Motivation for cardiopulmonary resuscitation: Scale development and psychometric analysis

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ABSTRACT

Background: The high motivation of rescuers for cardiopulmonary resuscitation (CPR) can result in high-quality CPR. However, there is no instrument to measure the CPR motivation. The purpose of this study was to design the Cardiopulmonary Resuscitation Motivation Scale (CPRMS) and evaluate its psychometric properties.
Methods: Directed qualitative content analysis and other related instruments were used for the production of items pool, and then the psychometric properties of the CPRMS were evaluated using face, content and construct validities, and internal consistency, and stability for reliability.
Results: The CPRMS was consisted of 43 items. The Scale-Content Validity Index was reported as 0.97. Exploratory factor analysis led to eight factors, which in total accounted for 48.58% of observed variance. Confirmatory factor analysis also showed the average fit of the explored model. The values of alpha, omega and intraclass correlation coefficients were reported as 0.92, 0.76–0.86, and 0.90 respectively.
Conclusion: CPRMS is a valid and reliable instrument for the measurement of CPR motivation in eight dimensions of facilitators of resuscitation, feeling of achievement, high chances of success, low chances of success, recognition and appreciation, accountability, perceived importance, and beliefs. CPRMS can differentiate between rescuers with high and low motivation.

1. Introduction

Each year, more than 500,000 deaths occur as a result of cardiac arrest [1], and about 209,000 adults and over 6000 children in the United States receive cardiopulmonary resuscitation (CPR) for cardiac arrest in the hospital [2]. Despite more than five decades of CPR as a cardiac arrest treatment and many advances in techniques, drugs and equipment used for CPR, the survival rate subsequent to cardiac arrest in and out of the hospital has not been significantly improved [3,4]. The success of CPR is influenced by a variety of rescuers related factors including technical, communication and management skills, previous experiences [5], fatigue, and the motivation for CPR [6].

Studies have shown that motivation, besides having an association with achieving and endurance of CPR skills [7], can help with the provision of appropriate interventions [8] and high-quality CPR [9]. Studies have shown that, work motivation lead to high-quality performance and better clinical outcomes [10–12]. The assumption that

motivation affects rescuers performance and CPR outcomes suggests that the selection of high-motivated rescuers for CPR is necessary [6,9]. However, to the best of our knowledge, there is no valid and reliable instrument for the measurement of CPR motivation. It is recommended to use qualified criteria for selection of competent personnel, these criteria can lead to valid comparison, judgment and decision [13].

To explain the CPR motivation construct, the Vroom's expectancy theory can be used as a theoretical framework within this study. Vroom's theory is recognized as one of the most comprehensive and valid process theories of motivation [15]. The propositions of this theory are consistent with the CPR event [6]. Based on the propositions of this theory, individual's feeling is motivated; firstly, when their effort will lead to an appropriate level of performance (expectancy); secondly, their performance will lead to expected outcomes (instrumentality); thirdly, the expected outcomes is worthy for them (Valence) [16].

Therefore, considering that motivation is one of the most important issues related to organizational behavior, and knowledge about staff

motivation is necessary for managers [14], the present study aimed to design the Cardiopulmonary Resuscitation Motivation Scale (CPRMS) and evaluate its psychometric properties.

2. Methods

2.1. Study design and setting

This paper reports on the design and psychometric analysis of the CPRMS. The study was conducted in the ICU, CCU and emergency department in seven educational hospitals of Mashhad and Sabzevar Medical Sciences Universities in Iran.

2.2. Development of the CPRMS

For designing this instrument, the authors used qualitative interviews and other related instruments (about work motivation) to enrich the items' pool. Semi-structured interviews were conducted with 24 members of the CPR team (5 physicians and 19 nurses) and the transcriptions were analyzed through directed qualitative content analysis based on the Vroom's expectancy theory [17]. A thorough literature search on motivation was performed. For this purpose, Medline (Ovid, PubMed), Scopus, ProQuest, ScienceDirect, Web of Science and Google Scholar databases by using keywords such as cardiopulmonary resuscitation, CPR, motivation, motive, instrument, scale, questionnaire, inventory, scale, index, and various combinations of them were searched from inception to 2018. While no instrument for "CPR motivation" was found, an instrument on work motivation based on the expectancy theory was found [18]. The items of other instruments including nursing motives for helping scale [19], psychiatric nurses of job motivation scale [20], work motivation scales that have been used frequently in health studies [10,21], situational motivation scale [22], science learning motivation questionnaire [23] and occupational self-efficacy scale [24] were used for item generation (Table 1). The reason for selection of these instruments was the general compatibility of CPR motivation with work motivation and coherence of concepts discussed in these instruments with categories and subcategories emerged in the qualitative phase. First, operational definitions of CPR motivation and its domains, items and their scale were developed. The number of items in this phase was 213, which were reduced to 151 and 134 items after two stages assessment and editing by the research team, respectively. Lastly, they were made ready for the evaluation of their psychometric properties.

