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Evaluating the Turkish validity and reliability of the Mini Z 2.0 Clinician Worklife Survey among physicians

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ABSTRACT

Aims: Physicians face stress, job dissatisfaction, and burnout in their careers. There are many scales that assess burnout. Among them, Maslach Burnout Inventory is a standard tool used to assess burnout. The Mini Z 2.0 Clinician Worklife Survey was developed as a new, easy-to-use tool for identifying the factors which cause burnout, job dissatisfaction, and stress. Maslach Burnout Inventory can be utilized in the general population whereas the Mini Z 2.0 survey assesses the worklife of physicians. In Turkiye, there are no scales which can assess all those factors in the worklife practically and collectively among physicians. This study therefore aimed to evaluate the Turkish validity and reliability of the Mini Z 2.0 Clinician Worklife Survey and contribute to the literature.

Methods: The study was conducted with 221 physicians. The construct validity was determined using confirmatory factor analysis. Test-retest reliability and internal consistency were assessed using Spearman's correlation coefficient and Cronbach's alpha, respectively. The concurrent validity was determined by testing correlations between Mini Z 2.0 and Maslach Burnout Inventory subscales were met using Spearman's correlation coefficient.

Results: The confirmatory factor analysis showed that the scale has two factors. The Spearman's correlation coefficient results varied between 0.753 and 0.858. Cronbach's alpha values of the scale and subscales were found to be between 0.881 and 0.942 in the internal consistency analysis. Floor/ceiling effects were considered not to be present.

Conclusion: It was found that the Turkish version of the Mini Z 2.0 Clinician Worklife Survey is valid and reliable.

Keywords: Burnout, job dissatisfaction, stress, Mini Z 2.0

INTRODUCTION

Today, several research studies address the challenges of worklife. Work overload, long working hours, problems with fellow employees and administrators, and conditions of the workplace cause stress among employees.[1,2] When individuals come up against work demands that are not compatible with their knowledge and abilities and challenge their coping skills, their reactions lead to job stress.[3] Such circumstances reduce job satisfaction, therefore increasing the likelihood of physical and psychological problems, and burnout among employees.[4,5]

Physicians represent one of the occupational groups that frequently face stress, job dissatisfaction, and burnout in their careers.[5] Multitude of their responsibilities, work overload, long and irregular working hours, financial problems, lack of time they make for themselves and their families, conflicts with administrators, fellow employees, and patients, medical errors and litigations, and challenges with the electronic health records lead to stress among physicians.[6] Job dissatisfaction and burnout impact physicians' approach toward their patients. The burnout syndrome causes longer recovery durations for patients, increased number of medical errors, and decreased patient satisfaction.[7] It may increase the risk of making medical errors and reduce job satisfaction, consequently causing physicians to quit their jobs. The syndrome may also hinder safe, accessible, and low-cost healthcare services and decrease the quality of healthcare.[8] Impacts of this situation on patients have alarming repercussions on patients and the society, and it is addressed as a public health concern.[9]

There are many scales that assess burnout. Among them, Maslach Burnout Inventory (MBI) is a standard tool used to assess burnout.[10] The Mini Z 2.0 Clinician Worklife Survey was developed as a new, easy-to-use tool for identifying the factors which cause burnout, job dissatisfaction, and stress among physicians.[11] MBI can be utilized in the general population whereas the Mini Z 2.0 survey assesses the worklife of physicians.

With the Mini Z 2.0 Clinician Worklife Survey, factors leading to stress among physicians in their work lives, their levels of job satisfaction and burnout can be evaluated rapidly and with fewer questions. It is stated that the results of the Mini Z 2.0 Clinician Worklife Survey can be utilized to guide

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interventions that aim to ensure physician wellbeing and improve performance of the healthcare system.[9,12]

In Turkiye, there are no scales which can assess all those factors in the worklife practically and collectively among physicians. This study therefore aimed to evaluate the Turkish validity and reliability of the Mini Z 2.0 Clinician Worklife Survey and contribute to the literature.

METHODS

Translation and Cultural Adaptation

For the validity and reliability study of the Mini Z 2.0 Clinician Worklife Survey, Dr. M. Linzer who developed the survey and C. Ergin who conducted the Turkish validity and reliability study of the MBI, which is the other scale utilized in the study, were contacted via e-mail. Required permissions were received for using the scales in the present study. The study was carried out with the permission of the Ankara University Human Researches Ethics Committee (Date: 13.04.2022, Decision No: İ04-191-22). This investigation was carried out in compliance with the principles outlined in the Declaration of Helsinki. Each participant accepted informed consent for the use of their data in the research.

