

Psychometric properties of the Turkish version of the Nordic Occupational Safety Climate Questionnaire (NOSACQ-50)

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Abstract

Background: Occupational safety climate, a key predictor of workplace safety performance and employee well-being, requires culturally adapted and psychometrically robust measurement tools such as the NOSACQ-50 to effectively assess safety perceptions across different industries and populations.

Objective: This study aimed to conduct the cross-cultural adaptation of the interview-administered Turkish version of the Nordic Occupational Safety Climate Questionnaire (NOSACQ-50) and to assess its psychometric properties in the metal industry.

Methods: A methodological study was conducted among 387 employees working in a metal industry enterprise in Balıkesir BEST Transformer. Internal consistency was assessed using Cronbach's α , construct validity was examined through confirmatory factor analysis (CFA) and known-groups comparisons, and discriminant validity was evaluated via correlation analyses with related scales. Statistical analyses were performed using SPSS 27.0 and Jamovi 2.3.28.

Results: The Turkish version of NOSACQ-50 comprises seven subscales, with Cronbach's α coefficients ranging from 0.85 to 0.92. Person reliability values from Rasch analysis ranged between 0.81 and 0.87. CFA demonstrated acceptable model fit indices for all subscales. Significant correlations were observed between NOSACQ-50 subscales and the peer support, supervisor support, sense of community, trust, job satisfaction, and burnout subscales of the KOPSOR-TR. Furthermore, NOSACQ-50 subscales showed significant associations with the subscales of the Safety Climate Scale, supporting convergent validity.

Conclusions: The Turkish version of NOSACQ-50 demonstrates satisfactory reliability and validity, and it can be used as a standardized tool for assessing occupational safety climate among employees in Turkey.

Keywords

occupational health, psychometrics, occupational safety climate

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Introduction

Work life constitutes a significant portion of individuals' daily existence, and insufficient safety measures may lead to serious risks such as occupational accidents and work-related illnesses. Globally, approximately three million people lose their lives annually due to occupational accidents and diseases, while 395 million workers are exposed to non-fatal work-related injuries.¹ In this context, the safety climate plays a critical role in preventing workplace accidents and directly affects employee health. This is particularly relevant in the metal industry, where high-risk work environments increase the importance of

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employees' safety perceptions and behaviors.²⁻⁴ Safety climate is a concept that reflects the shared attitudes and perceptions of employees regarding the importance and priority attributed to safety in the workplace, reveals the current state of workplace safety, and is used in the evaluation of safety performance.⁵ The establishment of a high level of safety climate enhances employees' compliance with safety rules and regulations, thereby contributing to the creation of a high level of occupational health and safety conditions in the workplace.⁶

There are scales whose validity and reliability have been evaluated in sectors such as healthcare, emergency services, construction, and the military, where safety climate is measured quantitatively.⁶⁻⁹ One of the instruments used to assess safety climate is the Safety Climate Questionnaire-50 (NOSACQ-50). In this study, the NOSACQ-50 was selected because it is a reliable and valid instrument designed to measure safety motivation, perceived safety level, and self-assessment; it has been successfully adapted across different sectors and countries; and it possesses a factor structure grounded in organizational and safety climate theories.¹⁰ The scale is also notable for providing information on employees' perceptions of management and coworkers, which are crucial for occupational safety climate, and for reflecting the organizational safety climate. Indeed, the psychometric properties of the NOSACQ-50 have been evaluated among steel industry workers in Saudi Arabia,¹¹ healthcare workers in Thailand,¹² military personnel in Germany,⁶ employees from various sectors in Colombia,¹³ and steel industry workers in Iran,⁷ and the instrument has been found to be valid and reliable.

Turkey, a rapidly developing country located between Asia and Europe, has shown some improvement in employees' knowledge, perceptions, and attitudes toward occupational safety; however, these aspects have not yet reached the desired level compared to those in developed countries.¹⁴ Safety climate perceptions may vary across industrial contexts, countries, and economic conditions, influencing employees' safety-related attitudes and behaviors. Although recent legislative improvements have been made, there remains a need to systematically examine how these regulations translate into workplace practices and affect the safety climate. Although various methodological studies on occupational safety climate exist in the literature,^{8,9} there remains a need for a Turkish version of the NOSACQ-50, a standardized and comprehensive instrument for assessing safety climate, with established validity and reliability. In this context, the adaptation of the NOSACQ-50 into Turkish and the evaluation of its psychometric properties will enable the safety climate in Turkey to be measured in a standardized, valid, and reliable manner, facilitate cross-national comparisons, and provide a significant methodological contribution to the literature. The novelty of this study lies in filling a gap

in the literature by providing a valid and reliable safety climate instrument for Turkey, and by adapting the NOSACQ-50 to measure employees' safety perceptions in high-risk sectors, particularly in the metal industry.

The present study aims to evaluate the validity and reliability of the Turkish version of NOSACQ-50.

Hypotheses

The Turkish version of NOSACQ-50 is a valid and reliable instrument for assessing occupational safety climate among workers in the metal industry.

H1a: The internal consistency (Cronbach's α) of NOSACQ-50 subscales is ≥ 0.70 , indicating adequate reliability.

H1b: NOSACQ-50 subscales exhibit significant positive correlations with the Safety Climate Scale and relevant subscales of KOPSOR-TR (convergent validity).

H1c: The factor structure of NOSACQ-50 can be confirmed through confirmatory factor analysis (construct validity).

H1d: NOSACQ-50 subscales demonstrate significant differences across known groups based on gender, age, education, or prior occupational accident experience (known-groups validity).

