Prioritization of Assessment Criteria of HSE Management Performance in Healthcare Centers

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Date of submission: *02 Feb. 2019,* ***Date of acceptance:*** *23 Jun. 2019*

Original Article

Abstract

INTRUDUCTION: Staff of medical centers, who are saviors of accident victims, face risks at work that may even lose their lives. Although different criteria have been used in different studies, the performance of medical centers in terms of health, safety, and environment (HSE) management has not been evaluated. Therefore, the extraction, grouping, and prioritization of the HSE management assessment criteria of medical centers were performed in the present study.

METHODS: Using the systematic method, following examining the most important methods, the criteria and sub-criteria associated with the HSE management of the medical centers were extracted, grouped and prioritized using the opinions of experts. The entropy method was employed to analyze the criteria.

FINDINGDS: Total of 33 criteria and 166 sub-criteria were extracted which from them the criteria of operation control, risk management, and resource management had the highest repetition in the performance assessment methods. Finally, the cases were classified in 13 criteria and 35 sub-criteria, and the criteria of strategic management and compliance with laws and regulations were of the highest importance from the viewpoint of the study experts.

CONCLUSION: The investigation on different methods showed that the criteria used did not cover all of important issues (such as strategy, goals and programs, resource allocation, evaluation of stakeholder needs, and selection of suppliers from the perspective of HSE management). The results provide a good ground for introducing and developing criteria for evaluating the HSE management of medical centers to improve the performance and compare different centers.

Keywords: Healthcare Centers; Performance Assessment; Health; Safety; Environment

How to cite this article: Azimi-Hosseini SS, Mansouri N, Azizinezhad R, Karimzadegan H. **Prioritization of Health, Safety, and Environment Management Performance Assessment Criteria Included in Assessment Methods of Healthcare Centers.** Sci J Rescue Relief 2019; 11(3): 163-73.

Introduction

In hospitals and care facilities worldwide, millions of individuals work in various occupations the health of whom is threatened by many occupational hazards (1). Healthcare is now recognized as a high-risk industry for patients and staff, and compared to other industrial sectors, the healthcare sector ranks second in terms of the number of injuries and diseases (2).

Treatment staff encounter numerous risks such as infectious, chemical, physical, and ergonomic agents (3). The presence of flammable substances, medical gases, ionizing radiation, and chemicals

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[DOI: 10.52547/jorar.11.3.163]

requires constant care to save the lives of patients and staff (4).

Not only are health care workers at various risks, but there are also environmental problems in these centers that endanger public health (5). Additionally, given that Iran is exposed to a variety of natural and man-made hazards, and according to the Global Assessment Report on Disaster Risk Reduction, Iran's risk level only for natural hazards taking into account about 106,000 deaths over the past four decades, is estimated to be 8 out of 10 (6). The role of medical centers in critical situations is very serious (7). Given the above-mentioned issues, it is essential to ensure the compliance with the health, safety, and environment (HSE) measures in health care centers.

Countries are increasingly publishing health system performance statistics in parallel with similar organizations to show excellent performance, success, and continuous improvement (8). Various tools have been developed over time to measure performance (9). The four main methods of measuring the performance of medical centers include regulatory inspection, public satisfaction assessment, third-party evaluations, and comparison of statistical indices, of which using statistical indicators and third-party evaluations (e.g., accreditation) are among the most popular applied in health care institutions around the world (10); defining and identifying accurate criteria are the most important steps in the evaluation process (11).

Various studies have employed different methods and criteria in evaluating medical centers, most of which have evaluated these centers from the perspective of service quality, patient safety, and patient satisfaction. For instance, the study by Bramesfeld measured the quality of medical services in Europe (12) and the study by Marshalller examined patient safety culture in surgeons (13).

The Balanced Score Card (BSC) method has been applied in several studies, including the study carried out by Vafaee-Najar et al. combined with Delphi Technique (14), the study by Dastmardi et al., which was integrated with Laboratory Quality Management System (LQMS) (15), or in the study by Heidari Dehvi et al., which used a combined approach of interpretive structural equations and network analysis process method (16). Moreover, in the study by Omidvari et al., BSC was combined with FANP (17), or the organizational excellence model used in the study by Samadi et al. (18).