The Turkish adaptation of the Mini Z 2.0 Clinician Worklife Survey was performed by three linguists and two subject matter experts to ensure linguistic validity. Two forward translators worked independently (double-blind) and translated the original Mini Z 2.0 Clinician Worklife Survey into Turkish. The Turkish version was back translated into English by two independent translators and compared to the original scale. These two independent translators are the independent individuals unfamiliar with the original scale. The Mini Z 2.0 Clinician Worklife Survey was finalized based on the feedback of a Turkish linguist who reviewed the English and Turkish meanings of the scale items.

After the translation process, the scale was first applied to a group of 40 people and the answers to the questions were analyzed to check the comprehensibility and applicability of the questions in the scale. Since the answers were logical and evenly distributed, it was concluded that the scale was applicable to the target group.

Work Items

Mini Z 2.0 Clinician Worklife Survey: The Mini Z 2.0 Clinician Worklife Survey was developed by Mark Linzer, MD, and his team at Hennepin Healthcare. The Mini Z Survey was derived from the "Z" Clinician Survey (for Zero Burnout Program). The survey was adapted from prior work performed for the Physician Worklife Survey and the minimizing error and maximizing outcomes (MEMO) study.[13,14] It consists of 10 items rated using a 5-point Likert scale. The Mini Z 2.0 Survey has two subscales. Subscale-1 is used to assess "supportive work environment" (satisfaction, burnout, value alignment with leaders, and teamwork) whereas subscale-2 is used to assess "work pace and electronic medical record (EMR) stress" (stress, documentation time pressure, home EMR use and EMR proficiency). Questions 1-5 are rated within subscale-1. Higher scores from this subscale refer to a more supportive work environment. Questions 6-10 are rated within subscale-2, and higher scores from this subscale represent reasonable work pace and manageable EMR stress. Higher total scores obtained from the entire survey indicate the presence of better working conditions.

Maslach Burnout Inventory: Maslach Burnout Inventory which was developed by Maslach and Jackson[15] and of which Turkish validity and reliability study was conducted by Ergin[16] was utilized as the reference scale in the present study. The original form rated using a 7-point Likert Scale was rated again by Ergin using a 5-point Likert Scale. This scale consists of 22 items and three subscales in total. Among those subscales, emotional exhaustion (EE) is composed of nine items, depersonalization (DP) is composed of five items, and personal accomplishment (PA) is composed of eight items. EE and DP subscales are negative, and PA subscale is positive in the inventory used in the present study. Higher levels of burnout are indicated by higher scores from the emotional exhaustion and depersonalization subscales, and lower scores from the personal accomplishment subscale. Lower scores from the emotional exhaustion and depersonalization subscales and higher scores from the personal accomplishment subscale refer to lower levels of burnout.

Data Collection

The first question of the survey is about approval concerning that the participants took part in the study voluntarily. The survey form is comprised of questions about sociodemographic information, occupational data, and items of the Mini Z Clinician Worklife Survey-Turkish Form and the Maslach Burnout Inventory. The third question of the Mini Z Clinical Worklife Survey was added as a control question to prevent participants from responding randomly. The survey form was sent to the physicians working at the departments of Basic Medical Sciences, Internal Medical Sciences, and Surgical Medical Sciences via e-mail. The form was completed online by a total of 233 physicians; 12 physicians who did not provide the desirable response to the control question were excluded from the study, and the study was conducted with 221 physicians. The survey forms were sent to the same physicians again one month later. 189 of 221 physicians completed the survey again.

Statistical Analysis

The data were analyzed on SPSS 11.5 and AMOS 24.0 software. As descriptive statistics, mean±standard deviation and median (minimum-maximum) were utilized for quantitative variables, and number of persons (percentage) were used for qualitative variables. For quantitative variables, Mann-Whitney U test was performed to see whether there was a statistically significant difference between categories of the qualitative variable with two categories. For qualitative variables, Kruskal Wallis H test was used to find out whether there was a statistically significant difference between categories of the qualitative variable with more than two categories since the assumptions of normality could not be met. Confirmatory factor analysis, linear regression, and Spearman's rank correlation coefficient were used for construct validity, predictive validity, and concurrent validity,

respectively. Spearman's rank correlation coefficient was also utilized for the reliability of the test-retest. Cronbach's Alpha was also calculated for the reliability. Mann-Whitney U test was performed for Item Discrimination Index. Statistical significance level was accepted to be 0.05.