2.3. Psychometric testing

2.3.1. Participants

In exploratory factor analysis (EFA), 300 members of the CPR team completed the CPRMS, and in confirmatory factor analysis (CFA), 270 physicians and nurses working in the ICU, CCU and emergency department in seven educational hospitals filled out the CPRMS. The

Table 1
Available instruments in the field of assessment motivation and related factors.

Title of instrument	Authors
The Michigan organizational assessment package	Nadler et al. (1975)
Nursing motives for helping scale (N-MHS)	Gutiérrez et al. (2006)
Turkish psychiatric nurses of job motivation scale	Engin and Cam (2009)
The Motivation at Work Scale	Gagné et al. (2010)
Work Extrinsic and Intrinsic Motivation Scale	Tremblay and C. M. et al. (2009)
The Situational Motivation Scale (SIMS)	Guay and R. J. et al. (2000)
Students' motivation toward science learning (SMTSL)	Tuan* et al. (2005)
A short version of the occupational self-efficacy scale	Rigotti et al. (2008)

Table 2
The demographic characteristics of the samples in construct validity.

Variable	CFA		EFA	
	%	n	%	n
Gender				
Male	32.2	87	34	102
Female	67.8	183	66	198
Discipline				
Nursing	83	224	90	270
Medicine	17	46	10	30
Total	100	270	100	300
	SD	*Mean*	SD	*Mean*
Age (years)	6.71	32.71	7	32.49
Work experience (years)	6.02	8.49	6.37	8.39
Work experience in the current ward (years)	3.64	4.16	3.65	4.07
Number of participation in CPR per month	29.03	11.80	27.36	10.61

EFA: Exploratory factor analysis; CFA: Confirmatory factor analysis; CPR: Cardiopulmonary resuscitation.

characteristics of participants are given in Table 2.

2.3.2. Face validity

For qualitative face validity, 10 members of the CPR team were requested to assess the items in terms of difficulty of understanding, the degree of fitness and their relationship with dimensions of the scale, the likelihood of misunderstandings of phrases or deficiencies in the meanings of words. Necessary amendments were made in this phase. Quantitative face validity was assessed using the item impact technique. For this purpose, 10 members of the CPR team were asked to determine the importance of each item for measuring the CPR motivation based on their experiences. The item impact score (IIS) of each item was calculated, and a score ≥1.5 was considered appropriate [25].

2.3.3. Content validity

Qualitative and quantitative methods were used to assess content validity. A panel consisting of 10 experts in the field of CPR, motivation and instrument development were selected based on the suggestion by Grant and Davis [26]. For qualitative content validity, they were asked to give comments about grammar, the use of words and placement of items in the scale. For quantitative content validity, the content validity ratio (CVR) [27], content validity index (CVI) [28,29] and modified Kappa coefficient (k*) were calculated [29]. Therefore, the experts were asked to comment on the necessity and relevance of the items to the CPR motivation in terms of simplicity and clarity. Items with a CVR less than the acceptable value according to the Lawshe table were deleted [27]. The appropriate CVI for each item (I-CVI) was considered to be greater than 0.78, and the mean score of the I-CVI to all remaining items was defined as the scale content validity index (S-CVI/Ave) was considered 0.9 or higher. The modified kappa statistic higher than 0.74 was considered excellent and between 0.60 and 0.74 was good [29].

2.3.4. Construct validity

Firstly, data normality was defined by using univariate analysis (using skewness and kurtosis) [30]; then the rate of missing data was checked. EFA with maximum likelihood (ML) extraction method, varimax and direct oblimin rotation were used to examine the construct validity of the scale. Next, the explored construct using EFA was matched to the structure presented by the Vroom's expectancy theory, and was examined using CFA (Fig. 1).

