ESPECIAL ARTICLE

Factor structure, reliability and validity of the Work Environment Evaluation Instrument-7 (WEEI-7) and its association with burnout symptoms according to the Maslach Burnout Inventory (MBI)

Estrutura fatorial, confiabilidade e validade do Instrumento de Avaliação do Ambiente de Trabalho-7 (WEEI-7) e sua associação com sintomas de burnout segundo o Maslach Burnout Inventory (MBI)

Estructura factorial, confiabilidad y validez del Instrumento de Evaluación del Clima Laboral-7 (WEEI-7) y su asociación con síntomas de burnout según el inventario de Burnout de Maslach (MBI)

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Abstract

The aim of this study was to develop a brief version of the Work Environment Evaluation Instrument (WEEI) and to evaluate its association with burnout symptoms. **Method:** 2,537 Brazilian physicians and medical students answered the WEEI and the Maslach Burnout Inventory (MBI) as part of an online survey. Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), Item Response Theory (IRT) Analysis, and simple linear regressions were performed. **Results:** An unidimensional construct based on institution/supervisor items was proposed. The resulting model included seven items, revealing an excellent fit with the data (factor loadings: 0.583-0.869). McDonald's Omega was 0.89, showing a high internal consistency. The factor scores explained 10%-22% of the variance of the MBI dimensions (P<0.001). **Conclusion:** The WEEI-7 emerges as a valid and reliable brief scale to assess institutional aspects that can be addressed to ameliorate burnout.

Keywords: Workplace; Occupational medicine; Burnout professional

Resumo

O objetivo deste estudo foi desenvolver uma versão resumida do Instrumento de Avaliação do Ambiente de Trabalho (WEEI) e avaliar sua associação com sintomas de burnout. **Método:** 2.537 médicos e estudantes de medicina brasileiros responderam ao WEEI e ao Maslach Burnout Inventory (MBI) como parte de uma pesquisa online. Análise Fatorial Exploratória (EFA), Análise Fatorial Confirmatória (CFA), Análise de Teoria de Resposta ao Item (TRI) e regressões lineares simples foram realizadas. **Resultados:** Foi proposto um constructo unidimensional baseado nos itens sobre instituição e supervisor. O modelo resultante incluiu sete itens, revelando um excelente ajuste com os dados (cargas fatoriais: 0,583-0,869). McDonald's Omega foi de 0,89, mostrando uma alta consistência interna. Os escores dos fatores explicaram 10%-22% da variância das dimensões do MBI (P<0,001). **Conclusão:** O WEEI-7 surge como uma escala breve válida e confiável para avaliar aspectos institucionais que podem ser abordados para amenizar o burnout.

Palavras-chaves: Ambiente de instituições de saúde; Riscos ocupacionais; Esgotamento profissional

Resumen

El objetivo de este estudio fue desarrollar una versión abreviada del Work Environment Assessment Instrument (WEEI) y evaluar su asociación con los síntomas de burnout. **Método:** 2.537 médicos y estudantes de medicina brasileños completaron el WEEI y el Maslach Burnout Inventory (MBI) como parte de una encuesta en línea. Se realizaron Análisis Factorial Exploratorio (AFE), Análisis Factorial Confirmatorio (CFA), Análisis Teórico de Respuesta al Ítem (IRT) y regresiones lineales simples. **Resultados:** Se propuso un constructo unidimensional basado en los ítems sobre institución y supervisor. El modelo resultante incluía siete ítems, mostrando un excelente ajuste con los datos (cargas factoriales: 0,583-0,869). McDonald's Omega fue de 0,89, mostrando una alta consistencia interna. Las puntuaciones factoriales explicaron entre el 10 % y el 22 % de la varianza de las dimensiones del MBI (P<0,001). **Conclusión:** El WEEI-7 surge como una escala breve válida y confiable para evaluar aspectos institucionales que pueden ser abordados para paliar el burnout.

Palabras clave: Agotamiento profesional; Riesgos laborales; Condiciones de trabajo

Introduction

The wellbeing of health professionals has been a major concern that has been aggravated by the challenges of the COVID-19 pandemics[1,2]. Before the pandemics, rates of exhaustion and mental health concerns were affecting 30-60% of all doctors and physicians in training in North America[3]. In fact, rates of burnout, depression and suicide are on the rise[1-3], and many authors even see those syndromes in a continuum where the individual resources colapse in facing stressors that may be innerent to the field[4,5].