In other studies, medical centers were measured by specific criteria, such as assessing the level of awareness and attitude of employees in the field of HSE in the study conducted by Rezaei et al. (19), the healthcare performance assessment in the knowledge management process use in the study by Mirghafouri et al. (20), or the vulnerability of public hospitals affiliated to Tehran University of Medical Sciences, Tehran, Iran against earthquakes in the study accomplished by Seyedin et al. (21). In another study, Lapcevic et al. applied the hospital safety index (HSI) to determine preparedness for emergency conditions in floods in primary care centers (22).

Shafi et al. investigated the level of awareness of nurses of the principles of radiation protection in hospitals (23), or another study addressed observance of the principles of radiation protection in the Intensive Care Units (ICUs) of Imam Reza Educational and Medical Center in Kermanshah, Iran (24). In the field of environmental issues, studies have been accomplished on waste management in selected hospitals of universities of medical sciences of Tehran (25) and Karaj (26), in addition to another study performed on energy consumption in 13 private hospitals in Spain (12).

Several methods are used for evaluating health centers in different countries, the most important of which are discussed in the following: the assessment models of Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and the Joint International Commission (JCI), which as the most well-known accreditation authorities, have introduced evaluation criteria for eight groups of medical centers, including hospitals (27), ambulatory care (28), clinical care (29), clinical laboratories (30), long term care (31), primary care (32), home care (33), and medical transport organizations (34). The International Society for Quality in Health Care (ISQua) model evaluates medical centers based on three principles of leadership, support services, and service delivery, as well as eight standards (35).

The comprehensive tool for smart hospitals of Pan organization is an international evaluation model consisting of two parts: building and operations, and addresses safety and environmental

[DOI: 10.52547/jorar.11.3.163]

issues such as energy management, ventilation, waste management, emergency response, etc. (36).

The Australian Commission on Safety and Quality in Health Care (ACSQHC) has provided 10 National Safety and Quality Health Service (NSQHS) Standards for safety and quality improvement systems, covering quality and safety management in healthcare organizations, collaboration with patients, prevention and control of health-related diseases, medication safety, patient identification, clinical transmission, blood and blood products, prevention and treatment of injuries, diagnosis and response to clinical weakness, prevention of falls, and related injuries (37).

The French accreditation system has introduced 28 standards and 82 criteria in two sections, which assess the level of standards expected from medical centers at four levels (incomplete structure or performance to performance appraisal or continuous quality improvement) (38).

In the accreditation system of Egypt, 716 standards have been developed and divided into three groups, of which 69, 322, and 325 standards have been identified as essential standards, central or important standards, and desirable or non-central standards, respectively (39).

In Iran, efforts have been made to improve the quality of health services, and performance appraisal systems have been implemented in hospitals, including clinical governance, accreditation, and patient safety-friendly hospital systems. The fourth course of national accreditation of hospitals, which is currently the basis for evaluating hospitals in Iran, consists of 19 axes as the main components, which include 110 standards and 514 criteria (in three levels) (40).

Reviewing various studies, no study was found on the introduction of HSE criteria in medical centers. Besides, the HSE performance evaluation criteria lead to the improved condition of medical centers, increased employee health, and improved quality of medical services. Therefore, the present study is conducted aiming to introduce the HSE management criteria of the medical center models and their priorities that can be used to self-evaluate medical centers or to evaluate and rank similar medical centers.

Methods

Primary Selection of Medical Centers HSE Management Performance Evaluation Criteria: In this study, it was tried to collect, group, and determine the importance of HSE criteria used in medical centers performance evaluation methods. After reviewing the research literature and the medical centers evaluation methods, eight evaluation methods (JCI, ISQua, PAN, and ACHS, accreditation method used in France, Iran, Lebanon, and Egypt) were selected. The process of selection of the evaluation methods was such that the methods with more comprehensive and accurate criteria in different geographical areas were the basis for research. 33 criteria and 166 sub-criteria of the relevant criteria were extracted, which were classified into 13 criteria and 35 sub-criteria after identifying and examining the major HSE issues of medical centers. The questionnaire was then used to determine the significance of the criteria. Besides, expert judgment was employed to determine the content validity of the questionnaire from the perspective of clarity and simplicity of expression. Then, according to the corrective opinion of the experts, the necessary modifications were made in the content of the method and the final questionnaire of "Determining the importance of the effective criteria in measuring the HSE management performance of medical centers" was designed.

