Comparison and prioritization of nurses' stressors and its role on patient's safety using SPSS and AHP methods

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Abstract

Stress is a subject which extended from legendry to fact in history. It is now certain however that nervous stress or stress is among hot subjects in today's organizations in our changing world which endangers physical and psychological health of the human resources which consequently leads into exorbitant costs. Nowadays, human resources encounter various complicated problems in numerous organizations and institutes in Iran, one of which is nervous stress. Health care workers (HCWs) who work in hospital experience a variety of physical and psychological effects which influences their exhaustion and stress tolerance which in turn will have potential consequences in patient's care. The present research intends to investigate nurses job stress involved in patients care utilizing SPSS and AHP. This is a descriptive research which has conducted in three hospitals affiliated to Tehran medical branch of Islamic Azad University during six months of August to December 2016. The questionnaire was prepared and its validity and reliability was proved. A statistical population including 90 nurses was selected randomly who answered 53 questions. An expert group consisting of managers and administrators of the three hospitals determined their criteria for a better option including cost, time and organizational regulations. The best choice was made based on AHP to modify the procedure to reduce job stress. The results based on SPSS demonstrated that the staff welfare and support plays the major role in job stress while participation in planning and decision taking played the minor role, followed by respect and relationship, security, job motive and justice. Furthermore, the research result based on AHP analysis indicated that participation in planning and decision taking is as the most important factor as stressor followed by security and job motive, staff welfare, support and justice. Motivation can be provided for nurses by suppressing stressors which helps in preventing human error especially repetitive errors which paves the way for a safe health care environment for patients.

Keywords: AHP, job stress, patient safety, HCWs

Introduction

Nowadays, human resources encounter numerous complicated problems in the organization and institutes of Iran, one of which is stress [9]. Stress has been investigated for many years in the medical sciences however it is a quite new subject in organizational behavior. Recently, the experts analyzed nervous stress and its consequences on human resources and in the organizations [10].

It's definite that stress is part of people's life that has a job which exerts its adverse effects of psychological stress in a variety of ways [11]. Job changes such as organizational transformation, change in salary and payments, job promotion, expansion and decrease in human resources and

social turnabouts are among subjects which exert stress on the staffs, leading in anxiety, worry, agitation and trepidation [8]. It's obvious that increasing job stress on individuals will undoubtedly influences his/her physical and psychological health that will have an adverse effects in his performance both in the work environment and in the family [1,3].

Since 1960's, job was a major mental concern. Occupation is an exciting challenge for individuals, although it serves as a major source of stress through their lives. Stress has been a noteworthy subject in research arenas in recent year so that some researchers called it the stress century [21].

HCWs working in hospitals experience high levels of physical and psychological effects which is reflected in their work stress and exhaustion. This will have potential undesired outcomes in the patient's care [12].

In recent years, managers of health systems in different countries of the world utilized numerous methods to upgrade both quality and safety of health care service and their optimal management. They considered patient safety along with service quality, emphasizing the organization's obligation to implement high levels of standards [7].

Some solutions have been proposed and implemented to promote staffs job motivation in health care centers. These solutions helped useful but in a short run which did not serve as a well-established ones. This roots in lack of criteria determination for solution implementation as well as no applied and theoretical prioritization was made in this regard. If no basic analysis on human errors was made, probable damage resulting from medical health care system increases in patients which will have irreparable loss.

The main goal of the present research is to determine main job stressors including education and understanding job duties, the principles of respect and work relationship, participation in planning and decision taking, staff welfare and support, justice and job security and motivations to supress job stressors in nursing which protects patients against human errors.

Stress in nursing is considered a usual problem throughout the world [4] and medicines and nurses experiences high risk of stress [2,5]. Reducing stress and exhaustion through organizational chart in order to minimize its adverse effects in HCWs is of high advantages for hospitals and health care centers which leads into promotion of staff health care and guarantee patient's safety [13]. WHO and pioneer organizations suggested establishment of a comprehensive systematic structure based on patient safety promotion in order to reduce adverse outcomes and provide suitable response to

the injured. It is possible through establishment of patient safety culture and suitable organizational mechanisms.

The patients' safety status in three hospitals were investigated during a yearlong in which 17 patients' fell off the bed, 4 cases of losing pathologic sample, 25 cases of mis-prescrition, 2 cases of medicine mis-injection, 3 cases of babies vaccine mis-injection, 10 cases of leaving hospital with personal desire due to unsuitable service of the hospital, 2 cases of baby mis-placement and 32 cases of bed soars were reported.