In the face of the COVID-19 pandemic, a meta-analysis conducted in 2021 with 271,319 healthcare workers showed that 33% of them, exposed to COVID-19, reported depressive symptoms (95% confidence

intervals [CI] = 28–38%), 42% anxiety features (95% CI = 35–48), 40% acute stress (95% CI = 32–47), 32% post-traumatic symptoms (95% CI = 26–37%), 42% insomnia (95% CI = 36– 48), 37% burnout (95% CI = 31–42)[1]. In the same way, another meta-analysis analyzed 26,824 medical students and found a prevalence of burnout of 37.23%, of emotional exhaustion of 38.08%, of depersonalization of 35.07%, and of personal accomplishment of 37.23%. Age (older) and sex (female) were both significant predictors of burnout[2].

In 2018, the World Health Organization (WHO) recognized Burnout as an occupational phenomenon and included it in the 11th Revision of the International Classification of Diseases (ICD-11). Burnout was characterized by three dimensions: feelings of energy depletion or exhaustion; increased mental distance from one's job, or feelings of negativism or cynicism related to one's job; and reduced professional efficacy[6].

It is well established that the work environment plays an important role in subjects' well-being and/or distress. However, the aspects of the institutional environment that are more related to psychological distress in the work setting are still not defined. A variety of factors, e.g., individual vulnerability, institutional pressures, and socioeconomic factors, are involved in the phenomena that lead individuals to become severely distressed in the context of the workplace[4,7,8]. The institutional environment may be of particular importance to those who are healthcare professionals.If in one hand, several authors have observed that health professionals as a group have been intensely affected by changes in the administrative structure of hospitals and the decline of physician autonomy in the health institutions[4,9,10], on the other hand aspects related to the work environment can be seen as an asset to face stress, particularly regarding interpersonal relations, assertive communication and collaborative problem solving within the institutions[11,12]. In fact, a meta-analysis revealed a significantly smaller effect of interventions aimed at the individual level compared to those geared to the institutional level[13,14].

The aim of this study was to provide a brief and self-applied instrument that could be used to easily assess aspects previously related to burnout[11,15] being potentially useful in evaluate institutional aspects, aiming at developing and testing effective interventions that could ameliorate the wellbeing of the health professionals and, therefore, the quality of the care they can delivery to the patients.

Methods

In this online cross-sectional study, 2,537 individuals were evaluated in October 2019, using a snowball method over fifteen days. We chose an electronic questionnaire in order to reach a greater number of respondents. Online questionnaires also have the potential advantage of enhancing reliability by augmenting the perception of anonymity[16,17]. The advertisement explicitly stated the survey's anonymity, and the subject only continued to the questionnaire if agreed with the online informed consent form. After completion, the questionnaire provided telephone and electronic contact information for suicide prevention and support centers located in Brazil. The study was approved by the ethics committee of the Hospital de Clínicas de Porto Alegre (Porto Alegre, Brazil) (protocol 70231617.6.0000.5327).

Sample

All 26 Brazilian States and the Federal District were represented in the sample, although some Brazilian regions were more heavily represented than others: 48% of participants were from the Southern region, 28.1% from the Southeast region, 5.6% from the Midwest region, 15.2% from the Northeast region and 2.4% from the Northern region. This difference probably reflects the advertising strategies, and to some extent the distribution of doctors in Brazil. The mean age was 39.92 (SD 12.64). Sociodemographic and work-related variables are described in Table 1.

Table 1. Description of the Sample

N=2537	No. (%)
Sex, female	1594 (62.8)
Ethnicity, White	2111 (83.2)
Careerphase	
Medical student	300 (11.8)
Resident	343 (13.5)
General Physician	282 (11.1)
Specialist	1568 (61.8)
Retired	44 (1.7)
Supervisor (universityor hospital)	797 (31.4)
Place(s) ofwork	
University	615 (24.2)
ResidenceProgram	616 (24.3)
Public hospital	1358 (53.5)
Private Hospital	1044 (41.2)
Primary or secondary health care	753 (29.7)
Private office	1204 (47.5)
Works atnight	1223 (48.2)
Works weekends	1588 (62.6)

Survey instruments

Besides sociodemographic and work-related information, the online questionnaire included the following instruments used in this study:

The Work Environment Evaluation Instrument (WEEI)[15]: The original version of the WEEI was developed based on several focus groups with experts, professors, medical students and residents. The aim was to elaborate on the items related to the work environment that could be related to emotional distress in training physicians' populations, triggering conditions such as burnout. At first, fourteen items were elaborated and tested in a pilot study[11]. The comprehension of the items and the face validity were evaluated and discussed, and small adjustments were made. The resultant version, called WEEI, has 11 items. It is a Likert scale of five points where 0 corresponds to "Totally false" and 4 corresponds to "Totally true". Five items evaluate the

relationship with preceptors/supervisors, three with colleagues/peers and three the relation to the institution itself. The instrument evaluates aspects such as feeling comfortable asking for help, feeling heard and helped versus feeling pressured by preceptors/supervisors, the feeling of belonging and the presence of a collaborative atmosphere in the institution, the perception of support by peers, among others. The WEEI presented high internal consistency and reliability: the Cronbach's Alpha coefficient (α) for the total score in the validation study was 0.898, and for each dimension it was 0.79 for "institutions", 0.78 for "colleagues", and 0.87 for "preceptors". Both total scores and dimensions correlated significantly with Burnout scores (p<0.01)[15]. For the current study the items were adapted to be suitable for all phases of medical career and tested in a national sample of physicians and medical students.

Maslach Burnout Inventory – Human Services Survey (MBI-HSS): The MBI-HSS measures burnout on three subscales: emotional exhaustion (EE), depersonalization (DP), and the sense of personal accomplishment (PA). It is a self-completion questionnaire answered by a Likert scale of seven points with "0" being "never" and "6" every-day. These three dimensions are related to each other but independent[18].

Statistical analysis

First, the sample was split in half for independent testing of Exploratory Factor Analysis and Confirmatory Factor Analysis.

Second, all items from the WEEI entered an Exploratory Factor Analysis (EFA). Parallel analysis compares the scree of factors of the observed data with that of a random data matrix of the same size as the original, providing the best number of factors in the sample using polychoric correlations to account for the categorical nature of the items. EFA was performed using the weighted least square factoring method for polychoric correlations.

Third, we used Confirmatory Factor Analysis (CFA) to test the best solutions in the second half of the sample. For fit indices, the following indices were estimated: comparative fit index (CIF), Tucker-Lewis index (TLI), and root mean square error of approximation with 90% confidence interval (RMSEA-90%CI). A CFI and TLI values about 0.90 or close to 0.95 represent a good fit. RMSEA values close to or below 0.05 represent a good fit, and those below 0.08 an acceptable fit. Moreover, the reliability of the best factor solutions was tested by means of the McDonald's Omega.

Fourth, considering a unidimensional model solution, an item response theory (IRT) analysis was conducted using the graded response model in the second half of the sample.[19] The latent trait that we called "institutional environment" was centered on 0 with a SD of 1. The importance of using also IRT to analyze the scale has several reasons. One of them is that we want to know if the instrument is evaluating well both sides of the latent trait. For instance, we need to know if it captures well both healthy and toxic institutional environments. That is important because, besides understanding what contributes to developing mental problems, it is also very important to know what promotes health and well-being within the work environment. Also, it is important to evaluate the performance of each item in separate and how they individually contribute

to the measurement of the latent trait. This is essential, not only, but also to evaluate if a simple sum of the items would be a sufficiently reliable measure of the latent trait, namely "institutional environment", to be used in further studies.

Finally, simple linear regression analysis was performed to investigate associations between WEEI' factor scores and internal validators (burnout scores) using again the second half of the sample.

Parallel analysis and Exploratory Factor Analysis were performed using the *fa.parallel()* and fa functions from the psych package[20]. Confirmatory Factor Analysis was performed using the *cfa*() function from the lavaan package[21]. Item response Theory Analysis was performed using the *grm()* function the ltm package[22] and *irt. fa()* function from the psych package[20]. Regression analysis were performed with the *lm()* function from base R. All analyses were performed in R[23].

Results

Parallel analysis and exploratory factor analysis

Parallel analysis revealed that 2 factors represents the best solution to explain variance in the WEEI items (Figure 1). The first factor explained 36% of the variance, whereas the second explained 15% of the variance. The first factor encompassed items involving the institution (Table 2; items 2, 4, 6) and supervisors (Table 2, items 1, 3, 7, 9). The second factor encompassed items involving peers (Table 2, items 5, 8, 10). The item 11 presented a factor loading which is markedly lower than the average of the factor loading from the other items of the first dimension (λ=0.23 vs. average λ=0.73). The correlation between the first and second factors was moderate 0.47.

