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# RELIABILITY AND VALIDITY ADAPTATION OF THE HOSPITAL SAFETY CLIMATE SCALE

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**Reliability and Validity Adaptation of the Hospital Safety Climate Scale**

*Healthcare organisations take many precautions to ensure the safety of patients, the workplace and hospital staff, both because of health and safety legislation and to provide a quality service. Therefore, hospital safety climate scales are used to obtain important information. Aim: The aim of this study is based on Gershon, Karkashian, Grosch et al. (2000), and Smith, Zhao, Wang, Ho (2013) to adapt the reliability and validity of the 20-statement hospital safety climate scale. Method: The survey method was used in the research, and 401 students studying in health departments of 3 different foundation universities in Istanbul-Turkey were reached. SPSS for Windows 22.00 and AMOS 22.0 programs were used to analyse the data, confirmatory factor analysis of the scale was performed in AMOS program and Cronbach's alpha values were calculated. In addition, AVE and CR values were calculated based on the size after confirmatory factor analysis. Results: In this study, four-stage CFA was applied to adjust the reliability and validity of the hospital safety climate scale. According to the statistical analyses applied, the fit values of the confirmatory factor analysis model found with the modifications in the fourth stage of the scale were within the limits of agreement, and finally 7 items of the 20-item scale were eliminated and a new structure consisting of four dimensions and 13 items was obtained. Results: It is considered that the hospital safety climate scale can be used in hospitals in Turkey, as its original dimensions are preserved in its structure consisting of 13 items obtained in the fourth stage.*

***Keywords:*** *Factor Analysis, Validity, Reliability, Safety Climate Scale.*

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***Йилдирим О., Хаустова В. Є., Іляш О. І. Адаптація надійності та валідності шкали лікарняного клімату безпеки***

*Організації охорони здоров'я практикують численні запобіжні заходи для убезпечення пацієнтів, робочого простору та персоналу лікарні ? як на виконання вимог законодавства про охорону здоров'я та безпеку, так і з метою надання якісних послуг. Поміж інших засобів для отримання важливої інформації використовуються шкали лікарняного клімату безпеки. Метою цього дослідження є адаптація надійності та валідності 20-бальної шкали для оцінки лікарняного клімату безпеки на основі досліджень Гершона, Каркашьяна, Гроша та ін. (2000) та Сміта, Жао, Ванга та Хо (2013). Метод: у наведеному дослідженні використовувався метод опитування, в якому взяв участь 401 студент медичних факультетів трьох різних базових університетів у Стамбулі (Туреччина). Для аналізу даних були використані програми SPSS for Windows 22.00 та AMOS 22.0, за допомогою програмного забезпечення AMOS був проведений підтверджувальний факторний аналіз шкали та розраховані значення альфи Кронбаха. Крім того, після підтверджувального факторного аналізу були розраховані значення AVE (середня вилучена дисперсія) і CR (композитна надійність) відповідно* *до розміру. Результати: у дослідженні було застосовано чотириступеневий підтверджувальний факторний аналіз для коригування надійності та валідності шкали лікарняного клімату безпеки. Згідно із застосованим статистичним аналізом, значення відповідності моделі підтверджувального факторного аналізу знаходилися в межах узгодження при модифікаціях на четвертому етапі аналізу, і, нарешті, 7 пунктів шкали з 20 пунктів були виключені й отримана нова структура, що складається з чотирьох вимірів і 13 пунктів. Результати: вважається, що шкала лікарняного клімату безпеки може бути використана в лікарнях Туреччини, оригінальні чотири виміри збережено в адаптованій структурі шкали, яка включає 13 пунктів, отриманих на четвертому етапі аналізу.*

***Ключові слова:*** *факторний аналіз, валідність, надійність, шкала клімату безпеки.*

***Рис.:*** *4.* ***Табл.:*** *6.* ***Бібл.:*** *22.*

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**Introduction**. The Hospital Safety Climate Scale is integral to healthcare because it provides a systematic approach to gauge the safety perceptions and attitudes of healthcare workers. This scale plays a pivotal role in highlighting areas in safety practices that require improvement. It evaluates factors like leadership engagement, communication efficacy, and the readiness of staff to adhere to safety protocols. These insights are vital for enhancing patient safety, reducing medical errors, and fostering a culture of safety within healthcare institutions. By regularly using this scale, healthcare organisations can monitor changes in safety climate over time, ensuring continuous improvement in patient care and staff safety. Healthcare organisations take many precautions to ensure the safety of patients, the workplace and hospital staff in order to provide a quality service and to comply with occupational health and safety legislation.