RESULTS

Validity

Content validity: Content validity in the study was evaluated by 15 experts categorizing 10 questions with a triple rating system as being "essential," "useful, but not essential," or "not necessary". The table value of the smallest content validity ratio (CVR) for 15 experts is 0.49. CVR is calculated with the equation CVR=[E/(N/2)]-1; where E: number of experts indicating "essential", and N: total number of experts. Based on the CVR values in Table 1, it was concluded that all items should be retained in the item pool since CVR values of all items are greater than 0.49.

Table 1. CVR and CVI values of items

Items	Essential	Useful, but not essential	Not necessary	CVR	CVI
I1	14	1	0	0.867	0.813
I2	13	2	0	0.733	
I3	13	2	0	0.733	
I4	15	0	0	1.000	
I5	13	2	0	0.733	
I6	13	1	1	0.733	
I7	14	1	0	0.867	
I8	14	1	0	0.867	
I9	13	2	0	0.733	
I10	14	1	0	0.867	

CVR: Content validity ratio, CVI: Content Validity Index

Content Validity Index (CVI) for the scale equals to the mean CVR across items retained in the item pool. In the present study, it was found CVR=(0.867+0.733+0.733+…+0.867)/10=0.813. As CVI=0.813>0.67 (cut-off value), the scale was concluded to be statistically significant.

Logical validity: Since the scale measured the most important components accurately and properly and provided the desired information most accurately, its logical validity was established.

Validity as against a reference: How well the scale used in a study assesses the attribute in question compared to the gold standard is tested in the presence of a scale known and used as the gold standard in the literature. To that end, the two most common validity tests conducted with a reference are:

- Concurrent validity, and
- Predictive validity.

Concurrent validity: The Mini Z 2.0 Clinician Worklife Survey used in the present study has two subscales which are "Supportive Work Environment" and "Work Pace and EMR Stress". Maslach Burnout Inventory used as the gold standard has 3 subscales which are "Emotional Exhaustion", "Personal Accomplishment", and "Depersonalization". Results concerning the correlation between the scales used in the study were shown in Table 2.

Table 2. Correlation between scales

Scales		Emotional exhaustion	Personal accomplishment	Depersonalization
Supportive work environment	Correlation coefficient	-0.823	0.789	-0.770
	p-value	<0.001	<0.001	<0.001
Work pace and EMR stress	Correlation coefficient	-0.804	0.753	-0.769
	p-value	<0.001	<0.001	<0.001
Mini Z total score	Correlation coefficient	-0.858	0.816	-0.815
	p-value	<0.001	<0.001	<0.001

EMR: Electronic medical record

Coefficients of the correlation between the supportive work environment subscale and the emotional exhaustion, personal accomplishment, and depersonalization subscales were found to be -0.823, 0.789, and -0.770, respectively. Coefficients of the correlation between the Work Pace and EMR Stress subscale and the Emotional Exhaustion, Personal Accomplishment, and Depersonalization subscales were found to be -0.804, 0.753, and -0.769, respectively. Coefficients of the correlation between the Mini Z total score and the Emotional Exhaustion, Personal Accomplishment, and Depersonalization subscales were found to be -0.858, 0.816, and -0.815, respectively. These results suggest that concurrent validity for the Mini Z 2.0 Clinician Worklife Survey and its subscales is adequate.

Predictive validity: For the present study, the emotional exhaustion, personal accomplishment, and depersonalization subscales were considered dependent variables, and the Supportive Work Environment and work pace and EMR stress subscales, and the Mini Z total score were considered independent variables. Univariate linear regression results are given in Table 3. As can be seen, the results were significant for all variables. The results mean that Mini Z and its subscales can be used instead of the gold standard.

Testing of factorability: Kaiser-Meyer-Olkin (KMO) test was used to establish whether the sample examined in the factor analysis was fit for the analysis. A KMO measure of over 0.80 is expected for a good factor analysis.[17] The KMO value of 0.936 was found in the present study, and the sample was concluded to be adequate for the factor analysis. In addition, Bartlett's test of sphericity was performed to see whether the correlation matrix was fit for the factor analysis, and the result was found to be significant (p<0.001).