The questionnaire consisted of two parts, with the first part including background information on the respondent's characteristics such as education, field of study, job, and related work history, and the second part including scoring the sub-criteria effective in measuring HSE performance of medical centers using a five-point Likert scale (very insignificant, insignificant, relatively important, important, very important).

To complete the questionnaire, a statistical sample of 97 subjects was found to be significant based on Morgan table and in this study, the opinions of 98 experts in the field of medical center HSE were collected. The experts included specialists in the areas of HSE management, health service management, industrial safety, environmental management, passive defense, occupational health, and environmental health. The individuals were selected from among academic specialists and staff of 30 public and private hospitals in provinces of Tehran, Guilan, Qazvin, Zanjan, and East Azerbaijan. The results of the questionnaire evaluation indicated that most of the participants (40.5%) had a master's

[DOI: 10.52547/jorar.11.3.163]

degree and 49% had more than 10 years of work experience related to HSE subjects. Furthermore, the Cronbach's alpha coefficient was utilized to evaluate the internal consistency of the effective factors. Considering that the Cronbach's alpha coefficient was calculated as 0.919 and more than 0.7, it can be concluded that the questionnaire was of a very good and acceptable reliability (41).

Determining the importance of criteria: Different criteria have different effects on the evaluation system (42). Among the methods for determining the weight of the criteria, the methods including the expert response, the Linear Programming Technique for Multidimensional Analysis of Preference (LINMAP) method, the least squares method, the Eigen vector technique, Shannon's entropy, etc. can be mentioned (43).

In this study, in order to assign weight to the criteria, the Shannon's entropy method was employed. The most important advantages of this method are: the possibility of simultaneous use of multiple quantitative and qualitative indicators, ease of use, the possibility of changing the input information, expressing the results as a preference coefficient, simultaneously considering the value of each indicator in each operating unit, and the preference of indicators that lead to more reliable results (44).

In the information theory, entropy is a measure of uncertainty expressed by a certain probability distribution Pi. This method is derived from the systems theory and is considered as compensatory methods (45). This method is based on the fact that the higher the dispersion in the values of an index, the more important that index is (46). In order to implement this method, it is necessary to first prepare the frequency matrix of the criteria according to the respondent as Table 1, which 98 respondents and 13 criteria were present in the current study.

Table 1. Decision matrix

Respondent	Criterion			
	C1	C2	…	C13
1	a_{11}	a_{12}	…	a_{113}
2	a_{21}	a_{22}	…	a_{213}
...	…	…	…	…
98	a_{981}	a_{982}	…	a_{9813}

In order to reduce the effect of different units of criteria (42), the elements of the decision matrix were non-dimensional zed using Equation 1:

$$p_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^{m} a_{ij}^2}}$$ Equation (1)

The entropy of the j-th (Ej) criterion was calculated as follows:

$$E_j = -K\sum_{i=1}^{m}[p_{ij}\ln_{ij}(p_{ij})]$$ Equation (2)

The value of the constant K in this study was calculated as follows:

$$K = \frac{1}{\ln(m)}$$ Equation (3)

m = 98, Ln98 = 4.585, K = 0.218

Finally, using the criteria information, the importance coefficient of each criterion was calculated. The calculation of the importance coefficient of each criterion W_j was performed using equation (5), indicating the importance of that criterion from the viewpoint of all experts (44).

$$d_j = 1 - E_j$$ Equation (4)

$$W_j = \frac{d_j}{\sum_{j=1}^{n} d_j}$$ Equation (5)

Findings

As mentioned in the Materials and Methods section, the methods of evaluation of the medical centers were examined and their HSE-related criteria were extracted. Table 2 demonstrates the criteria and sub-criteria extracted from the evaluation methods and type of communication (directly or indirectly associated with the HSE issues).

Figure 1 exhibits the use of the classified criteria in the medical centers evaluation methods. In this study, the entropy technique was utilized to evaluate the experts' opinions and identify the most important effective criteria used, the results of which are shown in Table 3, and finally a comparison was made on the importance of the criteria (Figure 2).