Healthcare workers are exposed to infectious diseases through patient contact and respiration. They are also at risk of accidents such as needlesticks and injuries from sharp instruments. In the provision of health services, unsafe conditions affect not only health workers but also patients. Many irreversible consequences result from diseases that can be transmitted from patient to patient, and from bacteria and microbes that result from an unsafe hospital environment. Hospitals with a low safety climate threaten human health and, in the long run, damage the country's economy at the micro level and the macro level of hospital owners. Non-physical or psychosocial risks also exist in hospitals. These risks can be listed as occupational stress, rotating shifts, heavy workloads, lack of control and inadequate supervision (Gershon et al, 2000:212). In this context, strict enforcement of occupational health and safety regulations is important for the safety of health care workers.

The safety climate is a summary of employees' perceptions of safety. Factors such as management decisions in the workplace, company safety norms and expectations, safety practices, policies and procedures are determinants of the safety climate. Organisations with a strong safety climate have fewer workplace injuries. A safe environment supports and reinforces individual safety behaviours. For example, hospital administrators warn and require health care workers to observe isolation to protect themselves from infectious diseases (Gershon et al, 2000:212).

The concept of "security climate" was first used by Zohar in 1980 in a study of industrial companies in Israel. Safety climate is a sub-dimension of organisational climate. Workplace safety climate consists of employees' perceptions of safety in the work environment (Neal et al, 2000; Mearns, et al, 2003). Recognising and measuring the safety climate in healthcare organisations is critical. The safety climate needs to be measurable in order to be managed, controlled and to understand its relationships with other variables. However, accurate measurements can be made using scales that have been properly tested for validity and reliability. In this way, the lack of safety in health care institutions can be detected in advance and the underlying cause can be clarified. Creating a safety climate that affects healthcare workers will increase their motivation and performance. The hospital safety climate includes dimensions such as management support, barriers to safe working practices, cleanliness/order, interpersonal conflict/communication, staff, safety-related feedback/training, personal protective equipment and engineering controls (Smith et al, 2013). The study by Dirik, Intepeler, and Hewison (2023) addresses the cultural adaptation of a safety climate survey specifically for the Turkish healthcare context. This study is important as it ensures that the tool for assessing safety climate is culturally relevant and valid within the Turkish healthcare system. It fills a crucial gap by providing a reliable and practical tool to assess safety perceptions among healthcare professionals in Turkey, thus aiding in the development of targeted safety improvement strategies.

The safety climate between and within hospitals varies according to the level of observation used, the measurement tool and the sub-areas of the safety environment (Nieva and Sorra 2003; Singer et al, 2008). Accidents in health care facilities, compensation, loss of employment, loss of life, injuries, chronic occupational diseases underline the need to establish occupational safety and health standards in health care facilities.

Legal obligations to improve both the quality of services and safety in the workplace are leading health care institutions to focus on this issue. By regularly measuring the perception of the safety climate in hospitals, it will be possible to analyse the data, evaluate the results and identify the areas where safety is lacking. Based on the results, proactive approaches will be developed and necessary precautions will be taken before the gap in the safety climate turns into an accident or a situation that threatens human health. By emphasising the importance of the safety climate, it will be easier to develop safety criteria and initiatives to improve it (Singer et al, 2009). Effective communication between staff is important in improving the safety climate (Hansen et al, 2011).

In this context, the Hospital Safety Climate Scale was discussed in the study. The validity and reliability of the scale to be used in the research is of great importance for the research results. The scale has undergone reliability and validity processes before it can be used for research. In general, the research scale that has been prepared in a foreign language has undergone the process of linguistic validity (translation-back-translation), while the structural validity of the scale has been examined. The purpose of these procedures is to determine whether the scale used for research purposes retains its original structure.

In order to avoid semantic shifts that may occur due to subcultural differences when translating for linguistic validity, the expert on the research topic was consulted and his opinion sought. The first statistical analyses that come to mind for construct validity are confirmatory factor analysis and exploratory factor analysis (Suhr, 2006). Exploratory factor analysis is carried out with the aim of exploring the underlying factor structure of expressions representing a new scale or variables of a scale translated from one language to another. On the other hand, confirmatory factor analysis is used to determine whether a previously used scale fits the original factor structure when used in the current research. In addition, a number of additional tests (e.g. analysis of variance, principal axis) may be required for the validity conditions of the scale (Hair et al., 2010; Velicer & Jackson, 1990).