Previous works

Arimura and his colleagues (2010) investigated a case study by the title of "Sleep, Mental Health Status, and Medical Errors among Hospital Nurses in Japan". The results demonstrated that sleep and mental status were of lower importance in nurses, therefore, shift working and weak psychological health are among considerable factors involved in incidence of medical errors [14].

Farquharson (2012) in an article by the title of "Nursing stress and patient care: real-time investigaton of the effect of nursing tasks and demands on psychological stress" investigated the relationship between nurses' duties and stress physiological measurements in order to examine job stressors impact on various duties. The results of the investigation suggested possible changes which served in reducing nurses' discomfort, promotion of patient's health care, development of modified methods resulted from stress investigation to optimize budget for patients' care [15].

Lyndall et al. (2013) in their article by the title of 'Factors that may influence midwives work-related stress and burnout' investigated major influencing factors involved in the stressors by determining midwives stress and burnout. All the 752 nurses working in two state-run hospital in New South Wales were questioned through burnout questionnaires in which nurses job stress were examined regarding shiftwork, exercise, … The research indicated that two third of the questioned nurses had emotional burnout while one third of them felt successful in their job. One third of them suffered from job burnout.

Furthermore, analytical analysis demonstrated that midwives with longer experience and more time allocation to exercise suffered from less job burnout [16].

In the previous works, job stress has been proved in various care groups. Some investigations proved that job stressors including insufficient sleep, income and mental status influence their duties which in turn are reflected in patients' safety.

Nowadays, there are new methods for process modification in which the best modification can be selected from numerous options based on the organizational criteria.

The present research has been conducted in order to examine nurses' job stress impact on the patients' safety using SPSS. This will reduce costs, promote satisfaction among customers and finally lead to a healthy society. Moreover, it has been tried to propose solutions for patients' safety promotion regarding job stress incidence, their examination and prioritization to reduce nurses' job stress.

Materials and Methods

The present research examines descriptive methods of the factors involved in nurses' job stress and their role in the patients' safety utilizing SPSS. The statistical population consists of 90 randomly clustered nurses working in Bu 'Ali, Amiralmomenin and Javaheri hospitals affiliated to Tehran medical branch of Islamic Azad University. This was conducted from August to December 2016.

Recognition of statistical population and the research field

Phase I: The hospitals were visited to get more detailed required data of the research field. So, the physical location of the hospital was inspected to determine such characteristics as rooms dimensions, color, building status, ...

Phase II: harmful physical and chemical parameters of environment were noted in the three aforementioned hospitals. Factors such as light, noise, air quality and ventilation, temperature stress, ray exposure and its spatial location were surveyed.

Phase III: staff welfare status in the three hospitals include rest rooms, nutrition, cultural and sport schedules, health status, ...

Phase IV: All the parameters in the questionnaires were sampled through detailed reconnaissance of the staffs.

Phase V: staffs complaint and criticism notes of the staffs during the recent year were studied after getting the permit from the administrations. It was attempted to do the sampling randomly rather than selective. It is noteworthy that all the visits to the hospitals were associated with interviews with the hospital staffs which supported us with the answers and notes that were reflected in the sessions with the experts and administration staffs to determine given criteria. Based on the questionnaires and regarding the recognition, a comparative study was conducted and a

classification was made based on age, sex, experience, job status, ... In order to have a more detailed sampling, parameters such as shift working, spouse employment status, residence status as well as education level were considered. After location visit in 15 times (5 times for each hospital), 30 samples were selected from each hospital. As male and female distribution was not equal, sampling was considered the proportion of male and female. The collection of data was conducted through questionnaires from which data extraction was made.

3.2 Determination of job criteria

Then a group of experts consisting of six people (the head of the hospital, deputy director of development and resources in three monitored hospitals) announced their criteria including cost of process modification, improvement recovery time and coherence with organization's rules and regulations for implementing corrective measures in six major parameters including education and acquaintance with the career tasks, the regulations of respect and job relationships, participation in planning and decision-taking, staff support and welfare, justice as well as job security and motive.

3.3 Weighting and paired comparison of the criteria

Criteria and options were compared using AHP. The first level of hierarchy is composed of main criteria. Expert's questionnaire deals with the priorities of each of the major criteria based on the paired comparison of major criteria. Therefore, criteria should be compared in pairs based on our goal. In order to do this, experts compared the criteria in pairs. The matrix had diameter value of 1 with the upper triangle as the mirror of the lower one. The matrix relative priority of criteria is observed in Table 3.1.