Figure 1. Parallel Analysis Scree Plots for determining the number of factors in Exploratory Factor Analysis
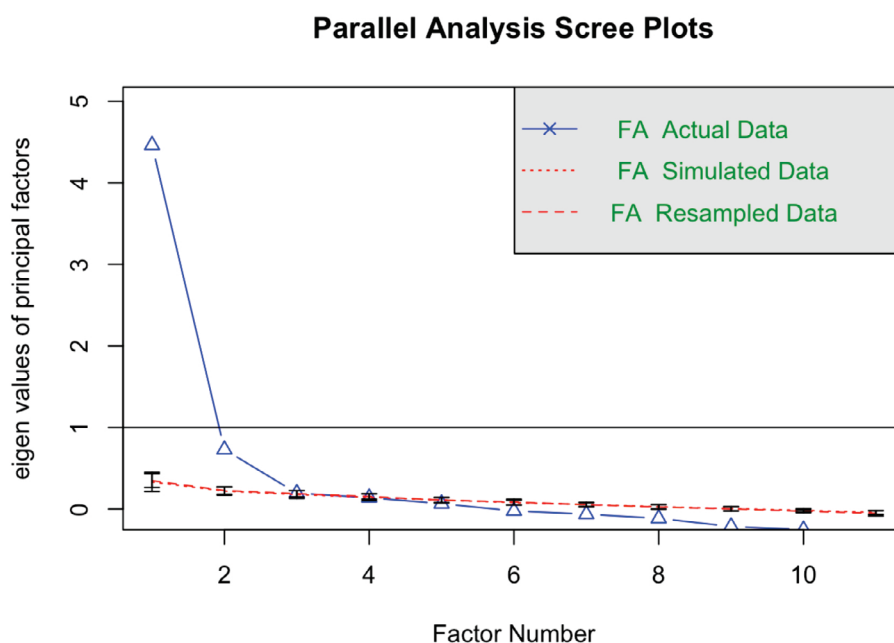
Because peers formed a second factor, separated from institution and superiors/supervisors' factors and presented with only 3 items, we decided to exclude the peer domain and performed the next analysis with a unidimensional construct based solely on institution/supervisor items.

Table 2. Exploratory Factor Analysis Results from the first half of the sample (n=1269)

Item code	Item content	Factor 1	Factor 2	Communalities	Uniquenesses
1	I feel more pressured than helped by my superiors / supervisors	**0,7**	-0,07	0,44	0,56
2	I feel like I belong to my institution.	**0,6**	0,05	0,39	0,61
3	I am not afraid to ask for help from my superiors / supervisors.	**0,67**	-0,08	0,41	0,59
4	I feel a collaborative climate in my institution.	**0,83**	0,01	0,7	0,3
5	I talk to my colleagues about problems at work / college, and this helps me deal with everyday problems.	0,22	**0,46**	0,35	0,65
6	I think the values of my institution are in accordance with my own values.	**0,72**	0,04	0,55	0,45
7	I feel helped by my superiors / supervisors.	**0,85**	0,02	0,74	0,26
8	I feel that colleagues are just colleagues and do not get involved with my problems.	-0,01	**0,83**	0,68	0,32
9	My superiors / supervisors understand and listen when I have complaints.	**0,75**	0,02	0,58	0,42
10	My colleagues are not my friends.	-0,02	**0,81**	0,64	0,36
11	I feel that I am always short of what the superiors / supervisors expect of me.	0,35	-0,01	0,12	0,88

Note: Factor loadings higher than 0.4 are marked in bold; the items were translated to English from the original Brazilian Portuguese Version

Confirmatory factor analysis and internal consistency

A unidimensional model including the remaining 7 items from the WEEI revealed an excellent fit to the data (RMSEA=0.053, CFI=0.997, TLI=0.996). All items loaded significantly on the unidimensional latent trait with factor loadings ranging from 0.583 to 0.869. McDonald's Omega was 0.89, showing a high internal consistency. (Table 3)