Model fit values, which indicate how well the designed model is defined, are expressed as x2, GFI, CFI, SRMR and RMSEA. Although the x2 statistic raises the issue of increasing the sample size, x2 gives an idea of the change in its value. For example, a decrease in the value of x indicates that the model is becoming more fit. On the other hand, if the sample size is larger than 200, the x2 value will be high and the statistical significance level of the x2 test will decrease. For this reason, in confirmatory factor analysis, the scales to be used and the appropriateness of the model are decided by looking at x2/df, other goodness of fit indices and residual covariance matrix values (Jöreskog and Sörbom, 1993; Bentler and Bonnet, 1980, Kenny and McCoach, 2003; Tabachnick and Fidell, 2007; Maiti and Mukherjee, 1991). If the values that the RMSEA can take in the 95% confidence interval are between 0.03 and 0.08, the model is considered suitable (Rigdon, 1996; Schumacker & Beyerlein, 2000).

**Research methodology**. The responses collected in the research were analysed using SPSS for Windows 22.00 and AMOS 22.0. Confirmatory factor analysis of the scale was performed in AMOS and Cronbach's alpha values were calculated. In addition, AVE and CR values were calculated based on the size after the confirmatory factor analysis.

*Participants.* Data were collected by applying a questionnaire to 401 students who were studying in the health faculties of a foundation university in Istanbul, Turkey, between June 2020 and December 2021 and who voluntarily agreed to participate.

*Confirmatory factor analysis (CFA).* The reliability and validity of hospital safety climate scale were investigated in the study of Gershon, Karkashian, Grosch et al. (2000), the 20-item hospital safety climate scale was considered in the further study of Smith, Zhao, Wang and Ho (2013). The 20 expressions of the original scale were named SC1, SC2, SC3,..., SC20 to be used in the research without breaking their order. The original scale appeared in four dimensions as follows. These dimensions are, respectively, employee personal protection (SCF1: SC1, SC2, SC3, SC4, SC5, SC6, SC10, SC11), employee interactions (SCF2: SC13, SC14, SC19, SC20, SC18, SC12), safety related housekeeping (it has four dimensions: SCF3: SC15, SC16, SC17) and time pressure (SCF4: SC7, SC8, SC9) (Smith, Zhao, Wang and Ho, 2013).

In the present study, the items of the scale were subjected to confirmatory factor analysis to adjust the hospital safety climate scale for reliability and validity. Whether the measurement model of the confirmatory factor analysis (CFA) and the safety climate scale is significant was examined using the AMOS 22.0 package program. When the result was examined, it was found that the measurement model was acceptable (Byrne, 2011). The fit of the full model was then assessed using goodness-of-fit criteria. The results obtained from 20 items in the first stage of confirmatory factor analysis are shown in Figure 1 below.

In Table 1, according to the results of the confirmatory factor analysis, it is understood that the model test values ($p<.05$) are not within the acceptable limits according to the values found.

When those with low standard scores were excluded from the analysis, the result in Figure 2 below was obtained (items 1, 2 and 18 were excluded from the analysis).