Criteria	Expense	Time	Organizational regulations
Expense	1	3	5
Time	1.3	1	1.3
Organizational regulations	1.5	3	1
Total	1.53	7	6.33

Table 3.1 the matrix relative priority of criteria.

Then, the normal matrix with norm 1 with columnar accumulation 1 was drawn and row averaging was conducted (Table 2.3).

A: Job security and motives

B: Staff support and welfare

C: Justice

D: Participation in planning and decision taking

Then, paired comparison matrix was drawn for all options based on the three criteria i.e. expense, time and organizational regulations. Furthermore, normalization was utilized for the determination of priorities which was obtained based on the weight normalization of each option based on the desired criterion.

The values obtained from calculations are called Eigenvector. Paired comparisons were made for the three criteria, so the priority of each option was calculated based on each criterion. Paired comparison matrix of the four stressors in nurses based on the expense criterion was shown in Table 3.4.

Expense	A	B	C	D
A	1	5	2	1.3
B	1.5	1	1.5	1.7
C	1.2	5	1	1.5
D	3	7	5	1

Table 3.4 paired comparison matrix based on the expense criterion

Expense	A	B	C	D	Eigenvector
A	0.21	0.28	0.24	0.2	0.23
B	0.04	0.05	0.03	0.09	0.05
C	0.11	0.28	0.12	0.12	0.16
D	0.64	0.39	0.61	0.59	0.56
Total	1	1	1	1	1

Paired comparison matrix of four stressor in nurses based on the time are shown in Table 3.5.

Time	A	B	C	D
A	1	5	3	1.3
B	1.5	1	1.3	1.5
C	1.3	3	1	1.2
D	3	5	2	1

Table 3.5 paired comparison matrix based on the time criterion

Time	A	B	C	D	Eigenvector
A	0.22	0.36	0.47	0.16	0.3
B	0.05	0.07	0.05	0.1	0.07
C	0.07	0.21	0.16	0.25	0.17
D	0.66	0.36	0.32	0.49	0.46
Total	1	1	1	1	1

Paired comparison matrix of four stressor in nurses based on the organizational regulations are shown in Table 3.6.

Organizational regulations	A	B	C	D
A	1	3	5	7
B	1.3	1	3	5
C	1.5	1.3	1	2
D	1.7	1.5	1.2	1

Organizatioanl regulations	A	B	C	D	Eigenvector
A	0.59	0.66	0.53	0.47	0.56
B	0.2	0.22	0.32	0.33	0.27
C	0.12	0.07	0.1	0.13	0.1
D	0.09	0.05	0.05	0.07	0.07
Total	1	1	1	1	1

It is necessary to multiply the weight of each criterion in its score and add them up to get the total score (Table 7.3):

	Expense	Time	Regulations
A	0.23	0.3	0.56
B	0.05	0.07	0.27
C	0.16	0.17	0.1
D	0.56	0.46	0.07
Weight	0.62	0.13	0.25

Table 7.3 Determination of final priority of choices

Data extraction utilizing SPSS

Questionnaires were filled by sample people, coded and analyzed through SPSS21. 53 people (58.9%) out of the 90 total sample persons were male while 37 person (41.1%) were female. 20 people (22.2%) were aged below 30, 18 people (20%) aged between 31-35, 20 people (22.2%) aged

between 36-40, 15 people (16.7%) aged between 41.45 and finally 17 people (18.9%) aged above 46. The least age among the population was 30 while the most was 52 with an average age of 38.44 and standard deviation of 7.86.

1.1. Descriptive analysis of the variable 'education'

2.25 of all the population were of pre-bachelor, 75.6% bachelor and 22.2% were master and above. As the assess level of the variable is rank-wise, the educational level is bachelor as the median.

1.2. Descriptive analysis of the variable 'shift work':

52 people (57.8%) out of the 90 persons were in irregular shift work, 32 persons (35.6%) in regular shift and 6.7% in fixed working hours. The mode of the variable was on irregular shift work.

1.3. Descriptive analysis of the variable 'experience':

40 people (44.4%) had less than 10 years' experience, 37 people (41.2%) had experiences between 11-20 years and 13 people (14.4%) with experiences more than 21 years. The least job experienced person in the population was 3 years while the most 28 years. The mean job experience was 13.65 and 6.81 standard deviation.