Discussion and Conclusion

In this study, the criteria related to the evaluation of HSE performance of medical centers were extracted, grouped, and weighted.

[DOI: 10.52547/jorar.11.3.163]

Table 2. Criteria and sub-criteria associated with the HSE issues in medical center evaluation methods

Criterion	Sub-criterion	JCI	ISQua	PAN	ACHS	French accreditation	Iran accreditation	Lebanon accreditation	Egypt accreditation	Association with HSE issues	
										Indirect	Direct
Strategic management	Quality policy and safety concerns	*									*
	Strategic plan							*		*	
Resource allocation in the field of HSE	Risk of shortage or depletion of credits						*			*	
Communication and participation	Communication with beneficiaries							*		*	
	Management of beneficiaries' comments and suggestions					*	*	*		*	
Resource management	Energy management	*	*			*	*		*		*
	Management of equipment related to safety, health, and environment		*	*			*	*			*
Emergency response	Emergency response plan			*			*	*	*		*
	Holding and evaluating maneuvers						*	*			*
	Emergency response equipment management			*			*	*			
Risk management	Risk identification and assessment	*	*		*	*			*		*
	Risk reduction	*	*		*		*	*			*
Incident management	Incident reporting and analysis and determining corrective actions	*			*	*		*			*
Operation control	Employee health and safety programs	*	*				*	*	*		*
	Inspection and maintenance programs	*	*							*	
	Structural, physical safety, and equipment management		*	*	*	*	*	*	*		*
	Safe transport	*									*
	Hygiene observance				*	*	*	*	*		*
	Radiation protection							*			*
	Warehouse safety						*	*			*
	Chemicals management	*					*	*	*		*
	Electrical safety						*	*			*
	Safety of contractors							*		*	

[DOI: 10.52547/jorar.11.3.163]

Table 2. Criteria and sub-criteria associated with the HSE issues in medical center evaluation methods (continue)

Criterion	Sub-criterion	JCI	ISQua	PAN	ACHS	French accreditation	Iran accreditation	Lebanon accreditation	Egypt accreditation	Association with HSE issues	
										Indirect	Direct
Pollution management	Air pollutant management			*		*					*
	Waste management	*		*		*	*	*			*
	Water and wastewater management			*			*	*			*
HSE	Fighting vermin						*				*
	Safety culture	*									*
Monitoring and evaluation	Internal audit						*			*	
	Workplace improvement program and its evaluation					*				*	
	Monitoring strategic goals and programs						*			*	
	Performance evaluation and improvement		*				*	*		*	
Compliance with rules and standards	Compliance of rules, regulations, and inspections with requirements	*							*	*	
Training and knowledge management	Holding training courses related to HSE topics	*			*		*	*	*		*
	Help books with HSE topics						*	*			*

[DOI: 10.52547/jorar.11.3.163]

