

A new approach to Maslach Burnout Inventory: Measuring burnout syndrome in health-care staff with fuzzy conjoint analysis

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ABSTRACT

Background and Purpose: Burnout syndrome (BOS), the popular phenomenon of our pandemic era, is examined in three dimensions: emotional exhaustion, depersonalization and cynicism, and personal inefficiency. One of the known and accepted ways of measuring BOS is Maslach Burnout Inventory (MBI), in which these three dimensions are measured by 22 items, using 5- or 7-point Likert scales. The aim of this study is to eliminate the loss of precision in BOS measurement and handle the subjectivity and uncertainty, as a result, to get rid of the bias caused by the classical way. **Methods:** To do this, fuzzy conjoint analysis (FCA) is used together with MBI. In the classical way, the calculations are made by assigning crisp values to the answers, which causes scientific bias and loss of precision because Likert scale type answers have subjectivity and uncertainty. **Results:** When the scores obtained with FCA are examined, all the scores and some BOS levels differ. When the position of the values according to the borders of the BOS levels is taken into account, it can be said that these tiny differences caused by the loss of precision make this difference. **Conclusion:** Findings show that the resulting scores changed significantly when calculations are made with FCA. Especially, when these scores are interpreted as intervals or grades, as in MBI, even tiny differences may result in significant scientific bias.

Keywords: Burnout syndrome, Fuzzy conjoint analysis, Fuzzy logic, Maslach Burnout Inventory

INTRODUCTION

Burnout syndrome (BOS), the popular phenomenon of our pandemic era, was first introduced in 1974 by Freudenberg, in an aid organization where volunteers became burnout.^[1] It was introduced that the work-related pressure and stress together with personal characteristics cause job-related BOS. Freudenberg's BOS was one dimensional in the name of "staff burnout." Later in 1978, Pines and Maslach^[2] defined BOS as the inability

to handle the emotional stress at work; in 1986, Freudenberg^[3] defined BOS as excessive use of energy and resources depending on the failure and exhaustion. Freudenberg's one-dimensional BOS is improved by Maslach and Jackson into three dimensions:^[4] emotional exhaustion, depersonalization and cynicism, and personal inefficiency, named as Maslach Burnout Inventory (MBI). Later, revised for detecting and measuring the severity of BOS.^[5]

'Emotional exhaustion' can be defined as the feeling that a person's emotional resources were overextended

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and depleted, where ‘depersonalization and cynicism’ as having negative, cynical, cold, and impersonal attitudes and feelings toward others, and ‘personal inefficiency’ as decreasing the sense of competence of a person and a tendency to negatively evaluate oneself, especially in terms of cooperation with others.^[6]

Burnout measurement at work with MBI has been widely studied, its validity and reliability tested in numerous studies and meta-analyses with the samples from various countries, cultures, and domains.^[7] Education and sports are two other major domains that MBI is widely studied, meaning that burnout not only stems from the care work but also from other professional activities. In addition, “academic burnout” term has aroused, caused by school-related stress, which leads to greater exhaustion.^[8] Academic burnout is measured by MBI-Student Survey.^[9] In the original health-care staff MBI, there are 22 items for measurement. In 1996, MBI was adapted to be applicable to more professions, having 16 items and named as MBI General Survey.^[10] Recently, the literature tells that BOS may also be detected in nonwork environments when the demands cannot be met because of a lack of resources.^[7]

In the literature, BOS in health-care professionals is a major research area. The findings tell us high prevalence of BOS exists in health-care professionals, namely in physicians and nurses.^[11] A high level of BOS is reported, especially in oncologists, anesthesiologists, physicians caring for AIDS patients, staff in emergency units, where workplace, climate, and workload are the determinants.^[12] When unexpected conditions occur such as pandemic, as experienced for approximately more than 1 year, the level of BOS rises.