Table 3. Confirmatory Factor Analysis and Item Response Theory Parameters

	CFA							IRT				
	Factor Loadings			Thresholds				Disc	Difficulties			
Items	Estimate	SE	p-value	1	2	3	4	a	b1	b2	b3	b4
WEEI2	0,583	0,021	<0,001	-1,398	-0,933	-0,421	0,684	1,471	-2,077	-1,265	-0,574	1,045
WEEI4	0,816	0,012	<0,001	-1,152	-0,528	-0,131	1,006	2,878	-1,305	-0,587	-0,169	1,164
WEEI6	0,767	0,014	<0,001	-1,05	-0,456	0,049	1,114	1,983	-1,386	-0,578	0,068	1,549
WEEI1	0,659	0,019	<0,001	-0,759	0,123	0,57	0,954	1,515	-1,074	0,127	0,801	1,479

WEEI3	0,631	0,02	<0.001	-1,318	-0,727	-0,38	0,376	1,402	-2,137	-1,16	-0,654	0,57
WEEI7	0,869	0,01	<0.001	-1,152	-0,558	-0,093	1,05	3,051	-1,293	-0,626	-0,087	1,198
WEEI9	0,766	0,014	<0.001	-1,039	-0,501	-0,013	1,171	2,103	-1,376	-0,55	0,052	1,584

Note: CFA – Confirmatory Factor Analysis; IRT – Item Response Theory; WEEI – Work Environment Evaluation Instrument.

Item response theory

Graded Response Model revealed high discrimination for all items (all above 1.4) and difficulties ranging from -2.1 for the lower threshold to 1.5 for the higher threshold. Test information function (Figure 2, Panel A) reveals the test captures reliable information from -2 (alpha 0.8) until +2 area (alpha 0.72) of the latent trait as revealed by the irt.fa function and has a good potential in differentiate both healthy and toxic environments. Item Information Curves (Supplemental Figure 1) and Item Characteristic Curves are (Supplemental Figure 2) are presented in supplemental material. The WEEI-7 showed approximately normal distributions in summed and IRT-based scores (Figure 2, Panel B). Conversion tables between summed and IRT-based scores are presented in Supplemental Table 1.

Construct and external validty

Finally, WEEI-7 factor scores explain 22% of the variance of the Emotional Exhaustion score (p<0.001), 10% of the Depersonalization score (p<0.001) and 14% of the Personal Achievement score (p<0.001).

Supplemental Table 1. Conversion table of Summed scores into IRT-based scores based on the average across participants

Summed score	Mean IRT-score	SD IRT score	SE IRT score
1	-2,29370072	0	0
2	-1,9823742	0,1137475	0,002258688
3	-1,80110105	0,14698519	0,002918689
4	-1,69188921	0,17468665	0,003468758
5	-1,56596961	0,23849269	0,004735756
6	-1,41679837	0,18414155	0,003656504
7	-1,27828302	0,185587	0,003685206
8	-1,15838956	0,17217852	0,003418954
9	-1,01258063	0,18372136	0,00364816
10	-0,89479916	0,16011227	0,003179354
11	-0,7355666	0,15244429	0,003027091
12	-0,61834542	0,14209309	0,002821547
13	-0,49846186	0,14393641	0,002858149
14	-0,38727117	0,13062085	0,002593742
15	-0,28487014	0,12823721	0,00254641
16	-0,16242579	0,13008785	0,002583158

Summed score	Mean IRT-score	SD IRT score	SE IRT score
17	-0,0805947	0,13930296	0,002766143
18	0,07421899	0,15634944	0,003104635
19	0,1998759	0,15086482	0,002995727
20	0,33619392	0,14525082	0,00288425
21	0,49132612	0,19699166	0,003911669
22	0,66017192	0,24800714	0,004924685
23	0,78819295	0,18822489	0,003737587
24	0,97916174	0,2209155	0,004386726
25	1,18757978	0,23686638	0,004703463
26	1,32750167	0,17320096	0,003439257
27	1,52689656	0,12310635	0,002444526
28	1,76048153	0,07338041	0,001457117
29	2,11401823	0	0