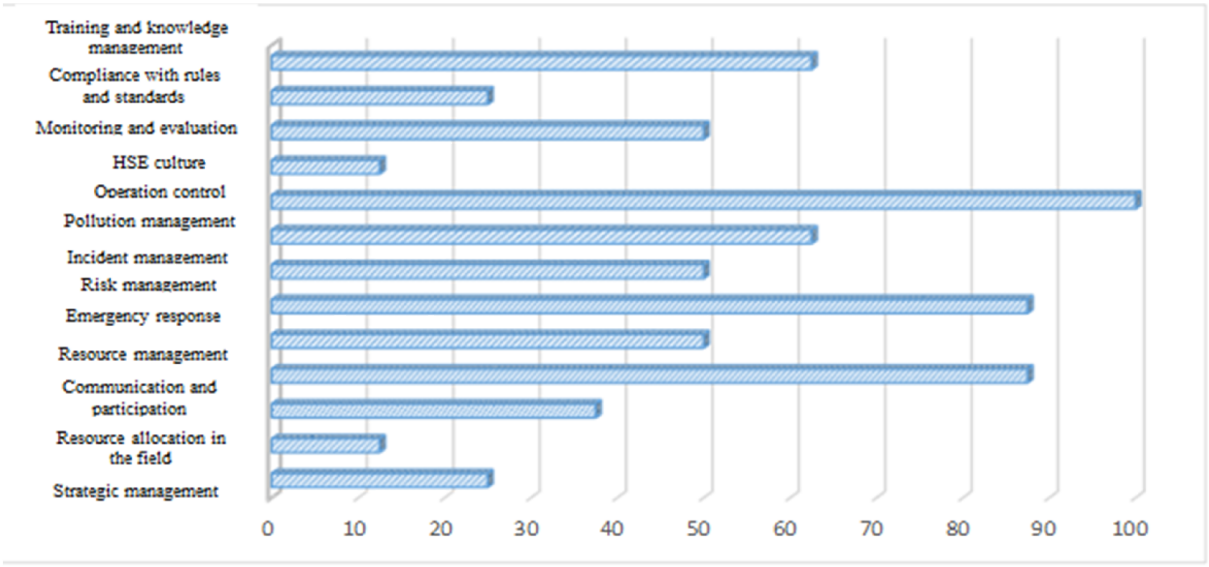

Figure 1. The extents of application of health, safety, and environment (HSE) standards in the medical centers evaluation methods

As illustrated in Figure 2, strategic management was identified as the most important criterion from the point of view of the experts in this study, but this criterion was only mentioned in the JCI and Lebanese accreditation methods, which in the JCI method only the policy and safety concerns have been addressed and the health and environmental issues have not been taken into account.

Table 3. Entropy and uncertainty values and weights of evaluation criteria of management of health, safety, and environment (HSE) in medical centers

Criteria	E_j	d_j	W_j
Resource allocation in the field of HSE	0.2049	0.7951	0.0764
Strategic management	0.1905	0.8096	0.0778
Training and knowledge management	0.2042	0.7958	0.0765
HSE culture	0.2017	0.7983	0.0767
Communication and participation	0.2045	0.7955	0.0764
Monitoring and evaluation	0.1984	0.8016	0.0770
Compliance with rules and standards	0.1944	0.8056	0.0774
Risk management	0.1983	0.8018	0.0770
Operation control	0.1965	0.8035	0.0772
Emergency response	0.1981	0.8019	0.0771
Incident management	0.1992	0.8008	0.0768
Resource management	0.2014	0.7986	0.0767
Pollution management	0.2009	0.7991	0.0767

In the Lebanese accreditation method, strategic management has been discussed generally and the need to consider the HSE issues has not been included in the long-term organization planning (Table 2). Additionally, strategic management has been proposed in ISO45001:2018, ISO14001: 2015, and ISO9001:2015 standards, and it is clear that without long-term planning, strategy formulation, and presence of goals and programs and their monitoring, improvement in the field of HSE of medical centers would not be possible.

Following strategic management, compliance with the rules and standards has the greatest weight from the perspective of experts (Figure 2), which is referred to in JCI and Egyptian methods (Table 2).

As depicted in Figure 2, the criteria for monitoring and evaluation, risk management, and emergency response obtained very high scores and very close to each other, indicating the great and almost identical importance of these cases from the perspective of experts. Risk management has been proposed in JCI, ISQua, French accreditation, Australia accreditation, Iranian accreditation, Egyptian accreditation, and Lebanese accreditation methods (Table 2) and in ISO14001:2015 and ISO45001:2018 standards, in addition to the plan to identify the environmental hazards and aspects and risk evaluation, HSE opportunities were also addressed.

[DOI: 10.52547/jorar.11.3.163]