In MBI, the participants are expected to express their burnout feelings with 5- or 7-point Likert scales. In the computation of BOS level, numbers from 1 to 5/7 are assigned to the answers of participants (to the Likert scales they choose), where 1 represents “strongly disagree” and 5/7 represents “strongly agree,” and the other numbers are in between, then arithmetical mean is taken. However, as of nature, these choices of Likert scales are linguistic terms, having somehow a kind of vagueness, which should be considered as fuzzy terms and should be defined as fuzzy sets. A participant cannot know where a Likert scale ends and where the following one starts. Sometimes, he can be confused about which one to choose, for example, moderately agree or strongly agree. This confusion and vagueness create a point of subjectiveness and scientific bias. In addition, assigning crisp values to subjective and

vague Likert scales cause us to lose precision, because there are millions of numbers between each following crisp values, 1 and 2 and 3 and so on.

Fuzzy logic is a successful method to handle vagueness and subjectivity in capturing individual perceptions. Fuzzy logic uses fuzzy sets, instead of crisp values, in which each element of the fuzzy set has a partial degree of membership to the crisp value. Instead of assigning a crisp value to the Likert scale, its degree of membership to that crisp value is determined. By this method, we also take into account, the numbers between each crisp value and prevent loss of precision. Each member of Likert will be our linguistic variable, whose value will be expressed in daily language terms (linguistic variables).

Conjoint analysis is the statistical method introduced in 1964, as a multicriteria evaluation to determine the value of a product that an individual places on, to determine the preferences of individuals with respect to criteria considered.^[13] It is mostly used in marketing research.

Since perceptions and preferences are subjective, vague, and fuzzy, fuzzy reasoning has a major advantage in determining individuals’ preference.^[13] Literature has proposed to use fuzzy logic and conjoint analysis together to model the preferences.^[14]

In the literature, although there are hundreds of MBI and BOS studies, none of them used fuzzy logic methodologies despite its full appropriateness. The objective of this study is to prevent the loss of precision in BOS measurement with MBI using fuzzy conjoint analysis (FCA) and put forth the differences between the classical measurement and FCA.

METHODS

This study is ethically approved by the Antalya Bilim University Social Sciences Ethical Committee on March 10, 2021, with the 2021/05 document.

The study design is given in Figure 1.

The responses of the health-care staff are captured using MBI questionnaire. Details about the questionnaire are given below. Then, according to Table 1, linguistic levels are defined, and fuzzy sets are assigned. By using the Formula (1) BOS values are determined with the classical method. With the Formulas (2) and (3), final similarities using FCA are calculated. Details of these processes are given in the subsections.

The internal consistencies of the ratings are measured by Cronbach’s Alpha coefficient by means of Statistical Package for the Social Sciences (SPSS) (IBM, New York, USA). Cronbach’s Alpha values >0.60 is considered reliable.

In the study, MBI with 22 items translated into Turkish is used to capture data about BOS levels of health-care staff. Participants are supposed to express their BOS ratings with 5-point Likert scale, ranging from 1, strongly disagree, to 5, strongly agree on three components/subscales: 9 items for emotional exhaustion, 5 items for depersonalization, and 8 items for personal accomplishment. In the first part of the questionnaire, participants are informed that no private information about the participants’ identity is asked, and they automatically give consent for the usage of the data which they provide in scientific research by filling the questionnaire.

In emotional exhaustion and depersonalization, higher scores are accepted as higher burnout levels, whereas higher personal accomplishment scores are accepted as showing lower burnout level. Classical BOS levels are calculated with,

$$BOS = \left(\sum_{i=1}^n [Xi \cdot Wi] \right) / n \tag{1}$$

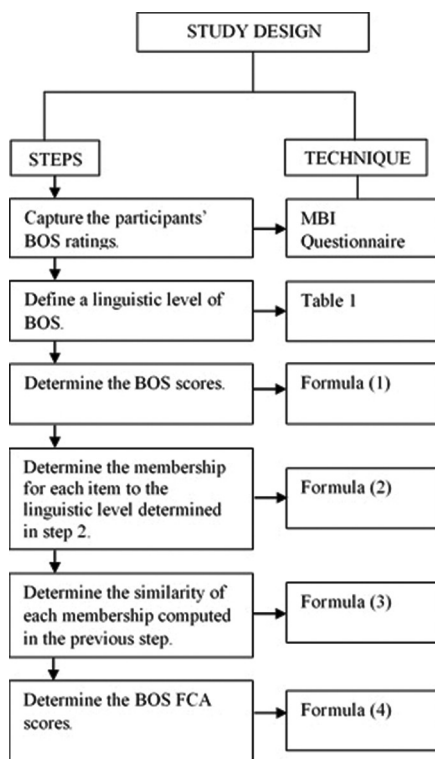


Figure 1: Study design.