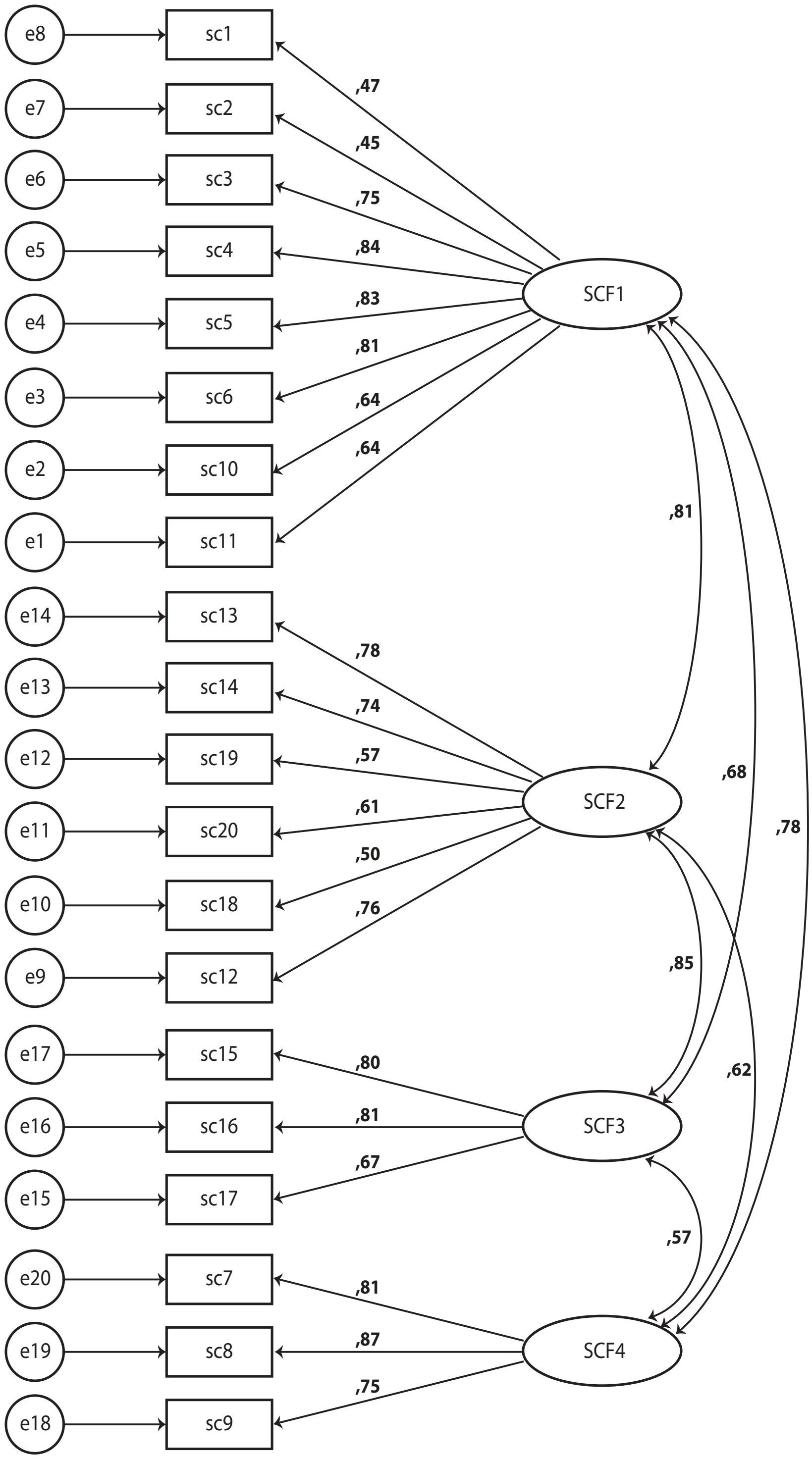


**Fig. 1. SC Scale Factor Analysis CFA. First analysis results**

*Source:* compiled by the authors

**Table 1**

**Confirmatory Factor Analysis Model Test Values, First Analysis**

| No | $x^2$ | $x^2/df$ | p | GFI | CFI | SRMR | RMSEA |
|---|---|---|---|---|---|---|---|
| 1 | 1764.78 | 10.71 | .00 | .673 | .706 | .0993 | .156 |