Construct validity: A confirmatory factor analysis was used in the present study since the Turkish validity and reliability study was performed for a scale for which validity and reliability was established in its original language. Factor loadings of the items in the scale were shown in Table 4 by subscales. As can be seen in the table, factor loadings of all items were found to be over 0.7, and construct validity was

Table 3. Univariate linear regression results

Independent variables	Dependent variables	β	SE	p-value	R^2	95% CI for β	
						Lower	Upper
Supportive work environment	Emotional exhaustion	-1.383	0.064	<0.001	0.679	-1.509	-1.256
	Personal accomplishment	1.186	0.059	<0.001	0.652	1.070	1.301
	Depersonalization	-0.823	0.042	<0.001	0.633	-0.907	-0.740
Work pace and EMR stress	Emotional exhaustion	-1.411	0.074	<0.001	0.623	-1.557	-1.265
	Personal accomplishment	1.180	0.069	<0.001	0.569	1.043	1.316
	Depersonalization	-0.855	0.047	<0.001	0.602	-0.947	-0.762
Mini Z total score	Emotional exhaustion	-0.768	0.033	<0.001	0.717	-0.833	-0.704
	Personal accomplishment	0.651	0.031	<0.001	0.672	0.591	0.712
	Depersonalization	-0.461	0.021	<0.001	0.680	-0.504	-0.419

SE: Standard error, CI: Confidence interval, EMR: Electronic medical record

established for the subscales of the scale. A Chi-square/degree of freedom (X^2/df) value below 3 is considered adequate; this value was found to be 2.555 in the present study. The acceptable value for GFI, CFI, and TLI is 0.9; the values found in the present study were 0.934 for GFI, 0.971 for CFI, and 0.959 for TLI. The acceptable value for RMSEA is 0.08; this value was found to be 0.08 in the present study. In summary, construct validity was established in terms of the criteria used for validity.[18] The path diagram for construct validity is given in Figure.

Table 4. Item factor loadings by subscales

Items	Supportive work environment	Work pace and EMR stress
1	0.885	
2	0.837	
3	0.877	
4	0.812	
5	0.820	
6		0.812
7		0.853
8		0.653
9		0.716
10		0.724

EMR: Electronic medical record

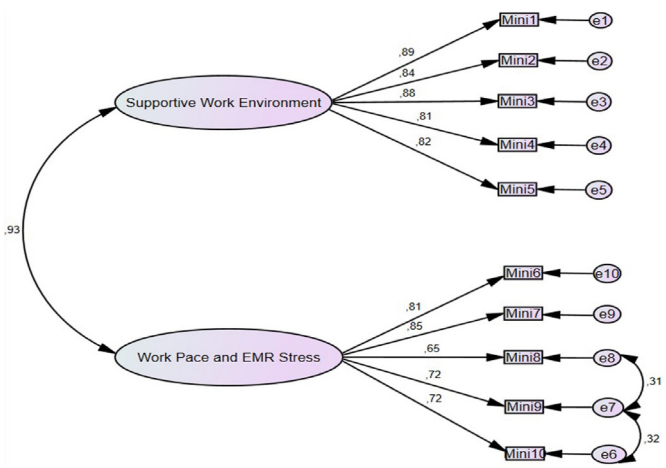

Figure. A confirmatory factor model for Mini Z with factor loadings

Reliability

Test-retest method: Spearman's rank correlation coefficients were found to be 0.988 for the Supportive Work Environment subscale, 0.987 for the Work Pace and EMR Stress subscale, and 0.991 for the Mini Z total score. The scale and its subscales were concluded to be reliable based on these results.

Cronbach's alpha: Cronbach's Alphas were calculated to be 0.926 for the Supportive Work Environment subscale, 0.881 for the Work Pace and EMR Stress subscale, and 0.942 for the Mini Z total score. Therefore, the scale and its subscales were concluded to have high reliability.

Comparison of top-bottom 27% groups (Item Discrimination Index): For the Supportive Work Environment, Work Pace and EMR Stress subscales, and the Mini Z total score, a significant difference was found between the top and bottom 27% groups ($p<0.001$, $p<0.001$, and $p<0.001$, respectively). The scale was therefore concluded to have an adequate item distinction index.