Where,

- Xi is the answer given by i-th participant.
- Wi is the weight of the corresponding i-th participant’s answer’s Likert scale.
- n is the total number of answers.

BOS levels are interpreted as “high,” “medium,” and “low” as shown in Table 2.^[15]

Fuzzy logic methodology is used in the study as a different approach in BOS research. Fuzzy logic is mainly used when the boundaries are not clear when there is vagueness and subjectivity. In fuzzy logic, linguistic variables are used, such as Likert scale ratings. Likert scale context, having ambiguity and multiplicity in meaning, is very suitable for fuzzy logic methodologies. Fuzzy triangular numbers are simple to use, so, they are very often used in fuzzy logic studies. In Figure 2, an example membership function to fuzzy triangular number (0.25, 0.50, and 0.75) is given.

Likert scales of MBI are converted into fuzzy triangular numbers. This conversion process is called as fuzzification process. In the fuzzification process, crisp values and

Table 1: Triangular fuzzy numbers assigned to Likert scales (linguistic variables).

BOS ratings	Fuzzy number
B1, Strongly agree	0.75, 1.00, 1.00
B2, MA	0.50, 0.75, 1.00
B3, NS	0.25, 0.50, 0.75
B4, MD	0, 0.25, 0.50
B5, Strongly disagree	0, 0, 0.25

BOS: Burnout syndrome, MA: Moderately agree, NS: Not sure, MD: Moderately disagree.

Table 2: Burnout syndrome level interpretation intervals.

Subscales	Low	Average	High
Emotional exhaustion	0–16	16.01–26.00	26+
Depersonalization	0–6	6.01–12.00	12+
Personal accomplishment	38+	31.01–38.00	0–31

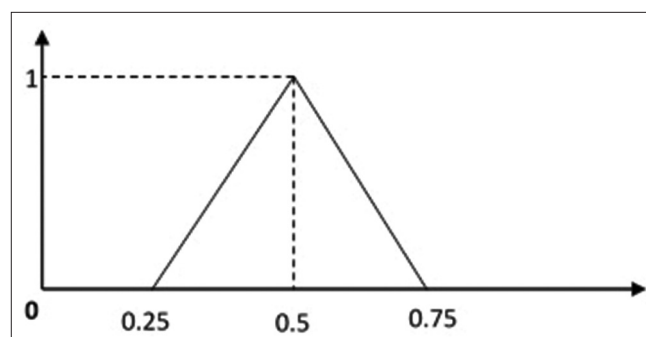


Figure 2: Fuzzy triangular function membership.

linguistic variables of the method are converted into fuzzy sets. In Table 1, the triangular numbers used to fuzzify BOS ratings captured are given.

The membership functions of the study are given in Figure 3. Using FCA, similarities of each item are computed. In another word, the degree of similarity between the fuzzy set of the responses and the reference fuzzy set of the linguistic terms is determined. In this level, the aim is to find the closest linguistic variable to the final resulting fuzzy set that will be reached by the linguistic variable with the maximum similarity value, in another meaning, the value closest to 1.

The membership of each BOS item (we have 22) to the defined linguistic variables (our Likert scales) $\mu R(X_j'', F''_j)$, is computed with;

$$\mu R(X_j'', F''_j) = \sum_{(i=1)}^n \left[\frac{w_i}{\sum w_i} \right] \cdot X_i \quad (2)$$

where

- w_i is the answer given by i-th participant
- $\sum w_i$ is the sum of the answers given to i-th BOS item
- $w_i / \sum w_i$ is the weight of the i-th participant
- X_i is the corresponding fuzzy set of the i-th respondents (if the answer is “moderately disagree” then X_i is [0, 0.25, 0.5])
- F_j is the jth BOS item
- n is the total number of answers.