Methods

Design and study population

This methodological study was conducted to evaluate the psychometric properties of the NOSACQ-50 TR in a metal industry company located in Balikesir, Southern Marmara region of Turkey, employing both white- and blue-collar workers, between July 15 and August 30, 2024. The Turkish adaptation of the scale was carried out following COSMIN guidelines and international recommendations for cross-cultural adaptation.¹⁵

Procedure

Translation and cross-cultural adaptation. The Turkish adaptation followed COSMIN guidelines and international recommendations. A literature review confirmed the relevance of NOSACQ-50, and permission was obtained from the original author. Forward translation was performed by two independent translators one subject-matter expert and one linguist unfamiliar with the construct and synthesized into a preliminary Turkish version. The pre-final version was back-translated by two independent translators blinded to the original scale, and semantic,

conceptual, experiential, and cultural equivalence was evaluated by an expert committee.

Content validity. Nine experts assessed items using a four-point scale for relevance, clarity, and cultural appropriateness. Item-level (I-CVI) and scale-level (S-CVI) Content Validity Indices were calculated. Items with I-CVI < 0.78 were revised, and the overall S-CVI indicated adequate content validity.

Pilot testing. The pre-final version was pilot-tested with 25 participants from the target population. Minor linguistic adjustments were made based on feedback. Pilot data were not included in the main analyses.

Participants and data collection. The study sample consisted of 387 voluntary employees from Balikesir BEST Transformer company who completed the survey, meeting COSMIN's minimum recommendation for structural validity analyses. Data were collected using the finalized Turkish version of the scale.

Validity assessment. Scale validity was assessed using confirmatory factor analysis (CFA), Rasch analysis, convergent and divergent validity, and known-groups validity. CFA model fit was evaluated using χ^2 / df , RMSEA, SRMR, CFI, and GFI. Rasch analysis reported item fit statistics (infit and outfit) and person reliability. Correlations with related scales and discriminative ability across demographic and occupational groups were analyzed using Mann Whitney U tests, and effect sizes were reported.

Reliability assessment. Internal consistency was assessed using Cronbach's α , with corrected item-total correlations and α if an item was deleted. Item analysis included mean, 95% confidence interval, median, and minimum–maximum values for each item (Figure 1).

Measures

The data collection instruments included a sociodemographic information form, the NOSACQ-50 Safety Climate Questionnaire, the Safety Climate Scale, and selected subscales of the Copenhagen Psychosocial Questionnaire (KOPSOR-TR): Meaninglessness of Work, Lack of Peer Support, Lack of Superior Support, Lack of Community Feeling, Lack of Trust, Lack of Job Satisfaction, and Burnout.

Sociodemographic information form. This form was developed by the researchers based on literature and included items on age, gender, education, income, perceived health, working conditions, and work environment.^{8,10,16}

Nordic occupational safety climate questionnaire (NOSACQ-50). The NOSACQ-50, developed by Kines et al., consists of 50 items rated on a 4-point Likert scale (strongly disagree, disagree, agree, strongly agree) across seven dimensions: Management Safety Priority, Commitment and Competence; Management Safety Empowerment; Management Safety Justice; Workers' Safety Commitment; Workers' Safety Priority and Risk Non-Acceptance; Safety Communication, Learning, and Trust in Co-Worker Safety Competence; Workers' Trust in the Efficacy of Safety Systems. Items 3, 5, 8, 9, 13, 15, 18, 21, 25, 26, 28, 29, 30, 31, 32, 34, 35, 41, 45, 47, 49 are reverse scored. Subscale scores are calculated as the mean of responses, with higher scores indicating a better safety climate. Subscale mean scores < 2.70 indicate a very low safety climate requiring major improvement; 2.70–2.99 indicates low safety climate with improvement needed; 3.00–3.30 indicates good safety climate with minor improvements; > 3.30 indicates a strong safety climate (Supplementary file). Cronbach's α in the original study ranged from 0.79 to 0.85.¹⁰

Copenhagen psychosocial questionnaire (KOPSOR-TR). KOPSOR-TR, developed by Kristensen et al. (2005) and adapted into Turkish by Sahan (2016), assesses psychosocial risk factors. Each subscale is scored independently. Job satisfaction items are scored on a 4-point Likert scale, while all other dimensions use a 5-point Likert scale. This study utilized the following subscales: Meaninglessness of Work, Lack of Peer Support, Lack of Superior Support, Lack of Community Feeling, Lack of Trust, Lack of Job Satisfaction, and Burnout. Cronbach's α ranged from 0.59 to 0.93 in the original study and 0.553–0.891 in the Turkish adaptation.^{17,18}

Safety climate scale. This 21-item scale, developed by Lin et al. (2008) and adapted into Turkish by Deveci et al. (2022), includes seven dimensions: Awareness and Competence in Safety, Safety Communication, Organizational Environment, Management Support, Risk Assessment, Safety Measures, and Safety Training. Responses are rated on a 5-point Likert scale (1 = Strongly disagree, 5 = Strongly agree). Possible total scores range from 21 to 105. Cronbach's α was 0.879 in the original study and 0.869 in the Turkish adaptation.^{8,19}

Statistical analysis

Item analysis included calculation of mean, 95% confidence interval, median, and minimum–maximum values for each item. Internal consistency was assessed using Cronbach's α , and corrected item-total correlations as well as Cronbach's α if an item was deleted were evaluated. Validity analyses included confirmatory factor analysis