Examination of ceiling/floor effect in the scale: In the study, there were 11 (5.0%) participants who scored 5 and 1 (0.5%) participant who scored 25. The lowest and highest possible scores from the Work Pace and EMR subscale were 5 and 25, respectively. 7 (3.2%) participants scored 5, and 1 (0.5%) participant scored 25 in the study. The lowest and highest possible scores from the entire scale were 10 and 50, respectively. Whereas 6 (2.7%) participants scored 10, none of the participants scored 50 in the study. These results suggest that there is no ceiling/floor effect on the scale and its subscales.

Descriptive Statistics

The scale and its subscales were provided in Table 5 for the physicians who participated in the study. No significant difference was found in terms of scale scores for gender and years of practice. There was a significant difference in at least one scale score for all other variables.

DISCUSSION

The Mini Z 2.0 is a simple, newly developed scale recognized as a powerful tool to assess physician burnout and the

Table 5. Comparisons of descriptive variables for subscale scores and total score

		Scores								
		Supportive work environment			Work pace and EMR stress			Mini Z total score		
Variables		Mean±SD	Median (min-max)	p-value	Mean±SD	Median (min-max)	p-value	Mean±SD	Median (min-max)	p-value
Gender	Female	12.43±4.67	12.00 (5.00-22.00)	0.755[a]	13.30±4.29	13.00 (5.00-25.00)	0.083[a]	25.72±8.38	25.00 (10.00-47.00)	0.232[a]
	Male	12.40±5.19	11.00 (5.00-25.00)		12.38±4.90	12.00 (5.00-24.00)		24.78±9.77	24.00 (10.00-48.00)	
Years of practice	<5 years	11.28±3.98	10.00 (5.00-21.00)	0.137[a]	12.35±3.68	13.00 (6.00-22.00)	0.666[a]	23.63±7.02	23.00 (14.00-43.00)	0.312[a]
	≥5 years	12.69±5.11	12.00 (5.00-25.00)		12.93±4.84	13.00 (5.00-25.00)		25.61±9.54	25.00 (10.00-48.00)	
Department	Basic medical sciences	14.27±5.61	14.00 (5.00-25.00)	<0.001[b]	14.98±5.01	15.00 (5.00-25.00)	<0.001[b]	29.26±10.15	28.00 (10.00-48.00)	<0.001[b]
	Internal medical sciences	12.40±4.62	12.00 (5.00-23.00)		12.55±4.24	13.00 (5.00-22.00)		24.95±8.26	25.00 (10.00-45.00)	
	Surgical medical sciences	10.31±3.69	10.00 (5.00-23.00)		10.79±3.78	10.00 (5.00-24.00)		21.10±7.27	20.00 (10.00-47.00)	
Exposure to violence	No	13.19±4.94	12.00 (5.00-25.00)	<0.001[a]	13.61±4.45	13.00 (5.00-24.00)	<0.001[a]	26.81±8.95	26.00 (10.00-48.00)	<0.001[a]
	Yes	10.36±4.32	9.00 (5.00-22.00)		10.72±4.50	10.00 (5.00-25.00)		21.08±8.30	19.00 (10.00-47.00)	
Making enough time for family	No	11.00±4.06	10.00 (5.00-23.00)	0.001[b]	11.18±3.77	10.00 (6.00-19.00)	<0.001[b]	22.18±7.28	20.00 (13.00-39.00)	<0.001[b]
	Yes	14.26±5.38	13.00 (5.00-25.00)		14.58±5.15	14.00 (5.00-25.00)		28.84±10.12	28.00 (10.00-48.00)	
	Sometimes	11.88±4.70	12.00 (5.00-22.00)		12.53±4.27	13.00 (5.00-23.00)		24.41±8.49	24.00 (10.00-45.00)	
Making time for oneself and one's hobbies	No	11.50±4.20	10.50 (5.00-23.00)	0.059[b]	11.67±3.84	11.50 (5.00-22.00)	0.003[b]	23.17±7.48	23.00 (10.00-43.00)	0.010[b]
	Yes	13.00±5.35	11.00 (5.00-25.00)		13.35±5.07	11.00 (5.00-25.00)		26.35±9.98	23.00 (10.00-48.00)	
	Sometimes	13.41±5.48	13.00 (5.00-23.00)		14.15±5.08	14.00 (5.00-24.00)		27.56±10.20	27.00 (10.00-47.00)	
Problem taking annual leaves	No	14.31±5.64	13.50 (5.00-25.00)	<0.001[b]	14.64±5.08	14.50 (5.00-24.00)	<0.001[b]	28.95±10.23	28.00 (10.00-48.00)	<0.001[b]
	Yes	10.79±4.05	10.00 (5.00-22.00)		11.26±4.01	10.00 (5.00-25.00)		22.04±7.62	20.00 (10.00-47.00)	
	Sometimes	12.51±4.23	12.00 (5.00-22.00)		12.90±3.95	13.00 (5.00-23.00)		25.41±7.66	25.00 (11.00-45.00)	