This membership gives us the fuzzy set of each BOS item. Now, it is time for comparison of these sets with the defined fuzzy sets, and to determine, to which linguistic variable the given response is closer. Here, the aim is to capture which original linguistic variable is the closest to the final fuzzy set obtained from participants’ answers. The similarity is measured by;

$$\text{Sim}(R_i(y_j, A), F(x_j, l)) = \frac{1}{\left[1 + \sqrt{\sum_{j=1}^n (\mu R_i(y_j, A) - \mu F(x_j, l))^2} \right]} \quad (3)$$

where

- $R_i(y_j, A)$ is the fuzzy set determined by 2 (Formula 2)
- $F(x_j, l)$ is the standard fuzzy sets defined [Table 2].

The result of this formula is a crisp number. That means, the similarity measure is also our defuzzification method. In real-world, we cannot use or interpret fuzzy numbers and sets, so, these fuzzy values must be defuzzified.

Now, we have all BOS similarities, meaning that we have found the closest Likert scale of the answers of the

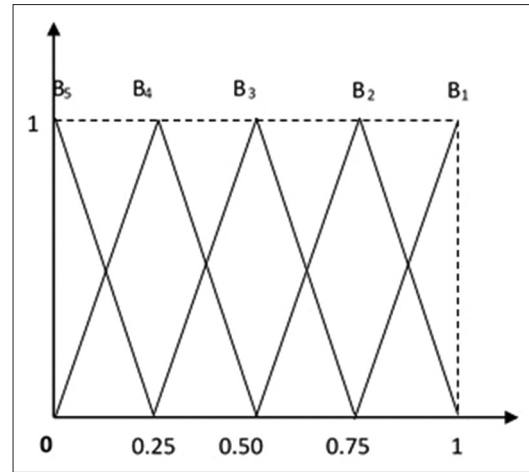


Figure 3: Membership functions for the burnout syndrome ratings.

participants using FCA. It is time to find the levels of BOS, BOS_{FCA} . This time we use,

$$BOS_{FCA} = \underset{=1}{\left[\text{Sim}(R_i(y_j, A), F(x_j, l)) \times Y_i \right]} \quad (4)$$

Where;

- $\text{Sim}(R_i(y_j, A), F(x_j, l))$ is the similarity of i-th item determined by 2 (Formula 2)
- Y_i is the crisp correspondent of the Likert scale.

RESULTS

The MBI questionnaire, with 5-point Likert scale, is applied to five different hospitals and 384 volunteer participants attended the study aged between 19 and 56. Two-hundred and seventy-one participants are female (70.57%) and 113 males (29.43%), 56 physicians (14.58%), 164 nurses (42.71%), 83 medical staff (21.70%), 20 managerial (5.12%), and 61 others (15.89%). Sixty-one participants express their education as high school graduate (15.89%), 96 as BS (25.00%), 154 as university (40.10%), 28 as MS (7.20%), and 45 as PhD (11.72%). Two hundred and eighty-three (73.70%) are married and 111 (26.30%) are single.

Cronbach alpha coefficients are measured as for total 22 items 0.82, for emotional exhaustion with 9 items 0.83, for depersonalization with five items 0.65, and for personal accomplishment with 8 items 0.73.

MBI values for measuring BOS levels by classical method are given in Tables 3 and 4. The highest MBI value is calculated in emotional exhaustion as shown in Table 3, in managerial staff, highest value is seen again in emotional exhaustion, when MBI values are calculated according to the profession as shown in Table 4.

The similarity coefficients and the closest Likert scales are given in Table 5. It is seen that most of the items are closer to “moderately agree” while a few are closer to the Likert scale “not sure.” The highest coefficients are marked as bold. In Table 5, the highest value is taken, in another word, the value closest to 1, as explained in

methods section. Corresponding Likert scale of the value is the most similar choice we are looking for. These values will be used to calculate the FCA BOS value using Formula 4. For example, for the first item of the emotional exhaustion, EE1, the similarity measure “0.659531” and the most similar Likert scale is “Not Sure.”

Table 3: Maslach burnout inventory values for all users.