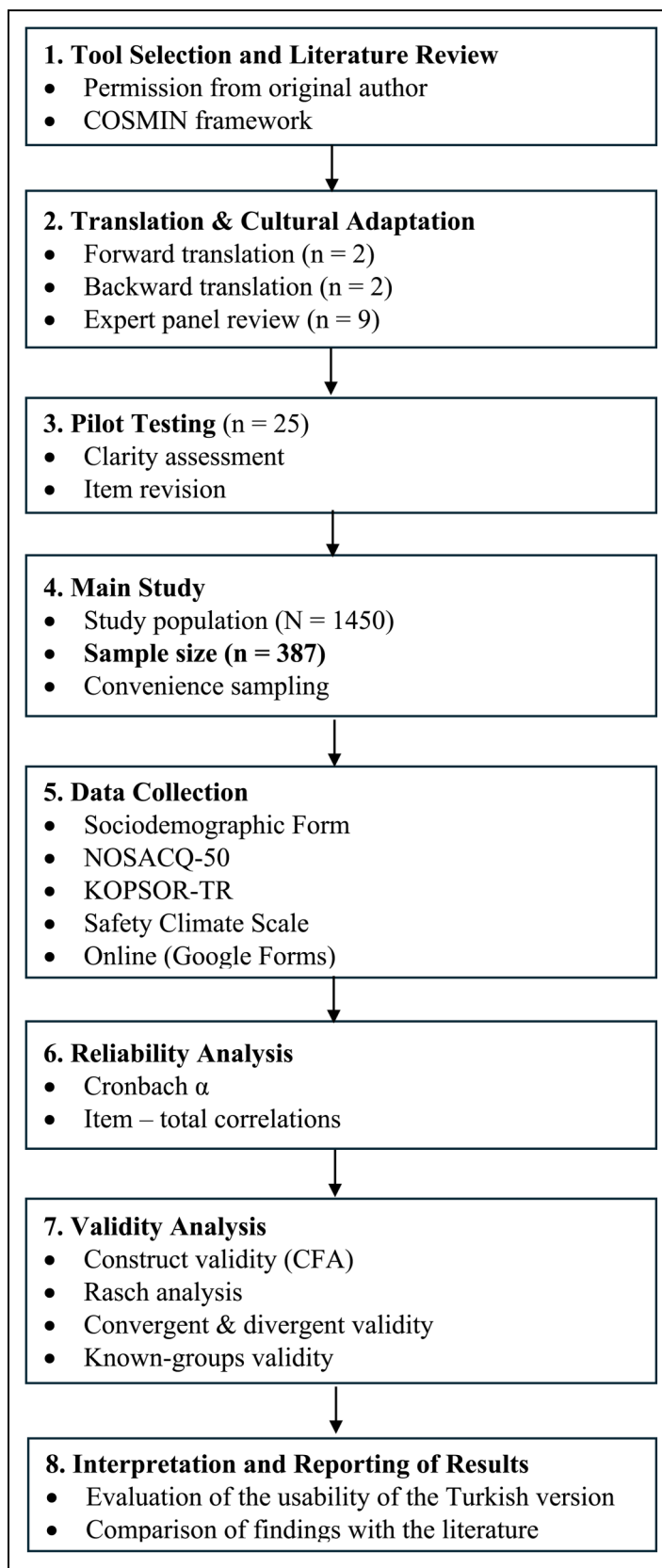


Figure 1. Research model of the Turkish adaptation of NOSACQ-50.

(CFA), Rasch analysis, convergent and divergent validity, and known-groups validity. CFA model fit was evaluated using χ^2/df , RMSEA, SRMR, CFI, and GFI; Rasch analysis reported item fit statistics (infit and outfit) and person reliability. Correlations with related scales and discriminative ability across demographic and occupational groups were examined using Mann Whitney U tests, and effect sizes were reported. Data analyses were performed with SPSS 27.0 and Jamovi 2.3.28.

Ethical considerations

The authors declare that this study was conducted according to the principals of the Declaration of Helsinki. Ethical approval was obtained from Non-Interventional Research Ethics Committee of Balikesir University, Health Sciences (Date: 04.06.2024, No: 2024 / 84). Written informed consent was obtained from all participants.

Results

Participant characteristics

Of the study sample, 92.0% were male, 26.9% were aged 33–39 years, with a mean age of 38.9 ± 8.8 years. More than half of the participants (51.2%) had completed high school, 48.6% reported income roughly matching expenses, 77.8% were married, 72.9% had children, 53.2% rated their overall health as good, and 18.2% reported a chronic illness. Regarding occupational characteristics, 78.6% were blue-collar workers, 59.2% worked in shifts, and 21.2% were employed in quality control or final processing units. Over their careers, 4.4% had been diagnosed with an occupational disease, 37.2% had experienced a near-miss incident, and 34.1% had been involved in a work accident. The mean weekly working hours were 48.1 ± 5.2 , mean tenure in the current unit was 11.5 ± 8.8 years, and total work experience averaged 17.9 ± 9.7 years.

Content validity results

The content validity of the scale was evaluated based on the assessments of nine experts. The item-level Content Validity Index (I-CVI) values ranged from 0.78 to 1.00, and the scale-level Content Validity Index (S-CVI / Ave) was 0.94, indicating excellent content validity of the scale.

Item-level analysis

The NOSACQ-50 comprises 50 items across seven subscales (D1-D7). Descriptive statistics indicated that item

means ranged from 2.59 to 3.51, with narrow confidence intervals. Median values were 3 or 4 for all items, and the minimum and maximum scores ranged from 1 to 4, indicating an overall well-structured scale.

Reliability analysis

Cronbach's α coefficients for the seven subscales ranged from 0.851 to 0.933, with an overall scale reliability of 0.970. Corrected item-total correlations ranged from 0.456 to 0.822. Removal of items 5, 18, 29, or 41 did not improve subscale internal consistency, supporting the robustness of the subscale structures (Table 1).

Overall safety climate

A radar plot illustrating mean scores for the seven NOSACQ-50 subscales is presented in Figure 2. As items were rated on a 1–4 Likert scale, subscale means above 3.00 indicate a generally positive safety climate perception. The highest mean score was observed in the “Management Safety Priority and Competence” subscale (3.36), followed by “Workers’ Trust in the Efficacy of Safety Systems” (3.32) and “Management Safety Empowerment” (3.19). Conversely, the lowest scores were noted for “Workers’ Safety Priority and Risk Non-Acceptance” (3.06) and “Safety Communication, Learning, and Trust in Co-Worker Safety Competence” (3.08), suggesting areas for organizational improvement. Overall, all subscales exceeded a mean of 3.00, indicating largely positive safety climate perceptions among participants, although certain subscales may require targeted awareness and reinforcement interventions.