The five-step guide developed by Williams et al. [31] was used to perform EFA. These steps were as follow: examining the suitability of data for factor analysis, identifying the method for performing the analysis for the primary extraction of factors, selecting criteria for
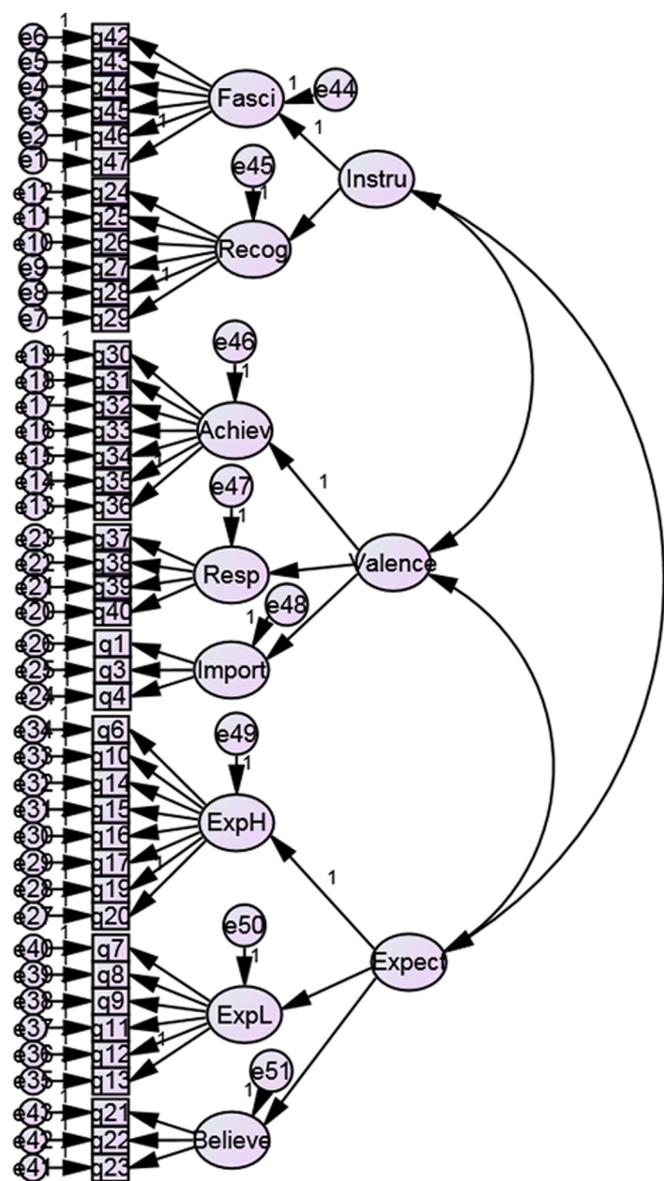
Fig. 1. Eight explored factor matched to the Vroom's expectancy theory structure.

extracting factors, choosing the rotation method and interpreting and naming factors [31].

The sample size at this stage was estimated to be 285 based on the ratio of 5 subjects per item [32]. However, 300 members of the CPR team were recruited for performing factor analysis. The sample adequacy was assessed in terms of Kaiser-Meyer-Olkin sampling index (KMO). Also, factorability of the data was investigated by the Bartlett's Test of Sphericity. For the extraction of factors, according to Thompson and Daniel, the simultaneous use of multiple methods was used. For this purpose, three methods of Kaiser Criteria, scree plot and percentage of cumulative variance explained by extracted factors were used [33]. Having an eigenvalue more than one, positioning of factors outside the horizontal line of the scree plot, and explaining at least 50 percent of the variance by extracted factors were used [31,34]. In this study varimax and oblimin rotations were used, and factors developed by these rotations and correlation between generated factors were checked. The results of oblique (oblimin) rotation were considered due to the correlation of more than 0.30 between some of the factors [30]. Pett *et al.,* also suggested the use of this type of rotation, which could result in an appropriate fit. In addition, the dependent nature of factors from each

other suggests the use of oblique rotation [34]. In this study, the cutting point was considered 0.4 for factor loadings, which resulted in more suitable factors [35]. Items with factor loadings less than 0.4 were deleted. Items that were cross-loaded in more than one factor were placed after conceptual analysis in the factor with a higher conceptual consistency. Those items that were conceptually had no proper correlations with factors were deleted [13]. For CFA, Amos software v.23 and maximum likelihood estimation method were used. To fit the model, fit indices X2, X2/df, goodness-of-fit index (GFI), comparative fit index (CFI), Tucker-Lewis index (TLI), root mean square error approximation (RMSEA) were used [36].