Sub-dimension	BOS value
Emotional exhaustion	24.47
Depersonalization	14.41
Personal accomplishment	21.91

BOS: Burnout syndrome.

Table 4: Maslach burnout inventory values according to the user professions.

	Emotional exhaustion	Depersonalization	Personal accomplishment
Physician	22.71	14.05	20.54
Nurse	24.37	14.94	22.31
Other medical staff	24.62	13.83	21.46
Managerial	25.10	13.75	22.35
Other	24.07	14.05	22.20

In Tables 6 and 7, the similarity coefficients and the most similar Likert scales according to the professions are given. The values are rounded to 2 decimal points to fit to the table.

In Tables 8 and 9, the comparison of scores reached by two methods is given. The interpretation of the BOS values and the resulting BOS levels are given in Table 10.

In both Tables 9 and 10, all the scores are different. In interpretation of BOS levels, in classical averaging method, participants have a middle BOS level in emotional exhaustion and personal accomplishment, but in depersonalization, BOS is high, when the measurement is made for all. When the scores are examined according to the professions, findings show that all the professions

Table 5: Similarity coefficients and the closest Likert scales.

Question	Similarity	Strongly Disagree	Moderately Disagree	Not Sure	Moderately Agree	Strongly Agree
EE1*	Not Sure	0.485520	0.555801	0.659531	0.657073	0.541807
EE2	Moderately Agree	0.457743	0.513335	0.636260	0.721780	0.579501
EE3	Not Sure	0.493875	0.580359	0.680896	0.632182	0.518709
EE4	Moderately Agree	0.423949	0.462746	0.583046	0.821227	0.634394
EE5	Moderately Agree	0.455718	0.527662	0.591182	0.673710	0.507805
EE6	Moderately Agree	0.436644	0.496268	0.615264	0.791260	0.567917
EE7	Moderately Agree	0.465805	0.564312	0.629273	0.645556	0.494241
EE8	Moderately Agree	0.449624	0.523368	0.642951	0.731844	0.541137
EE9	Moderately Agree	0.465207	0.555041	0.605065	0.634696	0.485528
DP1**	Moderately Agree	0.450016	0.523884	0.629479	0.722682	0.531274
DP2	Moderately Agree	0.445593	0.514748	0.634521	0.748742	0.547214
DP3	Not Sure	0.459697	0.558151	0.678637	0.667061	0.500924
DP4	Moderately Agree	0.438432	0.503773	0.629811	0.774662	0.557001
DP5	Moderately Agree	0.427290	0.468469	0.582553	0.832245	0.622972
PA1***	Moderately Agree	0.463653	0.550589	0.597969	0.632161	0.483065
PA 2	Moderately Agree	0.434253	0.496436	0.627273	0.792339	0.564035
PA 3	Moderately Agree	0.459430	0.559207	0.665920	0.665246	0.500868
PA 4	Moderately Agree	0.450300	0.532418	0.660254	0.714609	0.528711
PA 5	Moderately Agree	0.454291	0.543115	0.661771	0.692564	0.514773
PA 6	Moderately Agree	0.427115	0.461246	0.568589	0.818049	0.645630
PA 7	Moderately Agree	0.456337	0.551226	0.665909	0.676956	0.505278
PA 8	Moderately Agree	0.449328	0.535234	0.654607	0.701173	0.513897

*EE = Emotional Exhaustion **DP = Depersonalization ***PA = Personal Accomplishment

Table 6: Similarity coefficients and the closest Likert scales according to the professions-1.