Construct validity

Confirmatory Factor Analysis (CFA) was conducted to test the scale's structural validity, performed separately for each subscale (D1-D7) and the overall scale. Model fit was evaluated using χ^2 , degrees of freedom (df), χ^2 / df ratio, Standardized Root Mean Square Residual (SRMR), Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Goodness of Fit Index (GFI). Most subscales demonstrated χ^2 / df ratios below 3, indicating good model fit. Notably, D1 ($\chi^2 / df = 1.43$), D5 ($\chi^2 / df = 1.01$), and D6 ($\chi^2 / df = 0.78$) showed excellent fit. CFI values exceeded 0.95 for all subscales, and GFI values were above 0.99. For the overall scale, $\chi^2 / df = 1.90$, SRMR = 0.104, RMSEA = 0.062, CFI = 0.966, and GFI = 0.986, demonstrating satisfactory overall model fit (Table 2). Figure 3 visualizes the seven-factor CFA model, with most factor loadings ≥ 0.60 , indicating

Table 1. Distribution of responses and internal consistency of the NOSACQ-50 scale (n = 387).

Dimensions #	Items	Mean (95% CI)	Median (min-max)	Item-total correlation	If item deleted Cronbach's α	Cronbach's α
D1	1	3.28 (3.20–3.36)	3 (1–4)	0.815	0.921	0.933
	2	3.41 (3.34–3.49)	4 (1–4)	0.815	0.921	
	3	3.47 (3.40–3.53)	4 (1–4)	0.717	0.927	
	4	3.29 (3.22–3.37)	3 (1–4)	0.787	0.922	
	5	3.25 (3.16–3.33)	3 (1–4)	0.602	0.934	
	6	3.28 (3.20–3.36)	3 (1–4)	0.787	0.922	
	7	3.27 (3.20–3.35)	3 (1–4)	0.757	0.924	
	8	3.51 (3.44–3.57)	4 (1–4)	0.743	0.925	
	9	3.46 (3.39–3.53)	4 (1–4)	0.735	0.926	
D2	10	3.36 (3.28–3.43)	3 (1–4)	0.751	0.882	0.901
	11	3.13 (3.06–3.21)	3 (1–4)	0.769	0.880	
	12	2.96 (2.87–3.05)	3 (1–4)	0.731	0.884	
	13	3.41 (3.34–3.48)	4 (1–4)	0.619	0.896	
	14	3.29 (3.22–3.37)	3 (1–4)	0.773	0.879	
	15	3.16 (3.08–3.24)	3 (1–4)	0.608	0.899	
	16	2.99 (2.91–3.07)	3 (1–4)	0.725	0.884	
D3	17	3.25 (3.18–3.32)	3 (1–4)	0.753	0.858	0.886
	18	3.04 (2.95–3.12)	3 (1–4)	0.514	0.899	
	19	3.24 (3.17–3.32)	3 (1–4)	0.787	0.853	
	20	3.15 (3.07–3.22)	3 (1–4)	0.788	0.852	
	21	3.27 (3.20–3.34)	3 (1–4)	0.627	0.878	
	22	3.06 (2.98–3.15)	3 (1–4)	0.761	0.856	
D4	23	3.14 (3.07–3.21)	3 (1–4)	0.688	0.817	0.851
	24	3.17 (3.09–3.24)	3 (1–4)	0.655	0.823	
	25	3.25 (3.17–3.33)	3 (1–4)	0.619	0.829	
	26	3.20 (3.12–3.28)	3 (1–4)	0.579	0.837	
	27	3.24 (3.17–3.31)	3 (1–4)	0.672	0.819	
	28	3.20 (3.12–3.27)	3 (1–4)	0.603	0.833	
D5	29	2.59 (2.49–2.68)	3 (1–4)	0.456	0.867	0.862
	30	3.07 (2.99–3.16)	3 (1–4)	0.637	0.841	
	31	3.22 (3.14–3.30)	3 (1–4)	0.754	0.824	
	32	3.28 (3.20–3.35)	3 (1–4)	0.775	0.823	
	33	2.93 (2.83–3.02)	3 (1–4)	0.480	0.863	
	34	3.20 (3.12–3.28)	3 (1–4)	0.662	0.838	
	35	3.12 (3.04–3.20)	3 (1–4)	0.683	0.835	
D6	36	3.17 (3.10–3.25)	3 (1–4)	0.772	0.903	0.917
	37	3.17 (3.10–3.24)	3 (1–4)	0.822	0.899	
	38	3.00 (2.93–3.08)	3 (1–4)	0.763	0.903	
	39	3.24 (3.17–3.31)	3 (1–4)	0.738	0.905	
	40	3.19 (3.12–3.27)	3 (1–4)	0.803	0.900	
	41	2.85 (2.77–2.93)	3 (1–4)	0.537	0.924	
	42	2.95 (2.87–3.03)	3 (1–4)	0.671	0.911	
	43	3.09 (3.01–3.18)	3 (1–4)	0.758	0.904	
D7	44	3.18 (3.10–3.26)	3 (1–4)	0.682	0.879	0.893
	45	3.30 (3.23–3.37)	3 (1–4)	0.589	0.889	
	46	3.32 (3.24–3.39)	3 (1–4)	0.767	0.868	
	47	3.35 (3.29–3.42)	3 (1–4)	0.662	0.881	
	48	3.28 (3.21–3.36)	3 (1–4)	0.778	0.867	
	49	3.48 (3.41–3.54)	4 (1–4)	0.644	0.883	
	50	3.32 (3.24–3.39)	3 (1–4)	0.721	0.874	

D1: Management Safety Priority, Commitment and Competence; D2: Management Safety Empowerment; D3: Management Safety Justice; D4: Workers' Safety Commitment; D5: Workers' Safety Priority and Risk Non-Acceptance; D6: Safety Communication, Learning, and Trust in Co-Worker Safety Competence; D7: Workers' Trust in the Efficacy of Safety Systems.

adequate representation of items within their respective dimensions. Inter-factor correlations were moderate to high, supporting structural consistency and alignment with the theoretical model.