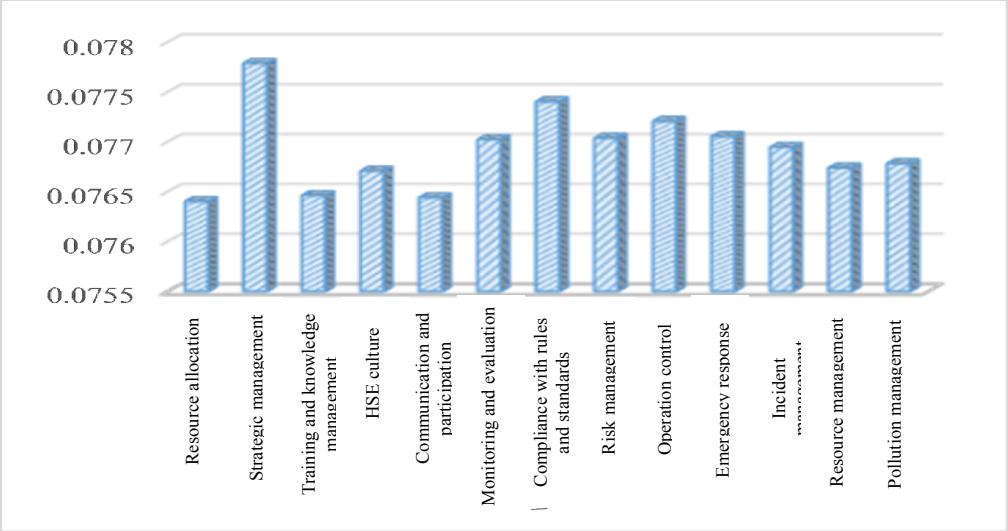

Figure 2. Level of importance of health, safety, and environment (HSE) performance evaluation criteria of medical centers from the perspective of experts

The structural management sub-criterion in this study is in line with the structural safety of the studies by Seyedin et al. (21) and Lapcevic et al. (22), and the non-structural management section including electrical, communication, fire control and emergency exit systems of the study by Seyedin et al. (21) is consistent with the emergency response management sub-criterion of the present study. In the study by Lapcevic et al. (22), access, physical safety, facilities and equipment were associated with the two sub-criteria of HSE-related equipment management and emergency response equipment management.

The criteria of resource allocation in the field of HSE and communication and participation have accounted for the lowest weight from the perspective of experts. However, it should be noted that the difference in scores obtained is very small (0.0764-0.0787) (Table 3).

Communication with beneficiaries in the Lebanese accreditation method and management of beneficiaries' comments and suggestions have been mentioned in the accreditation methods of France, Iran, and Lebanon, but as specified in Table 2, the communication with beneficiaries and collection and analysis of their suggestions on the HSE-related issues have not been directly addressed in these methods. Moreover, the resource allocation has been indirectly mentioned in the Iranian accreditation method.

As shown in Figure 1, the operation control criterion was the most widely used criterion in the evaluation methods of medical centers and was mentioned in all methods, which has been given a high degree of importance from the perspective of experts in this study (0.0772, Table 3). Furthermore, in this criterion, the sub-criterion of structural, physical safety and equipment management is the most mentioned issue in the evaluation methods reviewed (Table 2). The radiation protection sub-criterion in this group is in line with the studies by Shafi et al. (23) and Tohidniya et al. (24), who evaluated the level of awareness of the protection principles and observance of these principles against radiation, respectively.

The field of HSE awareness and culture rising is very limited and is mentioned only in the JCI method (Table 2), and the field of knowledge training and transfer has been limited to holding some safety topics and distributing booklets. Additionally, the study by Rezaei et al. (19) has addressed the level of awareness, attitude, and performance of employees in the field of HSE, and in similar studies such as the study by Mirghafouri et al. (20), the performance of medical centers in applying knowledge management has been studied, but the HSE issues have not been mentioned.

The pollution management group gained a score of 0.0767 (Table 3); waste management in this group has been the criterion for evaluating hospitals in the studies by Zeraatkar et al. (25) and Farzadkia et al. (26), and the energy management sub-criterion in the resource

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management criterion of the current study is in line with the energy consumption evaluation in the study by Garcia-Sanz-Calcedo et al. (41).

Examining the medical center HSE performance assessment methods, it was found that the issues raised in the field of evaluation of medical centers from the perspective of HSE are very limited and many key issues such as strategy development, HSE goals and programs, allocation of resources in the HSE field, identification and assessment of stakeholder needs from the perspective of HSE assessment, evaluation and selection of suppliers, compliance with HSE rules and requirements, and many other important issues have not been considered. Therefore, in future studies, the medical center HSE management evaluation criteria can be reviewed and formulated to provide a platform for evaluation of these centers from the perspective of HSE issues.

Acknowledgments

The Center for Environmental and Occupational Health of the Ministry of Health and Medical Education is appreciated for their cooperation in completing the study questionnaires.

Conflict of Interests

Authors have no conflict of interests.

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[DOI: 10.52547/jorar.11.3.163]