2.3.5. Reliability (internal consistency and test-retest)

Reliability was examined by internal consistency and stability methods [37]. To examine internal consistency of the scale, Cronbach's alpha and omega coefficients were calculated [38]. Given the method used to extract factors in factor analysis (ML), omega values were more appropriate for judging the internal consistency of the instrument [38,39]. For stability, a test-retest method was used. Therefore, 30 nurses were requested to fill out the scale within a 10-day interval. An intraclass correlation coefficient (ICC) was calculated to assess stability [40].

2.4. Ethical considerations

This study was approved by the local Ethics Committee affiliated with Mashhad University of Medical Sciences, Iran (decree code: IR.MUMS.REC.1394.105). Also, the participants in the content analysis stage were asked to sign the informed consent form. Participants in other parts of the study were informed that participation was voluntary.

3. Results

3.1. Qualitative and quantitative face and content validities

The item pool, which originally contained 213 items, was twice reviewed by members of the research team and overlapping items are deleted or merged. In the first and second stage, 151 and 134 items remained respectively which was provided to the panel of experts and members of the CPR team to examine the face and content validities. Seventy-seven items had scores less than acceptable values in terms of IIS, CVR, I-CVI and modified Kappa and were deleted. Therefore, 57 items remained (Fig. 2). The S-CVI was reported as 0.97, and the I-CVI ranged from 0.80 to 1.

3.2. Construct validity (EFA and CFA)

Skewness values between $+2$ and -2, kurtosis between $+7$ and -7 indicate the normality of the data [41]. The rate of missing data was also 0.637%, which is acceptable [42]. The KMO was reported as 0.853 indicating the suitability of samples. The Bartlett's Test of Sphericity was significant in this study ($p < 0.001$) indicating the ability to categorize the items and develop factors. Eight factors with an eigenvalues of more than one were located outside the horizontal line of the scree plot and explained 48.58% of the variance (Fig. 3). Fourteen items were deleted due to a factor loading below 0.4 and were not included in any of the extracted factors. Therefore, a scale with 43 items and eight factors was developed (Table 3).

The results of CFA (Fig. 1) and fitting indices of the model showed that the model had a moderate fit ($\chi^2 = 1946.56$, $\chi2/df = 2.29$, GFI = 0.76, CFI = 0.81, TLI = 0.79, RMSEA = 0.069). Modification indices did not result in significant improved fitness.

3.3. Reliability (internal consistency and test-retest)

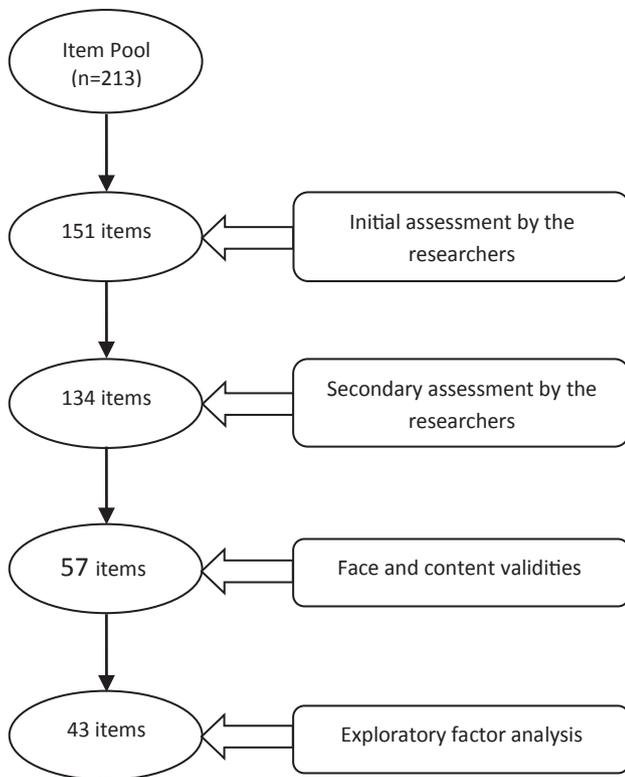Internal consistency of the whole scale and its factors were reported