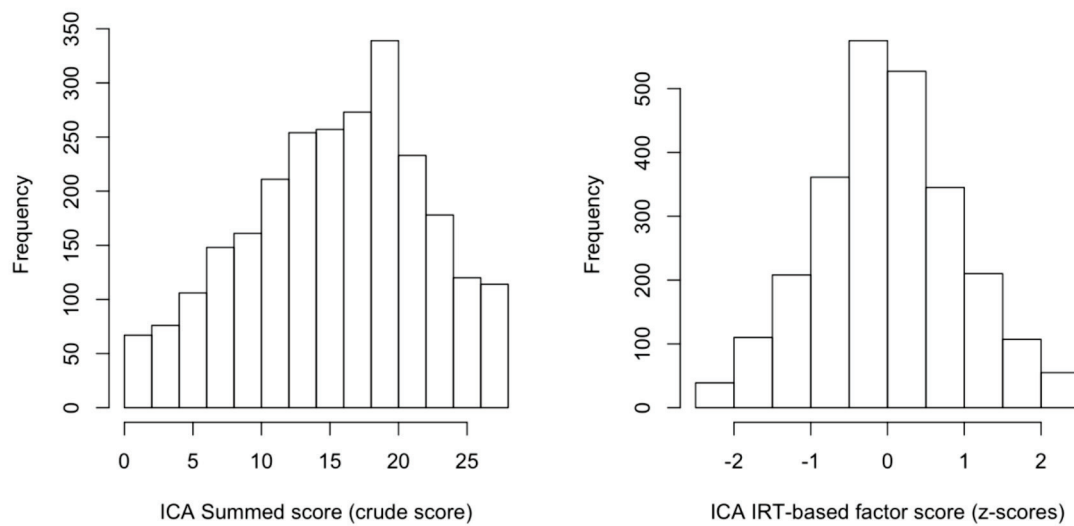**Supplemental Figure 1.** Item Level Analysis of the Item Information Curves
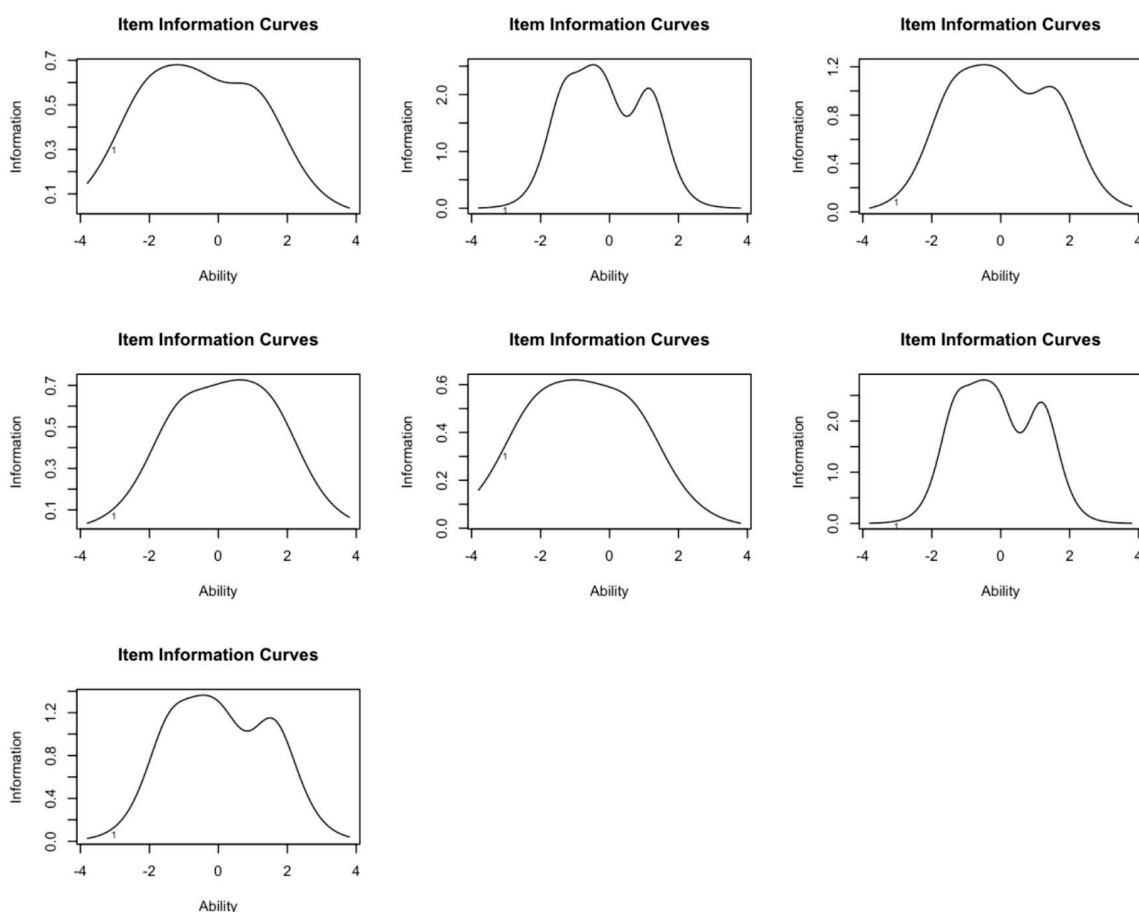