Rasch analysis

Rasch analysis was performed to evaluate item-level validity within each subscale. Person reliability coefficients ranged

Table 2. Summary of goodness-of-fit indices from the confirmatory factor analysis (n = 387).

Dimensions	χ^2	df	χ^2 / df	SRMR	RMSEA	CFI	GFI
D1	38.5	27	1.43	0.102	0.035	0.99	0.998
D2	29	14	2.07	0.062	0.055	0.989	0.999
D3	20	9	2.22	0.057	0.058	0.989	0.999
D4	29.4	9	3.27	0.106	0.078	0.944	0.997
D5	14.1	14	1.01	0.040	0.004	1.000	0.999
D6	15.6	20	0.78	0.042	0.000	1.000	0.999
D7	29.3	14	2.09	0.105	0.054	0.974	0.998
Total	2196	1154	1.90	0.104	0.062	0.966	0.986

SRMR: Standardized Root Mean Square Residual; RMSEA: Root Mean Square Error of Approximation; CFI: Comparative Fit Index; GFI: Goodness-Of-Fit Index.

from 0.797 to 0.871, indicating adequate discrimination among individuals across subscales. All items showed negative measure values (e.g., item 1: -2.740 ; item 49: -3.580), reflecting a generally high safety climate perception among participants and relatively “easy” items for this sample. Most infit and outfit mean-square statistics fell within the acceptable range of 0.5–1.5. Items 18 (Infit = 1.545, Outfit = 1.470) and 41 (Infit = 1.512, Outfit = 1.597) slightly exceeded this range, suggesting minor deviations from model expectations. These items do not necessitate removal but warrant careful consideration regarding cultural interpretation and phrasing. Overall, Rasch results support the consistency of the seven-factor structure and sufficient item-person reliability (Table 3).

Convergent and divergent validity

Correlation analyses examined relationships between NOSACQ-50 subscales, the Safety Climate Scale, and KOPSOR-TR psychosocial subscales (Table 4). Significant positive correlations ($p < 0.001$) with Safety Climate subscales indicated convergent validity. Strongest associations were observed between D6 (Safety Communication, Learning, and Co-Worker Trust) and Communication ($r = 0.70$) and Awareness and Competence ($r = 0.66$), supporting structural and theoretical alignment. Divergent validity was confirmed via negative correlations with KOPSOR-TR adverse perception dimensions, including Lack of Trust ($r = -0.34$ to -0.47) and Lack of Superior Support ($r = -0.26$ to -0.40). Low-to-moderate positive correlations with Meaningfulness of Work ($r = 0.26$ – 0.38) and weaker correlations with Burnout ($r = -0.18$ to -0.29) suggest complex or indirect associations between safety climate and these constructs. Overall, results support both convergent and divergent validity of the Turkish NOSACQ-50.

Known-groups validity

Subscale scores were compared across demographic and work-related groups using Mann Whitney U tests, with

rank-biserial correlation coefficients (rrb) calculated as effect sizes (Table 5). Significant differences were found by gender in D6 (rrb = 0.37, $p < 0.001$) and D7 (rrb = 0.23, $p < 0.05$), suggesting female participants perceived communication and system trust more positively than males. Age comparisons (18–39 vs. 40–65) revealed significant differences in D1 (rrb = 0.16, $p < 0.01$), D2 (rrb = 0.15, $p < 0.05$), and D7 (rrb = 0.13, $p < 0.05$), with older participants reporting stronger perceptions of management-driven safety priority and system trust. Shift vs. regular work schedules showed significant differences in D1–D4 and D6 ($p < 0.01$ or $p < 0.001$), with the largest effects in D2 and D3 (rrb = 0.21), indicating regular day workers perceive management empowerment and justice more positively. Participants with near-miss experiences reported significantly lower scores in D1–D6 ($p < 0.05$ – 0.001), with the largest effect in D5 (rrb = 0.25). Work accident history significantly affected D1–D3, D5, and D6, again with the highest effect in D5 (rrb = 0.21). No significant differences were observed based on education or job type (blue-collar vs. white-collar). These findings support the scale’s discriminative capacity and known-groups validity, with effect sizes generally small but theoretically consistent.

Discussion

This study provides an original contribution to the literature as one of the first comprehensive adaptations of a safety climate scale in Turkey. Unlike previous international adaptations, the NOSACQ-TR has been specifically evaluated for cultural and sectoral suitability in Turkish workplaces, with particular emphasis on leadership and management dimensions.

Descriptive characteristics of the NOSACQ-TR scale

Descriptive findings of the scale indicate that the mean scores of items across its seven dimensions and 50 questions generally ranged between 3.0 and 3.5, reflecting predominantly positive responses from participants. The

Table 3. Rasch analysis results (n = 387).