Physician	Similarity coefficient	The Most Similar Likert Scale	NURSE	Similarity coefficient	The Most Similar Likert Scale	OTHER MEDICAL STAFF	Similarity coefficient	The Most Similar Likert Scale
EE1***	0.64	*MA		0.72	NS		0.66	MA
EE2	0.68	**NS		0.74	MA		0.72	MA
EE3	0.68	NS		0.69	NS		0.67	NS
EE4	0.84	MA		0.83	MA		0.80	MA
EE5	0.65	MA		0.66	MA		0.67	MA
EE6	0.77	MA		0.83	MA		0.77	MA
EE7	0.62	MD		0.64	NS		0.68	MA
EE8	0.67	MA		0.75	MA		0.75	MA
EE9	0.58	MA		0.62	MA		0.60	MA
DP1****	0.70	MA		0.75	MA		0.70	MA
DP2	0.73	MA		0.79	MA		0.71	MA
DP3	0.68	NS		0.68	MA		0.68	NS
DP4	0.74	MA		0.81	MA		0.77	MA
DP5	0.84	MA		0.83	MA		0.82	MA
PA1*****	0.56	MD		0.64	MA		0.65	MA
PA2	0.78	MA		0.82	MA		0.80	MA
PA3	0.64	NS		0.70	MA		0.66	NS
PA4	0.69	MA		0.74	MA		0.69	NS
PA5	0.64	NS		0.72	MA		0.69	NS
PA6	0.83	MA		0.82	MA		0.80	MA
PA7	0.64	MA		0.67	NS		0.69	MA
PA8	0.70	MA		0.72	MA		0.67	NS

*MA = Moderately Agree **NS = Not Sure ***EE = Emotional Exhaustion ****DP = Depersonalization *****PA = Personal Accomplishment

Table 7: Similarity coefficients and the closest Likert scales according to the professions-2.

Managerial	Similarity coefficient	The most similar Likert scale	Other	Similarity coefficient	The most similar Likert scale
EE1	0.70	NS		0.68	NS
EE2	0.73	MA		0.70	MA
EE3	0.66	MA		0.68	NS
EE4	0.83	MA		0.79	MA
EE5	0.73	MA		0.72	MA
EE6	0.82	MA		0.71	MA
EE7	0.58	MA		0.73	MA
EE8	0.74	MA		0.70	MA
EE9	0.65	MA		0.74	MA
DP1	0.66	MA		0.69	MA
DP2	0.71	NS		0.69	MA
DP3	0.72	NS		0.71	MA
DP4	0.71	MA		0.72	MA
DP5	0.85	MA		0.83	MA
PA1	0.62	MA		0.64	MA
PA2	0.82	MA		0.70	MA
PA3	0.67	MA		0.68	MA
PA4	0.67	NS		0.74	MA
PA5	0.69	NS		0.72	MA
PA6	0.78	MA		0.81	MA
PA7	0.70	NS		0.74	MA
PA8	0.74	MA		0.68	NS

*NS: Not sure, MA: Moderately agree, EE: Emotional exhaustion, DP: Depersonalization, PA: Personal accomplishment.

have middle BOS level in emotional exhaustion and personal accomplishment, but have a high BOS level in depersonalization, compatible with the general results.

In this study, it is important to pay attention to the finding that the BOS values of emotional exhaustion are in the border of the intervals, middle, and high, whereas personal accomplishment and depersonalization values are considerably away from the interval borders.

When the scores obtained with FCA are examined, all the scores and some BOS levels differ. The BOS level in emotional exhaustion becomes high in general and in all professions except physicians. When the position of the values according to the borders of the BOS levels is taken into account, it can be said that these tiny differences caused by the loss of precision makes this difference.

These differences can be scientifically significant depending on the case. Drawing from results, especially when there are levels, intervals, grades, etc., and if the values are on the edges, borders, etc., there can be scientifically significance due to loss of precision in the methods using crisp values in vague and fuzzy measurements, as in our study. In this study, calculations are made using similarity coefficients in Table 5-7, the results in Table 8 and 9 are reached.

DISCUSSION

All the Cronbach's alpha values are apparently high and >0.6, showing the answers to questions are internally consistent. When compared to the other subscales, it is seen that Cronbach's alpha value for depersonalization is relatively lower, although it is above accepted threshold value. Other studies have a similar situation in scientific literature, that can be interpreted causing from low number of items.^[4,16,17]

In Tables 8 and 9, the comparison of scores reached by two methods is given. The interpretation of the BOS values and the resulting BOS levels are given in Table 11.