Figure 2. Test Information Function for the revised structure of the ICA and histograms of the summed and IRT-based factor scores
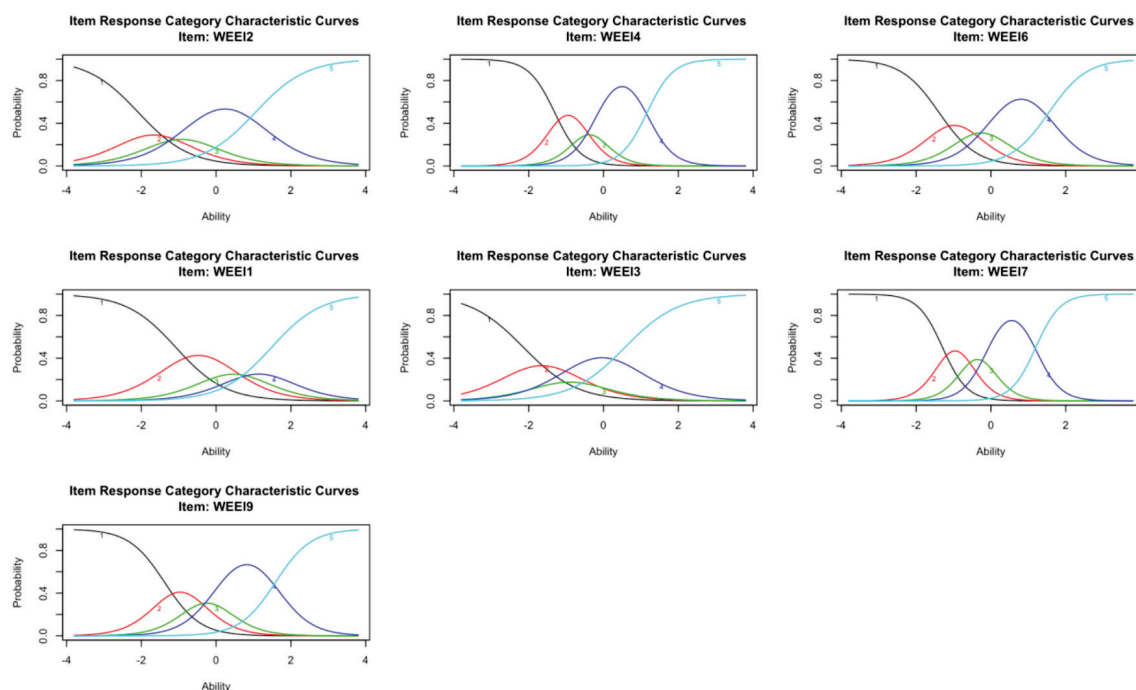
Panel A