Dimensions	Items	Measure	Infit	Outfit	Person reliability
D1	1	-2.740	0.848	0.749	0.852
	2	-3.340	0.882	0.661	
	3	-3.700	0.956	0.916	
	4	-2.750	0.850	0.803	
	5	-2.840	1.466	1.317	
	6	-2.820	0.918	0.758	
	7	-2.670	0.886	0.892	
	8	-3.930	0.926	0.654	
	9	-3.910	0.928	0.780	
D2	10	-3.150	0.925	0.779	0.841
	11	-2.150	0.718	0.719	
	12	-1.750	0.928	0.853	
	13	-3.310	1.287	1.161	
	14	-2.790	0.850	0.729	
	15	-2.170	1.370	1.235	
	16	-1.660	0.878	0.839	
	17	-2.400	0.853	0.773	
D3	18	-1.750	1.545	1.470	0.821
	19	-2.460	0.809	0.676	
	20	-2.030	0.756	0.700	
	21	-2.600	1.098	0.980	
	22	-1.820	0.884	0.800	
D4	23	-1.860	0.817	0.781	0.797
	24	-1.930	0.930	0.823	
	25	-2.410	1.133	1.000	
	26	-2.210	1.229	1.078	
	27	-2.220	0.963	0.831	
	28	-2.160	1.098	1.017	
D5	29	-0.741	1.349	1.358	0.829
	30	-1.543	1.023	0.998	
	31	-1.798	0.867	0.789	
	32	-2.109	0.684	0.626	
	33	-1.138	1.308	1.298	
	34	-1.709	0.969	0.924	
	35	-1.653	0.862	0.817	
D6	36	-2.790	0.795	0.699	0.871
	37	-2.660	0.617	0.572	
	38	-1.870	0.791	0.780	
	39	-2.990	0.874	0.847	
	40	-2.770	0.783	0.671	
	41	-1.080	1.512	1.597	
	42	-1.670	1.094	1.015	
D7	43	-2.260	1.158	1.033	0.819
	44	-2.150	0.994	0.987	
	45	-2.700	1.220	1.141	
	46	-2.710	0.961	0.781	
	47	-2.960	1.042	0.853	
	48	-2.500	0.828	0.714	
	49	-3.580	1.122	0.883	
	50	-2.760	0.946	0.848	

D1: Management Safety Priority, Commitment and Competence; D2: Management Safety Empowerment; D3: Management Safety Justice; D4: Workers' Safety Commitment; D5: Workers' Safety Priority and Risk Non-Acceptance; D6: Safety Communication, Learning, and Trust in Co-Worker Safety Competence; D7: Workers' Trust in the Efficacy of Safety Systems.

narrow confidence intervals around these means suggest consistent responses. Median values were approximately 3 for nearly all items, indicating that participants typically selected "agree" in response. Additionally, the full range of minimum and maximum scores (1–4) across all items suggests appropriate use of the scale's response options and adequate item variance. Particularly, some items within D1, D2, and D7 dimensions showed mean scores above 3.4, suggesting stronger positive attitudes, whereas item 29 in the D5 dimension recorded the lowest mean score (2.59). Overall, both mean (95% CI) and median (min-max) distributions demonstrate content balance and broad response utilization across items.

Reliability and validity of the NOSACQ-TR scale

Reliability analyses revealed a Cronbach's alpha of 0.97 for the entire scale and 0.851–0.933 for its subscales, exceeding the 0.70 threshold for acceptable internal consistency.²⁰ Similar findings have been reported in the original NOSACQ-50 development study¹⁰ and in adaptations to other languages.^{7,12,13,21} In the present study, subscale internal consistencies were consistent with those reported in the original instrument, both in dimensional structure and reliability.

Item-total correlations ranged from 0.456 to 0.822, exceeding the recommended 0.30 threshold,²² and no item deletion resulted in a notable increase in alpha values, supporting the retention of all items. Factor loadings were satisfactory, and error variances fell within acceptable limits, confirming the structural integrity of the scale and its subdimensions.²³ Comparably, in Kines et al.'s study, factor loadings ranged from 0.58 to 0.77, with factor correlations within the same interval.¹⁰ Other international adaptations reported varying item numbers and factor structures.¹³ On the other hand, in the study conducted by Yousefi et al., unlike the present study, the scale was found to consist of six dimensions,⁷ while in the study by Choosong et al. conducted in Thailand, it was observed to have five dimensions.¹² These differences may be attributed to the varying sociocultural characteristics of the study populations.

Confirmatory Factor Analysis (CFA) results further supported structural validity. Most χ^2 / df ratios were below 3 (1.01–3.27), indicating good model fit (Kline, 2016), with particularly strong fit for D1 ($\chi^2 / df = 1.43$), D5 ($\chi^2 / df = 1.01$), and D6 ($\chi^2 / df = 0.78$). The fit indices for the full model, CFI = 0.966, GFI = 0.986, RMSEA = 0.062, and SRMR = 0.104, fell within the recommended thresholds.^{24,25} These findings are consistent with those reported by Kines et al. (2011) and are comparable to the Iranian

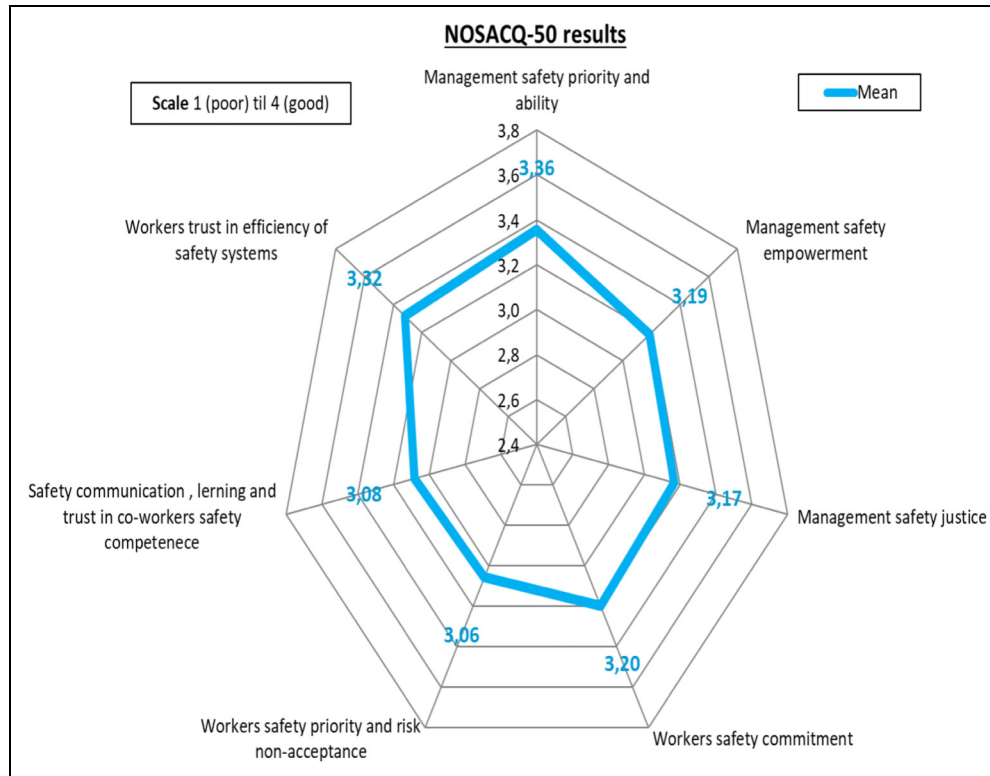


Figure 2. Radar chart of mean scores for NOSACQ-50 scale dimensions.