*Source:* compiled by the authors

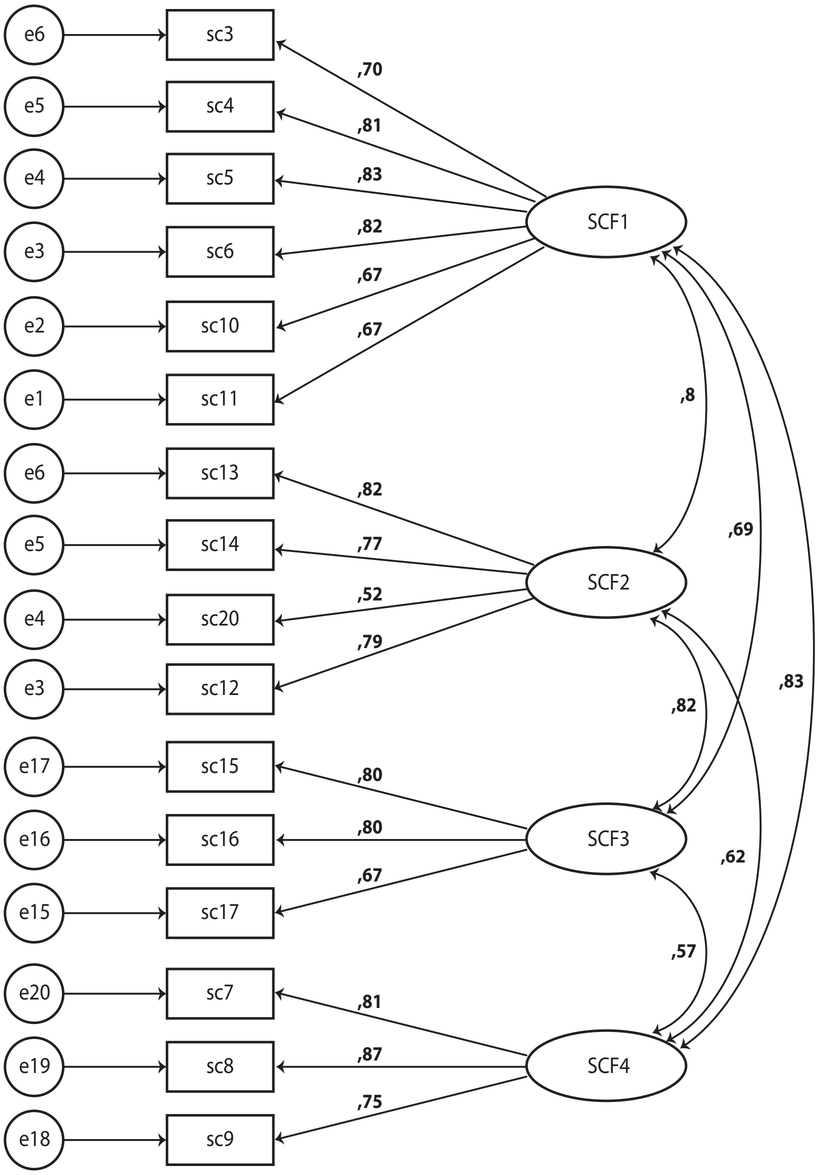


**Fig. 2. SC scale factor analysis DFA. Second Analysis**

*Source:* compiled by the authors

**Table 2**

**Confirmatory factor analysis model test values, Second Analysis**

| No | $x^2$ | $x^2$/df | p | GFI | CFI | SRMR | RMSEA |
|---|---|---|---|---|---|---|---|
| 1 | 1764.78 | 10.71 | .00 | .673 | .706 | .0993 | .156 |
| 2 | 1247 | 9.669 | .00 | .716 | .768 | .0850 | .147 |

*Source:* compiled by the authors

According to the results of the confirmatory factor analysis in Table 2 above, although the model parameter values are better than in the first analysis, they are still not within the limits of fit. For this reason, item extraction from the model was continued and the results shown in Figure 3 below were obtained in the CFA with 13 items.

The 3rd analysis' confirmatory factor analysis model test values that are shown in Table 3 above are better than of the second analysis. However, it is understood that the model is at the limits of fit. For this reason, the item will not be eliminated after this stage, but modifications will be tried. Below is the final CFA result of the model with the modifications with the highest change values.

According to the analysis results in Table 4, the CFA model fit values obtained by modifying the SC scale in the fourth analysis are within the limits of agreement. Therefore,