When the population descriptive data were analyzed, the professional questions were analyzed. The results such as mean and standard deviation of the variables are shown in the table 1.4. It is noteworthy that high scores indicate high job satisfaction and low stress. Training and acquaintance with job task had parameters of 10 subset and 50 scores, respect principles and job communication had 10 parameters and 50 scores, participation in programming had 5 subset and 25 scores, staff welfare parameters had 17 subset and 85 scores, justice with 6 subset and 30scores and job security and motivation with 5 subsets and 25 scores.

Table 1.4 mean and standard deviation of the scores of the variables

Characteristics/variables	Min score	Max Score	Mean	Standard deviation
Training and acquaintance with job tasks	17	43	33.48	6.12
Principles of respect and communication	26	49	36.76	6.38
Participation in planning	5	23	13.74	4.63
Staff welfare and support	32	66	46.37	10.90
Justice	6	24	16.42	4.95
Job security and motivation	5	21	12.77	4.73
Job stress	131	211	159.53	20.38

1.4.**Kolmogorov-Smirnov test**:

As most of the statistical tests such as Pearson correlation matrix analysis are based on the normal distribution of selective sample, we utilized Kolmogorov-Smirnov test to ensure normal distribution of the data before following the statistical methods. The results of the test for the dependent variables are shown in Table 2-4.

Table 2.4 results of Kolmogorov-Smirnov test for the main variables

	Z in K-S test	SHG meaningfulness level	result
Training and acquaintance with job tasks	0.922	0.363	Normal
Principles of respect and communication	1.57	0.136	Normal
Participation in planning	1.27	0.076	Normal
Staff welfare and support	1.930	0.352	Normal
Justice	1.20	0.112	Normal
Job security and motivation	1.47	0.263	Normal
Job stress	1.46	0.270	Normal

According to table 2.4, it can be distinguished that meaningfulness of Kolmogorov-Smirnov test for all the major variables is more than error level (5%). So, zero hypothesis is confirmed at 5% error level indicating normal distribution of variables.

1.4.1. **First hypothesis**: there is a meaningful relationship between job task and stress. Correlation coefficient is negative (0.177) among training and acquaintance with job tasks and job stress. Increasing training and acquaintance with job tasks decreases job stress and vice versa. Regarding significance of 0.096 which is more than 0.05, H_0 can be confirmed and H_1 can be neglected with higher levels of confidence (95%). Therefore, the first hypothesis which indicates the relationship between training, acquaintance with job tasks and job stress is not correct.

1.4.2. **Second hypothesis**: There is a meaningful relationship between respect-communication and job stress. There is a negative correlation (0.291) between respect-communication and job stress and vice versa. As the significance is 0.005 which is less than 0.01, H_1 can be approved with more than 99% confidence, so H_o is rejected. Therefore, the second hypothesis is approved which indicates relationship between respect-communication and job stress.

1.4.3. **Third hypothesis**: There is a meaningful relationship between programming-decision taking and job stress. A negative correlation between participation in programming-decision taking and job stress (0.625) indicates decrease in job stress with increasing in participation in programming-decision taking and vice-versa. As 0.005 significance is less than 0.01, H_1 can be approved and H_o can be rejected with more than 99% confidence. So the third hypothesis can be confirmed on relationship between participation in programming-decesion taking and job stress.

1.4.4. **Fourth hypothesis**: There is a meaningful relationship between staff welfare and support and job stress. A negative correlation between staff welfare and support and job stress (0.689) indicates decrease in job stress with increasing in participation in programming-decision taking and vice-versa. As the significance is less than 0.01, H_1 can be approved and H_o can be rejected. Therefore, the fourth hypothesis which expresses the relationship between staff welfare and support and job stress is confirmed.

1.4.5. **Fifth hypothesis**: There is a meaningful relationship between justice and job stress. There is a negative correlation between staff welfare and support and job stress which is 0.697. This means that increasing justice decreases job stress and vice-versa. Significance less than 0.01 confirms H_1 hypothesis and rejects H_0 with more than 99% confidence.

1.4.6. **Sixth hypothesis**: There is a meaningful relationship between job security and motivation and job stress. Negative correlation (0.757) between these parameters indicates job stress decreases with increasing job security and motivation and vice-versa. As the significance is less than 0.01, H_1 hypothesis is approved and H_0 is rejected with more than 99% confidence.