Fig. 2. A summary of the instrument development and psychometric evaluation.
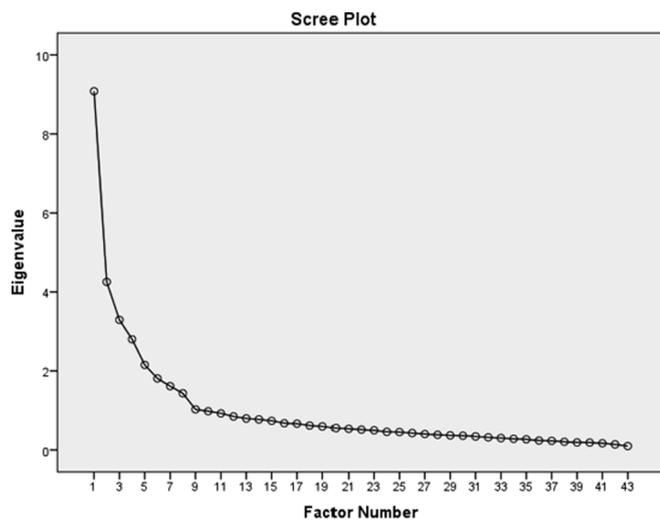

Fig. 3. Scree plot.

as appropriate. The results of the test-retest and intra-class correlations indicated the high stability of the whole scale and all its factors (Table 4).

4. Discussion

To the researchers' knowledge, there is no instrument for assessing the level of CPR motivation in rescuers. The scale designed in this study can measure the CPR motivation among hospital clinical staff in eight dimensions. However, authors recommend the use and validating the CPRMS on different populations in other cultures and contexts. Future research can examine the impact of choosing CPR team members based on CPRMS on CPR outcomes and performances (Such as quality of CPR,

survival rate, time of reaction to a scenario requiring CPR, rescuers' fatigue, satisfaction, burnout, etc.).

For validity, face, content and construct validities were assessed. Also, the internal consistency methods (alpha and omega) and test-retest were used to assess reliability of this instrument. The results of this study showed that the CPRMS was a valid and reliable instrument. The S-CVI was reported as 0.97 indicating the appropriateness of the CPRMS, because many sources consider the S-CVI greater than 0.9 as acceptable [29,43]. The internal consistency of the scale was reported using the calculation of the Cronbach's alpha and omega coefficients and were reported as 0.92 and 0.76–0.86, respectively. Since the value above 0.7 for a new instrument is acceptable, these values show that the items of the CPRMS have an appropriate homogeneity [13]. The low alpha value of the perceived importance dimension of the CPRMS can be due to the low number of items (4 items) in this dimension. This reason has been expressed by Di Iorio as an effective reason on the alpha coefficient [13]. Therefore, omega value was calculated that could provide a more appropriate judgment about internal consistency. The omega value was 0.76–0.86 for the dimensions of this scale indicating the appropriate internal consistency of the CPRMS [39]. The ICC of CPRMS was 0.90, and its dimensions ranged from 0.70 to 0.91. Terwee et al. consider ICC as one of the criteria for assessing an instrument, and values between 0.6 and 0.74 are interpreted as good and higher than 0.75 are excellent [44]. Therefore, given the ICC values, the CPRMS had excellent stability and its dimensions had good to excellent stability at different measurement times.

EFA was used in this study, because it allowed researchers to explore the various dimensions of the structure under study in a new context [45]. Considering the differences in the context of the present study with the context in which Vroom developed his theory (Canada and the United States), the importance of using EFA revealed. Because of the Vroom's expectancy theory was used to analyze data in the qualitative phase, CFA was used to assess the fitness of the theory structure in the new context [45]. The results showed that the structure of Vroom's expectancy theory in the study field had a mediocre fit. This showed that cultural and social differences in Iran led that the Vroom's expectancy theory failed to fully explain CPR motivation in Iranian rescuers. The impact of cultural and social differences on motivation has already been mentioned in other study [46].