adaptation by Yousefi et al. (2016) as well as the study conducted by Abegaz et al. in Ethiopia.^{7,10,26}

Rasch analysis indicated adequate person reliability across all subdimensions (0.797–0.871).²⁷ Most item infit and outfit values were within the acceptable range of 0.5–1.5,^{28,29} with minor deviations observed for items 18 and 41, warranting careful content evaluation. DIF findings in Kines et al.'s study may reflect the more heterogeneous population used in their research compared to the relatively homogeneous sample in this study.

Convergent and discriminant validity analyses revealed strong positive correlations between NOSACQ-50 subdimensions and those of the Safety Climate Scale, and negative correlations with the negative-work-perception dimensions of the KOPSOR-TR scale, supporting construct validity.³⁰ Known-groups validity analyses indicated significant differences in subdimension scores based on gender, age, work type, near-miss experience, and occupational accident history, confirming the scale's discriminatory power.³¹

The mean NOSACQ-50 score in this study was 3.19, suggesting a generally favourable safety climate with minor areas for improvement. Comparative studies indicate that safety climate scores are somewhat lower in Iran (mean = 2.89)⁷ and Ethiopia (mean = 2.70),²⁶ moderately positive in Sweden (> 2.5),³² and similar to the present study in Thailand (>3.02).¹² These differences may reflect

organizational structures, safety services, and sector-specific factors. Higher reliability in leadership-related dimensions may reflect the hierarchical structures commonly observed in Turkish workplaces, highlighting the central role of leadership and management commitment in shaping occupational safety climate. Future research should examine the mediating role of leadership between organizational policies and employee safety behaviors, and apply the scale across diverse sectors, including healthcare, construction, and service industries. Longitudinal studies could also assess whether improvements in safety climate scores relate to reductions in accidents and injuries. This study provides an original contribution to the literature as one of the first comprehensive adaptations of a safety climate scale in Turkey. Unlike previous international studies, the NOSACQ-TR has been specifically evaluated for cultural and sectoral suitability within Turkish workplaces, with particular attention to leadership and management dimensions. In this regard, the scale not only demonstrates reliability and validity but also offers a practical and comprehensive tool for assessing occupational safety climate in high-risk work environments in Turkey.

This study has several limitations. First, it was conducted solely in the metal industry, limiting the generalizability of the findings and its applicability to other countries may be limited. Future research in different sectors (e.g., healthcare, construction, services) and varying cultural or regional

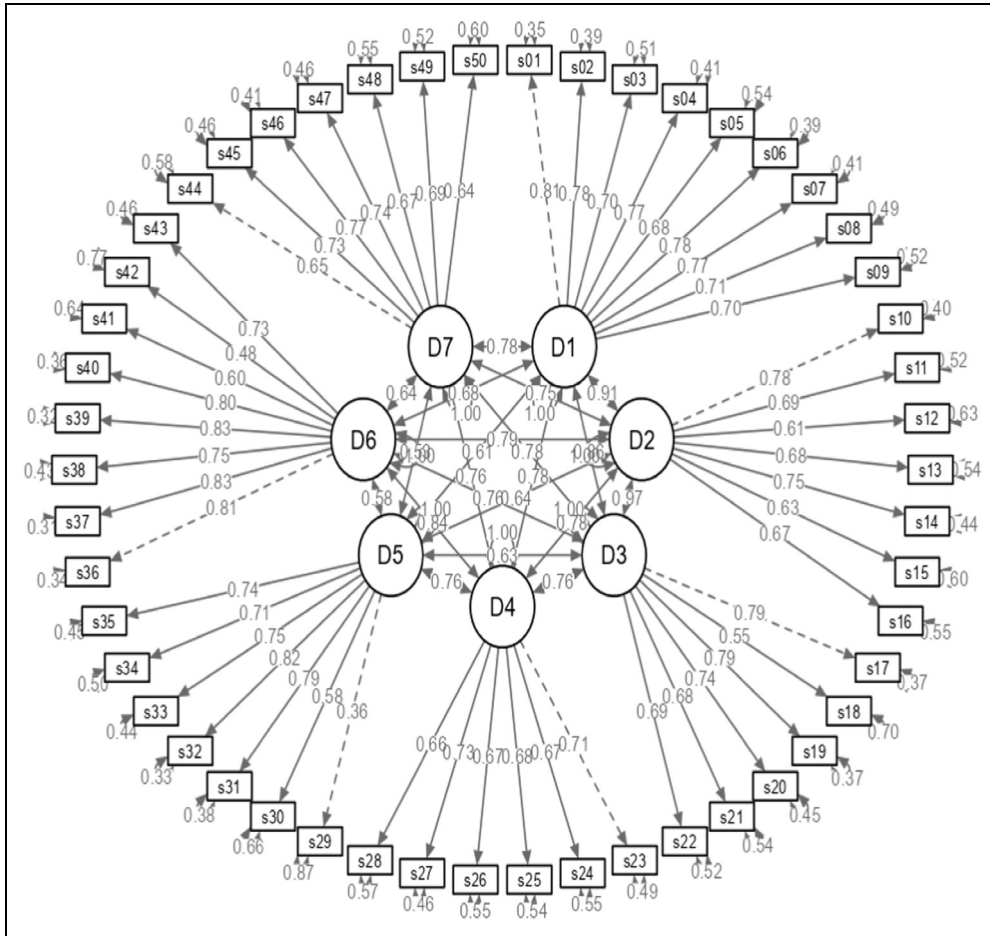


Figure 3. Results of the confirmatory factor analysis (CFA).