In both Tables 8 and 9, all the scores are different. In interpretation of BOS levels, in the classical averaging method, participants have middle BOS level in emotional exhaustion and personal accomplishment, but in depersonalization, BOS is high, when the measurement is made for all. When the scores are examined according to the professions, findings show that all the professions have middle BOS level in emotional exhaustion and

Table 8: Maslach burnout inventory sub-dimension values with fuzzy conjoint analysis (burnout syndrome fuzzy conjoint analysis).

Subdimension	BOS _{FCA}
Emotional exhaustion	26.80
Depersonalization	16.35
Personal accomplishment	23.77

BOS: Burnout syndrome, BOS_{FCA}: BOS fuzzy conjoint analysis.

Table 9: Maslach burnout inventory values according to the user professions with fuzzy conjoint analysis (burnout syndrome fuzzy conjoint analysis).

Profession	Emotional exhaustion	Depersonalization	Personal accomplishment
Physician	25.04	15.03	21.67
Nurse	27.18	15.78	23.32
Other medical staff	26.73	15.02	22.26
Managerial	27.16	15.55	22.28
Other	27.26	14.69	22.87

Table 10: Comparison of burnout syndrome values between two methods for all participants.

Subdimension	BOS	BOS _{FCA}
Emotional exhaustion	24.47	26.80
Depersonalization	14.41	16.35
Personal accomplishment	21.91	23.77

BOS: Burnout syndrome, BOS_{FCA}: BOS fuzzy conjoint analysis.

Table 11: Comparison of burnout syndrome values between two methods according to the professions.

Profession	Emotional exhaustion		Depersonalization		Personal Accomplishment	
	BOS	BOS _{FCA}	BOS	BOS _{FCA}	BOS	BOS _{FCA}
Physician	22.71	25.04	14.05	15.03	20.53	21.67
Nurse	24.37	27.18	14.94	15.78	22.30	23.32
Other medical staff	24.62	26.73	13.83	15.02	21.46	22.26
Managerial	25.10	27.16	13.75	15.55	22.35	22.28
Other	24.07	27.26	14.05	14.69	22.20	22.87

personal accomplishment, but have high BOS level in depersonalization, compatible with the general results.

In this study, it is important to pay attention to the finding that the BOS values of emotional exhaustion are in the border of the intervals, middle, and high, whereas personal accomplishment and depersonalization values are considerably away from the interval borders.

When the scores obtained with FCA are examined, all the scores and some BOS levels differ. The BOS level in emotional exhaustion becomes high, in general, and in all professions except physicians. When the position of the values according to the borders of the BOS levels is taken into account, it can be said that these tiny differences caused by the loss of precision makes this difference.

These differences can be scientifically significant depending on the case. Drawing from results, especially when there are levels, intervals, grades, etc., and if the values are on the edges, borders, etc., there can be scientifically significance due to loss of precision in the methods using crisp values in vague and fuzzy measurements, as in our study. In this study, the classical method gives us middle BOS level in emotional exhaustion, while it has high level. The other two subscales are also different, but the levels do not differ because they are not located near the border of the level they stand.

In this study, as given in Table 11, the intervals to interpret the levels are wide. However, if these intervals were narrower and the number of the levels was more, these differences would be more obvious and misleading. This loss of precision leads to important scientific biases.

Decision-making under fuzzy environment is a very big problem, to tackle with, the concept of fuzzy similarity measures is widely used.^[18] Especially, in measuring the perceptions, for the consistency of decision outcomes, fuzzy reasoning has major advantage (Sofian and Rambely, 2020). When approximated reasoning (fuzzy logic) is compared to exact reasoning, fuzzy reasoning's solution to the problems of modeling preferences, regarding fuzzy binary relations, is proved.^[19]

CONCLUSION

In this study, the FCA theory is integrated with MBI to analyze BOS of health-care workers. The findings support the powerful features of fuzzy reasoning in the scientific literature.

The method and approach used in this study may provide significant insights into the evolving measurements both in BOS studies and Likert-type measurements. Drawing from the findings in this study, it is proposed to use fuzzy conjoint analysis in all Likert using scales/inventories/questionnaires.

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Conflicts of interest

Güney Gürsel is an Editorial Board Member of the journal. The article was subject to the journal's standard procedures, with peer review handled independently of this editor and his research groups.

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