The final version of the CPRMS had eight dimensions and the scores of these dimensions could not be added together. Therefore, instead of a CPRMS's total score, each person has eight scores for the dimensions. The first dimension of CPRMS focuses on facilitators of CPR such as facilities, coordination, and good supervision and leadership in the resuscitation team. In other studies, the existence of necessary infrastructure, and hospital resources [47], positive supervision [48], good cooperation in health care team [6], are mentioned as factors affecting the motivation of health workers. The second dimension suggests a person's sense of accomplishment in performing the organizational, ethical and spiritual tasks associated with CPR, along with some consequences for the person. Achievement is mentioned as one of the most important job motivational factors in medical and nursing staff [49,50]. The items of the third dimension indicated conditions that increased the likelihood of successful CPR. In contrast, the fourth dimension described the conditions that reduced the likelihood of success in CPR. Vroom stated that, one of the most important motivator is the likelihood of success [16]. The fifth dimension concerned about the likelihood of positive outcomes for the rescuer (consequences such as attracting others' trust and respect, improving occupational safety, etc.) after successful CPR. Lambrou et al. mentioned receiving social respect and acceptance as an incentive for nursing and medical staff [49]. In the Herzberg's Two-Factor Theory of work motivation, recognition and advancement as the motivator of the staff, and job security as a hygiene factor are mentioned [51]. Franco et al. also defined job security as one of the most important motivational factors for health workers [52]. Accountability to competent authorities and patients affiliated are

Table 3

The items after direct oblimin rotation and factor loadings for the CPRMS (n = 300).

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
1. During the CPR, I try more than usual.							0.417	
2. I make the maximum effort in the CPR because it is important for me to bring back the patient to life.							0.728	
3. I make the maximum effort in the CPR because it is very important for me to save the patient without any harm.							0.827	
I believe that an attempt to CPR will lead to its success if….								
4. The patient gets a sudden cardio/respiratory arrest.			0.544					
5. The patient with brain damage needs CPR.				0.682				
6. Patient with underlying illnesses (liver, kidney, systemic infection, etc.) requires CPR.				0.718				
7. A patient with cancer needs a CPR.				0.730				
8. The patient needs CPR suddenly (for example, drowning, shock, poisoning, etc.).			0.508					
9. The patient often requires CPR.				0.674				
10. The patient has a history of prolonged hypoxia.				0.695				
11. The patient is in the end stage of life.				0.679				
12. The patient is not old.			0.634					
13. The patient has arrested in front of me or my colleagues.			0.736					
14. CPR is started immediately after arrest.			0.864					
15. The patient's condition is improving.			0.749					
16. The patient's conditions are similar to my other successful CPRs in the past.			0.507					
17. I feel very well prepared for doing CPR.			0.400					
I'm doing my best in CPR because…								
18. I believe that God (supernatural power, the supreme being, creator deity) is the main determinant of the time of death.								0.760
19. I believe that after God (supernatural power, the supreme being, creator deity), I am the main patient assistant.								0.627
20. I believe that my performance is under divine supervision.								0.582
21. Of that, the likelihood of understanding my distinctive performance by others is very high.					0.665			
22. Of that, the likelihood of attracting the trust of others (superiors/physicians/patient families) is very high.					0.684			
23. The likelihood of creating opportunities for improving my skills and abilities is very high.					0.608			
24. The likelihood that its success will lead to the satisfaction of the family and companions of the patient is very high.					0.517			
25. It is very likely that its success will lead to job security.					0.605			
26. The likelihood that its success will lead to more respectful behaviors with me is very high.					0.594			
27. Its success makes me feel useful.		0.697						
28. Its success makes me feel proud.		0.585						
29. I do my moral and humanistic duty.		0.483						
30. I do my organizational duty.		0.504						
31. It makes me feel better about myself.		0.682						
32. Its success makes me experience the pleasurable feeling of patient recovery.		0.697						
33. It causes divine satisfaction.		0.604						
34. It makes me immune to possible legal consequences.						0.714		
35. It reduces the risk of aggression of companions and the family of the patient.						0.641		
36. I must be responsive to patient's companion.						0.743		
37. I must be accountable to competent authorities.						0.778		
I'm doing my best in CPR if…								
38. Having a competent leader in our CPR team.	0.817							
39. We have a coordinated team, with competent member.	0.938							
40. The CPR environment is tidy and calm, with necessary and adequate facilities and equipment.	0.873							
41. DNAR order is not available for the patient.	0.479							
42. There are enough staff to do CPR for the patient.	0.741							
43. I do not feel too much fatigue.	0.599							

Table 4

The CPRMS reliability and its factors.