Test Information Function
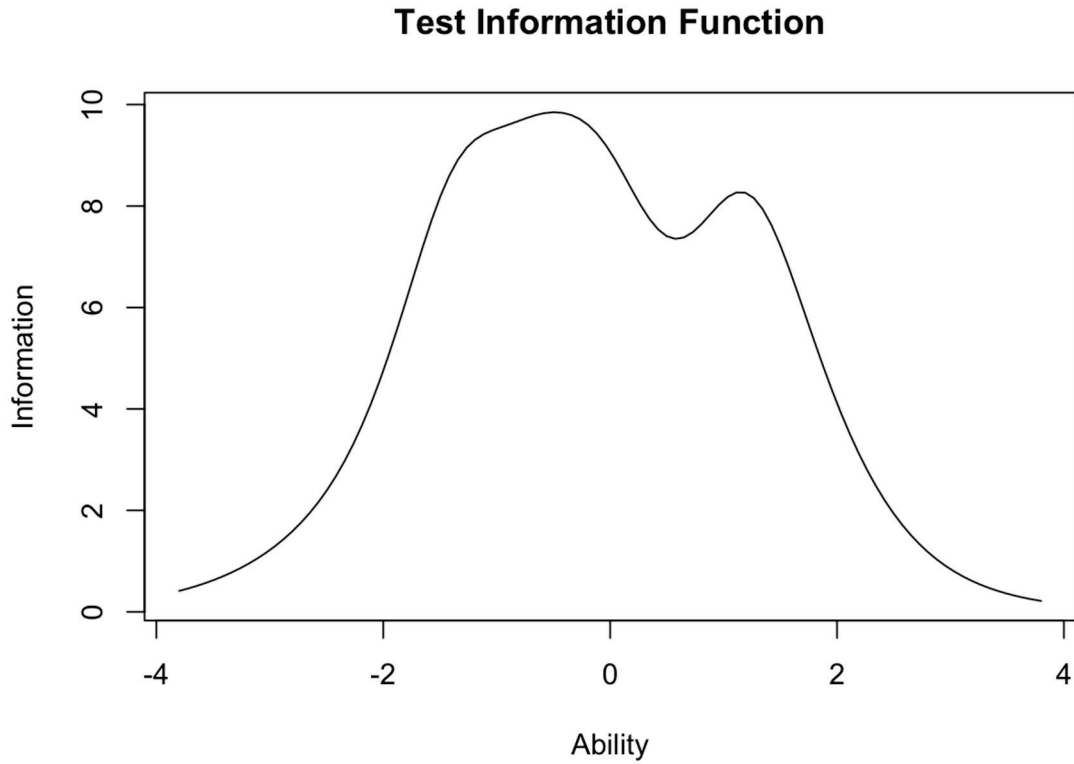
Panel B

Supplemental Figure 2. Item Level Analysis of the Characteristic Curves

Discussion

This study presents a valid and reliable brief self-applied scale to assess institutional environment aspects concerning the nature of the relationships with superiors/supervisors and the relation to the institutions themselves consistently related to MBI scores. The WEEI-7 revealed an excellent fit of the data (RMSEA=0.053, CFI=0.997, TLI=0.996) as well as high internal consistency (McDonald's Omega = 0.89), proving to be a suitable tool for the evaluation of institutional environment aspects that might be target to improve staff well-being, therefore reducing burnout consequences such as reduced empathy, increased reports of medical errors, significant personal suffering, reduced life quality, development of mental and physical disorders, among others[24-27]. The consistent correlation with burnout scores in this sample provides additional evidence in this sense.

To the best of our knowledge, there isn't an instrument with these features that assess the nature of the relationships with superiors/supervisors along with the relation to the institution itself as aspects of the institutional environment that may impact employees' health, and therefore could be targeted at developing effective interventions on the institutional level. Despite the concern for the mental wellbeing of health professionals being the focus of attention in recent decades and several measures have been taken, rates continue to rise[1,2]. Interventions at the individual level have proven to be little effective and tools that allow the development and testing of interventions at the institutional level are fundamental. WEEI-7 has the advantage of being a brief self-applied instrument that takes into account the perception of individuals in different stages of career and the holding of different positions within the institution. The items evaluated have been proven to be related to burnout symptoms in previous studies with medical residents as well in this national sample

of medical studies and physicians[12,28]. This approach can be a more effective strategy than limiting the scope to interventions at the individual level that tend to foster the augmentation of the individual resilience, but, in many cases, ignore some of the causes[5,10,13].

This investigation has notable strengths. First, we were able to develop a fast and self-administered instrument with high internal consistency that evaluated institutional environment in a sample of medical students and physicians. Second, we were able to test the instrument in a high number of participants. Third, we could evaluate aspects that are poorly addressed in the literature concerning the work environment features. Finally, we found an association between the WEEI-7 score and burnout dimensions, reinforcing its validity in measuring aspects related to work related distress vs. well-being. On the other hand, this study has limitations typical of preliminary studies that need replication in other samples and contexts. Also, it used a convenience sample in an online study, so only participants with easy access to the internet were likely and able to participate in the present study.

In conclusion, a recent paper by Hartzband and Groopman[9] call the attention to the fact that the modifications implemented in the health systems aiming at rising productivity and efficiency have eroded the very sense of the identity of being a doctor by taking away the important triad of autonomy, competence and relatedness, described by Gagne and Deci[29] as essential to support the professional's intrinsic motivation and psychological well-being. This might well be the case in other professions where the sense of effectiveness has followed an excessive materialistic view at the expense of essential human emotional needs. In this sense a validated and reliable instrument like the WEEI-7 may help in calling attention to aspects that seem to be essential to foster well-being within any institution.

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