EMR: Electronic medical record, SD: Standard deviation, Min: Minimum, Max: Maximum, a: Mann-Whitney U test, b: Kruskal Wallis H test

workplace-related stress factors. Validity and reliability of Mini Z 2.0's Turkish version was evaluated in the study.

It is expected that Turkish version of the Mini Z 2.0 will play a key role in assessing physician wellbeing and burnout in Turkiye. Physician burnout is a common issue in Turkiye, and routine assessments are required to prevent it.[19] MBI is recognized as the gold standard in assessing physician burnout;[20,21] however, Turkish version of the Mini Z has several advantages over MBI. Firstly, MBI is a long questionnaire composed of 22 items; on the contrary, the Mini Z has 10 items and is quite easy to apply. Secondly, MBI can be used for a fee whereas the Mini Z is free to use. Lastly, MBI assesses burnout only; on the other hand, the Mini Z can also assess satisfaction and other consequences of stress factors at workplace. Assessment of stress factors would help guide the interventions aiming to improve physician welfare in the healthcare system.[19,21]

It was reported in the original study that construct validity was established with a two-factor structure via exploratory factor analysis (EFA).[22] In the study conducted by Nagasaki et al.,[12] it was reported that the two-factor structure had good fit. They found a CFI value of 0.839, a TLI value of 0.762, and a RMSEA value of 0.148. Although the model with the best fit was reported to be the two-factor model, they stated that construct validity could not be established with the two-factor structure. In the present study, a confirmatory factor analysis was performed based on the two-factor structure in the original study. A CFI value of 0.971, a TLI value of 0.959, and a RMSEA value of 0.08 were found. Moreover, the correlation between the subscales of MBI, which is the gold standard, and the Mini Z 2.0 Survey and its subscales were investigated for concurrent validity, and correlation coefficients were found to be ranging between 0.753-0.858. Based on the totality of findings, it was concluded that the validity of the scale was established.

In assessments, a scale is considered more reliable as its Cronbach's alpha is closer to 1. In the original study of the scale, Cronbach's alphas were found to be 0.74 for the supportive work environment subscale, 0.72 for the Work Pace and EMR Stress subscale, and 0.80 for the Mini Z total score.[22] In the study performed by Nagasaki et al.,[12] only the Cronbach's alpha of the entire scale was calculated and found to be 0.80. In the present study, Cronbach's alphas were calculated to be 0.926 for the Supportive Work Environment subscale, 0.881 for the Work Pace and EMR Stress subscale, and 0.942 for the Mini Z total score. One of the methods used in the reliability analysis is to identify whether a responder will provide the same responses when the scale is repeated. The correlation coefficient evaluated to that end is expected to be positive and high. Test-retest correlation coefficients in the present study were found to be 0.988 for the supportive work environment subscale, 0.987 for the Work Pace and EMR Stress subscale, and 0.991 for the Mini Z total score. It was concluded from the results that the scale could be used reliably.

Limitations

The limitation of this study is that the scale was applied to the physicians as a scale. However, this limitation was eliminated by adding a control question in the Mini Z 2.0 survey to prevent responders from answering randomly. It was planned that the physicians who did not provide the desired answer to the control question "please mark the answer 'strongly agree' in this question" were excluded from the study. 12 physicians who did not provide the desired answer to the control question were excluded from the study.

CONCLUSION

The data obtained in the study suggest that Turkish version of the Mini Z 2.0 is a valid and reliable tool to assess physician burnout and the workplace-related stress factors. It is anticipated that the Mini Z 2.0 adapted to the Turkish language in this study can assess physician wellbeing and burnout to develop reformative policies.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Ankara University Human Researches Ethics Committee (Date: 13.04.2022, Decision No: İ04-191-22).

Informed Consent

Each participant accepted informed consent for the use of their data in the research.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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We would like to thank the physicians who voluntarily participated in our research.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line or all of the preparation and scientific review of the contents and approval of the final version of the article.

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