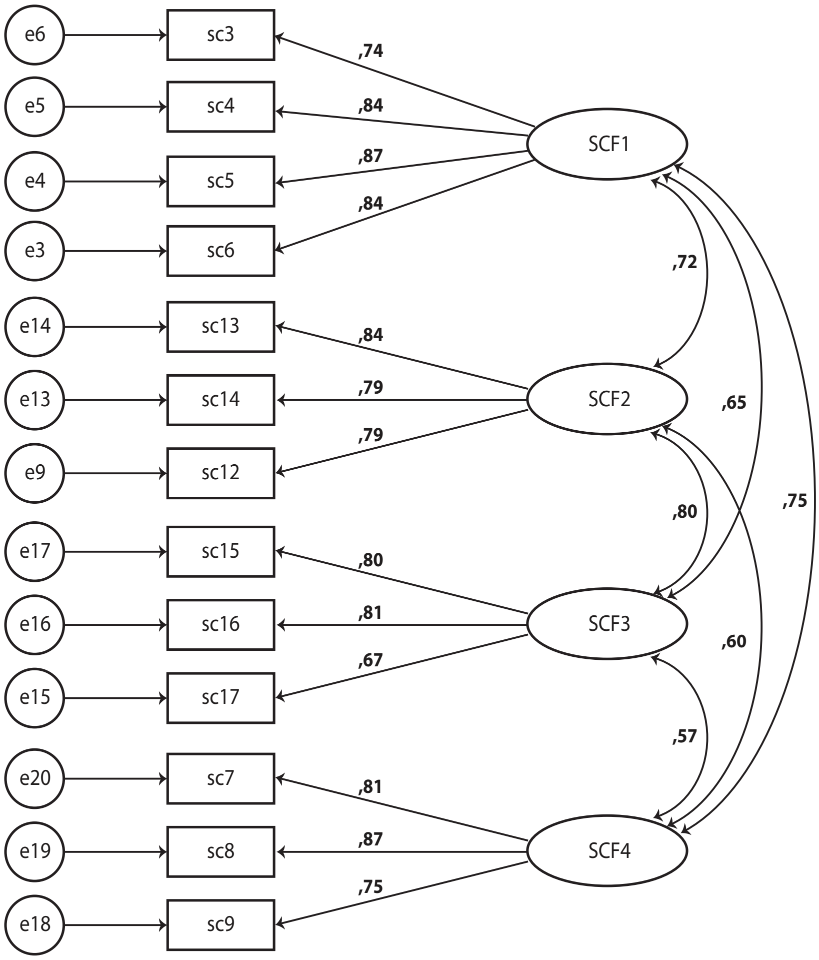


**Fig. 3. SC Scale Factor Analysis DFA. Third Analysis**

*Source:* compiled by the authors

**Table 3**

**Confirmatory Factor Analysis Model Test Values, Third Analysis**

| No | $x^2$ | $x^2$/df | p | GFI | CFI | SRMR | RMSEA |
|---|---|---|---|---|---|---|---|
| 1 | 1764.78 | 10.71 | .00 | .673 | .706 | .0993 | .156 |
| 2 | 1247.11 | 9.669 | .00 | .716 | .768 | .0850 | .147 |
| 3 | 260.573 | 4.416. | .00 | .905 | .938 | .0489 | .092 |

*Source:* compiled by the authors

the CFA result with its 13-item and 4-dimensional form was terminated at this stage. Significant covariances were calculated for all sub-dimensions of the SC scale. The highest covariance values were found between the 3rd and 2nd dimensions (.82) (Table 4).

*SC Reliability and Internal Consistency Criterion Scores.* The reliability of a scale is the degree to which it gives the same results when applied to the same sample at different times. In this sense, reliability is an indicator of how consciously the questions asked to measure a variable are answered (Schermelleh-Engel et al, 2003). In this research, Cronbach's Alpha model will be used in the reliability analysis.

Cronbach's Alpha is the correlation value between questions. Cronbach's Alpha value indicates the overall reliability level of the questions under the factor. The scale is considered reliable if the Cronbach's alpha value is 0.70 and above (Cronbach, 1970).

The validity of a scale is related to the extent to which the scale measures the variable it is intended to measure. Like the reliability test, the validity test does not have a specific coefficient on which it is based. For this reason, validity testing is carried out with theoretical analysis.

As can be seen in Table 5, the SC reliability value for the remaining 13 items was determined as (.921) as a result of the confirmatory factor analysis. In the sub-dimensions it appeared as 4-item SCF1 dimension (.893), 3-item SCF2 dimension (.845), 3-item SCF3 dimension (.791) and 3-item SCF4 dimension (.845).

