<sup>[5]</sup>

The correlation coefficient of the scores of the GSEGC in two assays with an interval of 2 weeks in sensory processing was 0.954 and in total items was 0.988 that were calculated as good correlations. The Cronbach's alpha coefficient was obtained for 35 items of 0.952 and 0.930 for the sensory processing sub-scores, which is more than 0.70. These findings are consistent with those reported for GSEGC in American children.<sup>[16]</sup>

The reliability of the GSEGC has been confirmed in the United States, and a significant difference was found in the use of this questionnaire compared to children with developmental delay and normal children. Regarding psychometric properties, the in-class correlation coefficient was 0.90 for socio-emotional development questions and on average 0.83 for sensory processing.<sup>[16]</sup> However, reliability has not been reported in the number of tests.

Tede *et al.* examined the internal consistency of the GSEGC with a small sample of Israeli children.<sup>[5]</sup> The results of the study were reported with a total alpha of 0.95 for the emotional-social part and 0.78 for the sensory processing sub-scores.

### Limitations

Considering that the present study is the first study related to the evaluation of psychometric properties of the Persian version of a socio-emotional development and sensory processing, it was not possible to use other tools to evaluate other psychometric properties. Due to the lack of a suitable system for recording children's information, access to these children was limited, so sampling was used in an accessible way.

For the first time, this study examined the validity and reliability of a tool for assessing socio-emotional development in Tehran. Therefore, this tool can be used to obtain the information in this field from various cities in Iran with Farsi dialects. Simultaneous use of quantitative and qualitative research, because qualitative research, given the context of society, provides appropriate information about the conditions of society, can help to better map the prevailing conditions.

The primary purpose of investigating the validity and reliability of this tool was to obtain a suitable tool that provides information about the current situation of Iranian society. Therefore, initially, using this tool, appropriate information about socio-emotional development and sensory processing can be obtained. Furthermore, the results of such research in Iran can be compared with information obtained from similar studies in other countries, including the conditions prevailing in developed and developing countries.

## CONCLUSIONS

The results of the present study showed that the Persian version of GSEGC has acceptable validity and reliability in Tehran society. Accordingly, the GSEGC can be used in clinical and research fields. The GSEGC is a short questionnaire designed to be completed by parents or caregivers in <12 min, easily administered and graded by experts in clinical or educational work with children and their families.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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