Number of factor	Factor	Number of items	Mean (SD)	Cronbach's α (n = 300)	Coefficient Ω (n = 300)	ICC (95% CI) (n = 30)
1	Resuscitation facilitators	6	31.04 (7.83)	0.93	0.86	0.72 (0.41–0.87)
2	Feeling of achievement	7	30.17 (4.01)	0.86	0.78	0.70 (0.37–0.86)
3	High chances of success	8	33.80 (5.02)	0.84	0.76	0.81 (0.59–0.91)
4	Low chances of success	6	17.49 (5.60)	0.86	0.80	0.90 (0.8–0.95)
5	Recognition and appreciation	6	21.50 (5.32)	0.86	0.80	0.91 (0.81–0.96)
6	Accountability	4	14.55 (3.48)	0.82	0.81	0.90 (0.80–0.95)
7	Perceived importance	3	13.23 (1.78)	0.67	0.80	0.86 (0.70–0.93)
8	Beliefs	3	13.33 (1.93)	0.80	0.83	0.84 (0.66–0.92)
	Total	43		0.92		0.90 (0.80–0.95)

ICC: intraclass correlation coefficient.

considered in the sixth dimension. Herzberg also stated responsibility for the employees' motivation factors [51]; which is consistent with the nature of the response dimension in the present study. In this regard, other studies stated that responsibility is one of the most important motivational factors in health care workers [50,53]. The seventh dimension points to the importance and value of the patient's return to the rescuer and its effects on their performance. Toode et al. state that when the nurse's work is valuable to them, their motivation to do it increases [54]. Finally, the beliefs of the rescuer considered in the eighth dimension. Skora and Riegel noted that religious and philosophical beliefs of bystanders participating in CPR have an impact on their motivation to help the patient through CPR [55].

According to the lack of a total score for CPRMS, rescuers can be compared by dimensions, and in the selection of the CPR team, rescuers with higher scores are prioritized. Acquiring a high score in dimensions such as perceived importance, feeling of achievement, and beliefs indicate a high internal motivation as well as in dimensions such as facilitators of resuscitation, recognition and appreciation, and accountability reflects the external motivation of the rescuers. Because rescuers with higher intrinsic motivation often do the job for the sake of its nature and its eventual inherent satisfaction, not for its outcome; they can preferably be included in the CPR team. Acquiring a high and low score in the dimension of the high and low chances of success respectively indicates that the rescuers are not motivated to accomplish the CPR when they think it is futile.

The closest tool to the CPRMS has been found by the authors be the Nursing Motivation for Helping Scale (N-MHS). In the N-MHS developed by Gutiérrez et al., EFA led to the development of three factors of altruism motivation, the motivation to seek rewards and the motivation to avoid punishment [19]. The factor of altruism motivation in this study was similar to the perceived importance factor. Also, the motivation to seek rewards and motivation to avoid punishment were similar to the factors of recognition and appreciation, and responsibility in this study, respectively. Therefore, dimensions such as facilitators of resuscitation, feeling of achievement, high and low probability of success, and beliefs in the present study were not developed in the N-MHS. The reason for this difference can be the specific features of 'resuscitation' versus the general aspects of 'helping' others.

5. Study limitations and strengths

Designing the CPRMS based on the classical test theory of measurement, and evaluate its psychometric properties only in Iranian clinical staff, is the limitation of this study, because sample characteristics influence the tool characteristics such as reliability, factor loadings, and discrimination [56]. Therefore, authors recommend the adaptation of the CPRMS in other cultures and contexts. Another limitation of this study is the lack of convergent and divergent validity that could result in a more comprehensive review of the validity of the instrument. The simultaneous use of IIS, CVR, I-CVI, S-CVI and modified Kappa methods (k*) for quantitative evaluation of face and content validities, and the use of alpha and omega methods for calculating internal consistency were the strengths of this study. They have been able to fully assess the validity and reliability of this scale. The use of k* by calculating the probability of chance agreement, reduces the random agreement between experts. Another strength point of this study was the use of other related tools and directed qualitative content analysis to produce the items' pool that helped generalizability of the instrument's dimensions to other contexts.

6. Conclusion

This study led to the development of a valid and reliable scale with eight dimensions consisting of 43 items. The CPRMS can assess the CPR motivation in dimensions of facilitators of resuscitation, feeling of achievement, high chances of success, low chances of success,

recognition and appreciation, accountability, perceived importance and beliefs. Future studies can examine the impact of using CPRMS in selecting members of the CPR team on its outcomes and interventions.

Conflicts of interest

The authors declare no conflicts of interest.

Contributions

Study Design: AA, FHN, & AE.
Data Collection and Analysis: AA, & AE.
Manuscript Writing: AA, FHN, & AE.

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