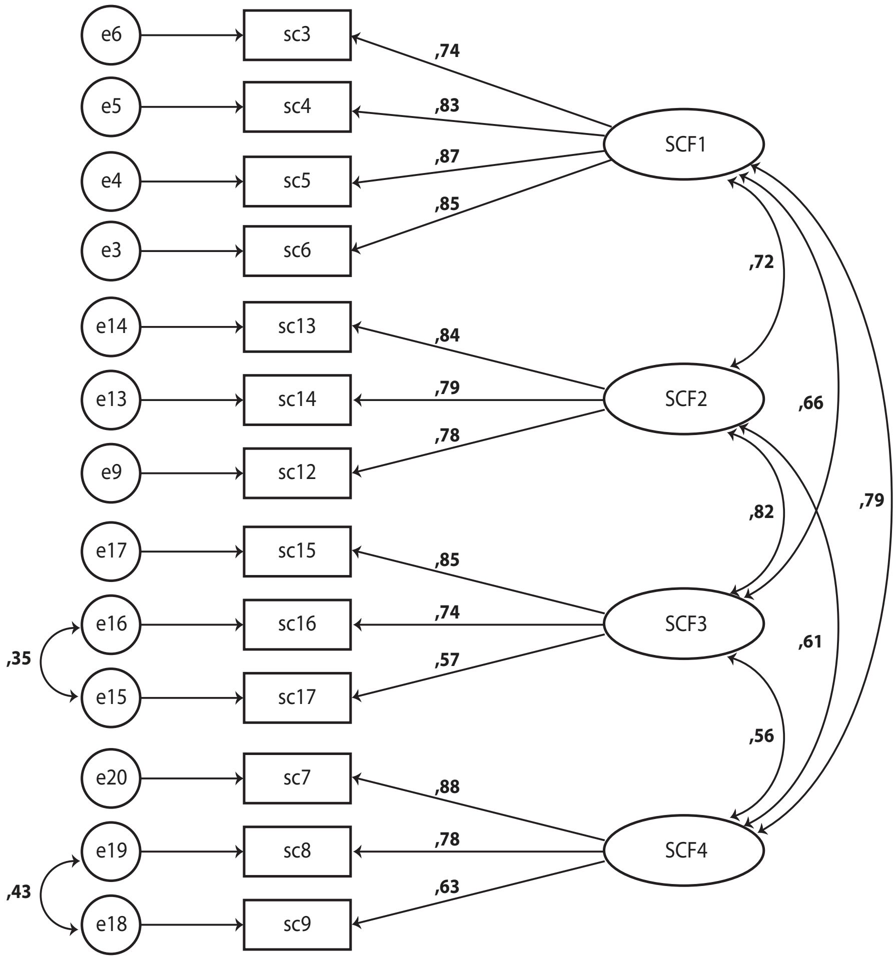


**Fig. 4. SC scale factor analysis DFA. Fourth Analysis**

*Source:* compiled by the authors

**Table 4**

**Confirmatory Factor Analysis Model Test Values, Fourth Analysis**

| No | $x^2$ | $x^2$/df | | p | GFI | CFI | SRMR | RMSEA |
|---|---|---|---|---|---|---|---|---|
| 1 | 1764.78 | 10.71 | | .00 | .673 | .706 | .0993 | .156 |
| 2 | 1247.11 | 9.669 | | .00 | .716 | .768 | .0850 | .147 |
| 3 | 260.573 | 4.416. | | .00 | .905 | .938 | .0489 | .092 |
| 4 | 189.813 | 3.330 | | .000 | .930 | .959 | .0471 | .076 |

*Source:* compiled by the authors

**Table 5**

**Reliability Values of the SC Scale**

| Scale | Number of items | Cronbach's Alpha |
|---|---|---|
| SC total | 13 | .921 |
| SCF1 | 4 | .893 |
| SCF2 | 3 | .845 |
| SCF3 | 3 | .791 |
| SCF4 | 3 | .845 |

*Source:* compiled by the authors

*Composite Reliability (CR) and Average Variance Extracted (AVE).* Combined reliability is used to measure the overall reliability of multiple, heterogeneous, similar statements. Since the Cronbach's alpha coefficient gives a high value when the number of items is high, the CR value is used as an alternative to the Cronbach's alpha coefficient and as a confirmatory tool. The CR value is expected to be greater than 0.7. The average variance extracted (AVE) is obtained by dividing the sum of the squares of the covariances (loads) of the expressions related to the factor by the number of expressions. A separate evaluation is made for each factor structure. It states that the expressions related to the variables are related to each other and to the factor they form. For convergent validity, the above-mentioned calculation method of Fornell and Larcker (1981) was used. According to this method, in order to ensure the convergent validity of the scale, the average variance extracted (AVE) values of the items are above 0.50; the composite reliability (CR) is expected to be above 0.70 (Raykov, 1998).