Table 4. Inter-scale correlation analysis for convergent and discriminant validity# (n = 387).

Scales	D1	D2	D3	D4	D5	D6	D7
<i>KOPSOR-TR</i>							
Meaninglessness of Work	0.34	0.34	0.30	0.35	0.31	0.38	0.26
Lack of Peer Social Support	-0.26	-0.31	-0.28	-0.34	-0.29	-0.41	-0.17
Lack of Supervisor Social Support	-0.31	-0.35	-0.35	-0.31	-0.26	-0.40	-0.17
Lack of Sense of Community	-0.28	-0.31	-0.34	-0.31	-0.30	-0.43	-0.25
Lack of Trust	-0.44	-0.46	-0.47	-0.43	-0.34	-0.42	-0.34
Lack of Job Satisfaction	-0.31	-0.33	-0.33	-0.29	-0.25	-0.30	-0.18
Burnout	-0.29	-0.19	-0.22	-0.23	-0.23	-0.21	-0.18
<i>Safety Climate Scale</i>							
Awareness and Competence	0.64	0.62	0.59	0.64	0.47	0.66	0.64
Communication	0.57	0.62	0.58	0.60	0.43	0.70	0.54
Organizational Environment	0.55	0.51	0.54	0.48	0.58	0.50	0.40
Management Support	0.48	0.51	0.56	0.46	0.31	0.50	0.49
Risk Assessment	0.30	0.29	0.33	0.24	0.29	0.23	0.21
Safety Measures	0.60	0.59	0.63	0.52	0.43	0.60	0.57
Safety Training	0.57	0.60	0.60	0.57	0.37	0.56	0.65

There is a statistically significant association across all dimensions at the $p < 0.001$ level.

D1: Management Safety Priority, Commitment and Competence; D2: Management Safety Empowerment; D3: Management Safety Justice; D4: Workers' Safety Commitment; D5: Workers' Safety Priority and Risk Non-Acceptance; D6: Safety Communication, Learning, and Trust in Co-Worker Safety Competence; D7: Workers' Trust in the Efficacy of Safety Systems.

Table 5. Known-groups validity: Comparison of NOSACQ-50 safety climate scale dimensions across selected characteristics (n = 387).

Variables	D1	D2	D3	D4	D5	D6	D7
Gender (Male / Female)	0.01	0.07	0.06	0.13	0.09	0.37***	0.23*
Age (18–39 / 40–65)	0.16**	0.15*	0.1	0.05	0.02	0.05	0.13*
Education Level (High school or below / University)	0.06	0.06	0.01	0.03	0.03	0.11	0.05
Work Schedule (Shift work / Regular daytime work)	0.17**	0.21***	0.21***	0.17**	0.11	0.17**	0.06
Near-Miss Incident (No / Yes)	0.21***	0.11	0.16*	0.16**	0.25***	0.21***	0.06
Work Accident (No / Yes)	0.14*	0.13*	0.13*	0.09	0.21***	0.14*	0.01
Job Status (Blue-collar / White-collar)	0.05	0.04	0.12	0.02	0.13	0.00	0.01

Effect size (rank-biserial correlation coefficient) interpretation: $0.1 \leq r_{rb} < 0.30$ indicates a small effect, $0.30 \leq r_{rb} < 0.50$ indicates a medium effect, and $r_{rb} \geq 0.50$ indicates a large effect.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

D1: Management Safety Priority, Commitment and Competence; D2: Management Safety Empowerment; D3: Management Safety Justice; D4: Workers' Safety Commitment; D5: Workers' Safety Priority and Risk Non-Acceptance; D6: Safety Communication, Learning, and Trust in Co-Worker Safety Competence; D7: Workers' Trust in the Efficacy of Safety Systems.

contexts is warranted to comprehensively evaluate the scale's reliability and validity. Additionally, multi-group CFA (e.g., across age, gender, tenure subgroups) could be employed to examine structural validity across diverse demographic profiles. Finally, assessing the relationships between safety climate, occupational accidents, safety behaviors, and employee health outcomes would further clarify the practical utility of the scale. Nevertheless, this study provides an original contribution to the literature as one of the first comprehensive adaptations of a safety climate scale in Turkey.

Conclusions

The Turkish version of the 50-item NOSACQ-50 demonstrated high reliability and validity. The scale effectively measures occupational safety climate among both blue- and white-collar workers. These findings support the use of the NOSACQ-50 Turkish form in occupational safety climate research in Turkey. The scale is recommended for evaluating workplace safety climate and assessing psychometric properties across different worker groups. Overall, the results indicate a favourable safety climate, with only minor improvements needed.

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Ethical considerations

The authors declare that this study was conducted according to the principals of the Declaration of Helsinki. Ethical approval was obtained from Non-Interventional Research Ethics Committee of Balıkesir University, Health Sciences (Date: 04.06.2024, No: 2024/84). Written informed consent was obtained from all participants.

Informed consent

All participants provided informed consent.

Contributions

Conceptualization, CC and HB; methodology, CC and HB; software, CC and HB; validation, CC, HV, BE, HB; formal analysis, CC and HB; investigation, CC, HV, BE; resources, CC, HV, BE, HB; data curation, CC, HV, BE; writing original draft preparation, CC, HV, BE, HB; and writing review and editing, CC, HV, BE, HB. All authors have read and approved the final manuscript.

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Availability of data and material

Materials described in the manuscript, including all relevant raw data, will be freely available to any researcher wishing to use them for non-commercial purposes, without breaching participant confidentiality.

Supplemental material

Supplemental material for this article is available online.

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