**Table 6**

**Composite Reliability (CR) and Mean Explained Variance (AVE) Values for the SC Scale**

| Dimension | Item | Factor Load | AVE | CR |
|---|---|---|---|---|
| SCF1 | SC6 | .846 | .681 | .895 |
| SCF1 | SC5 | .874 | | |
| SCF1 | SC4 | .833 | | |
| SCF1 | SC3 | .743 | | |
| SCF2 | SC12 | .782 | .649 | .847 |
| SCF2 | SC14 | .789 | | |
| SCF2 | SC13 | .845 | | |
| SCF3 | SC17 | .573 | .535 | .771 |
| SCF3 | SC16 | .740 | | |
| SCF3 | SC15 | .854 | | |
| SCF4 | SC9 | .631 | .597 | .814 |
| SCF4 | SC8 | .781 | | |
| SCF4 | SC7 | .885 | | |

*Source:* compiled by the authors

As can be seen in Table 6, the composite reliability (CR) and average variance extracted (AVE) values of the SC scale were calculated separately on a dimensional basis. Values higher than (0.50) were obtained for all AVE values. On the other hand, CR scores were calculated above the critical value (0.70). It is also clear that CR scores are higher than AVE scores in all dimensions. The combined reliability condition and the convergent validity condition of the SC scale are also fulfilled.

**Results and Discussion**. The tendencies and efforts of hospital administrators in this regard are of great importance in ensuring the safety climate in hospitals. Managers should participate in occupational safety activities, provide occupational safety training programmes for healthcare workers, constantly emphasise the importance of occupational safety on the basis of management, and adopt a problem-solving and consultative approach rather than looking for criminals in investigations after accidents/injuries/infectious diseases.

It can be seen that the situation caused by the significant number of deaths and injuries in the healthcare sector each year due to work-related accidents causes significant social and economic problems for healthcare workers and their families. In addition, the economic costs of work-related accidents are very significant. In order to develop proactive solutions by minimising these costs, a scale adaptation study was carried out based on the need to regularly measure the perception of the safety climate in hospitals. Confirmatory factor analysis is widely used in the social sciences. It is of great importance that the analysis is carried out as accurately as possible, as this is related to the validity of subsequent analyses. Since all factor analyses are open to subjective interpretation, the values to be taken within the limits are also open to interpretation. Therefore, following the rules as closely as possible is an element that makes the analysis valid.

In this study, four-stage CFA was used to adjust the reliability and validity of the Hospital Safety Climate Scale. At each stage, statistical analyses were applied and it was checked whether the confirmatory factor analysis values obtained were within the limits of agreement. As a result of the statistical analyses applied, it was seen that the fit values of the confirmatory factor analysis model found with the modifications of the fourth stage of the Hospital Safety Climate Scale were within the limits of agreement, and finally 7 items of the 20-item scale were eliminated and a new structure consisting of 13 items from four dimensions was obtained. In order to maintain the order of the original scale, SC1, SC2, SC10, SC11 in the SCF1 dimension (personal protection of staff) and SC18, SC19, SC20 in the SCF2 dimension (staff interactions) were excluded from the scale. On the other hand, items SC15, SC16, SC17 and SC7, SC8, SC9 in dimension SCF4 (time pressure) were retained in the original scale.

The study by Gershon et al. (2000) contributes significantly to healthcare safety, yet in different contexts. Gershon et al.'s study is pivotal in understanding the relationship between hospital safety climate, employee compliance with safe work practices, and the incidence of workplace exposures, particularly in the context of bloodborne pathogens. This research provided key insights into how organizational factors like management support and workplace conditions impact safety compliance and incidence rates, offering valuable guidance for healthcare institutions worldwide. On the other hand, the study by Dirik, Intepeler, and Hewison (2023) addresses the cultural adaptation of a safety climate survey specifically for the Turkish healthcare context.

This study is important as it ensures that the tool for assessing safety climate is culturally relevant and valid within the Turkish healthcare system. It fills a crucial gap by providing a reliable and practical tool to assess safety perceptions among healthcare professionals in Turkey.

This research specifically targets the adaptation of the Hospital Safety Climate Scale for the Turkish healthcare context, ensuring cultural and operational relevance. The study seems to employ a detailed methodological approach, including translation, factor analysis, and reliability testing, to validate the scale's effectiveness in the Turkish healthcare environment.

This research may provide a useful tool for assessing safety climate in Turkish hospitals, aiding in the development of targeted safety improvement strategies and emphasizes the importance of adapting safety assessment tools to specific cultural contexts, which is crucial for accurate and meaningful safety climate assessments.

Dirik, Intepeler and Hewison (2023) and Gershon's study (2006) and this research are critical in their respective fields, understanding the safety climate in healthcare and the latter providing a culturally adapted tool for specific regional application.

**Data availability**. Data are available from the corresponding author (Yildirim O.) on request.

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