1.4.7. **Seventh hypothesis**: The variables of respect-relationship, participation in programming and decision, staff welfare and support, justice as well as job security and motivation are all involved in job stress. After calculating correlation coefficient, determination coefficient, modified coefficient and error, it can be expressed that there is a correlation with job stress with the variables respect-communication, participation in programming and decision, staff welfare and support, justice as well as job security and motivation (0.961). The modifier is 0.923 and the modifying coefficient is 0.918 i.e. 92%, in other words, 92% of the job stress variation is specified through this variable and other variations (8%) is as a result of other variables. Furthermore, significance test of determination coefficient (F) indicates whether the determination coefficient is significant. Then, F is the average regression variance to the average remnant variance which equals 200.97 and 0 significance of 99% confidence. Therefore, the modified coefficient is statistically significant.

1.5.**The variable affecting on the stress**:

The regression coefficient of principles of respect and job communication is 1.155. The standardized regression coefficient was estimated 0.361 for the variable and 10.68 for t test. It is meaningful regarding 0 significance and 99% confidence.

The regression coefficient of participation in programming and decision taking is 0.547. The standardized regression coefficient was estimated 0.124 for the variable and 2.92 for t test. It is meaningful regarding 0 significance and 99% confidence.

The regression coefficient of staff welfare and support is 0.853. The standardized regression coefficient was estimated 0.456 for the variable and 12.53 for t test. It is meaningful regarding 0 significance and 99% confidence.

The regression coefficient of staff justice is 1.137. The standardized regression coefficient was estimated 0.276 for the variable and 6.76 for t test. It is meaningful regarding 0 significance and 99% confidence.

The regression coefficient of job security and motivation is 1.32. The standardized regression coefficient was estimated 0.308 for the variable and 6.72 for t test. It is meaningful regarding 0 significance and 99% confidence.

The assessment of the share and involvement in each independent variable in the specification of dependent variables (job stress) should be done utilizing beta values. These values are standardized and provide the determination of relative share of each variable. Staff welfare and support are the most important variable and are of the most shares, followed by respect-relationship, job security and motivation, justice, participation in programming and decision taking which can specify variance (Table 3.4).

Table 3.4 Standardized and unstandardized regression coefficient affecting job stress

Model	Unstandardized coefficient		standardized coefficient	T test	significance
	b	Standard deviation	B value		
Constant	34.429	5.028		6.847	004
Principles of respect-communication	1.155	0.108	0.361	10.685	0
participation in programming and decision taking	0.547	0.187	0.124	2.928	0
Staff welfare and support	0.853	0.068	0.456	12.537	0
justice	1.137	0.167	0.276	6.797	0
job security and motivation	1.325	0.213	0.308	6.217	0

Standardized regression equation:

$R= \alpha+\beta X+ \beta X_2+...+ \beta X_n$

R= 34.42+0.361 (Principles of respect-communication)+ 0.124(participation in programming and decision taking) +0.456(Staff welfare and support)+0.276(justice)+0.308(job security and motivation)

According to standardized regression equation, it can be distinguished that staff welfare and support have the most influence on the job stress, the participation in programming and decision taking has the least role.

1.5.1. **First hypothesis**: There is a meaningful relationship between job stress and experience.

According to table 4.4, job stress was less in 10%, medium in 45% and high in 45% of statistical population with less than 10 years' experience. The case was 43% of medium stress and 56.8% of high stress in 11-20 years job experience. In staffs with more than 20 years, 46.3% had low levels of stress, 38.5% of medium stress and 15.4% with high levels of stress. K^2 was 22.23 with 0 significance which was less than 0.01. It can be said that there is a significant relationship between job stress and job experience. In other words, staff with more experiences had less job stress. Moreover, F coefficient is 0.497 which indicates medium relationship between these two variables. So, H_0 can be approved with 95% confidence and H_1 is rejected.

Table 4.4 Relationship between job stress and experience

Experience		Stress status			Total
		low	medium	high	
<10 years	Number	4	18	18	40
	Percentage	10%	45%	45%	100%
11-20 years	Number	0	16	21	37
	Percentage	0%	43.2%	56.8%	100%
> 20 years	Number	6	5	2	13
	Percentage	46.2%	38.5%	15.4%	100%
Total		10	39	41	90
		11.1	43.3	45.6	100%
آماره		K^2		F	significance
		22.23		0.497	0

Fig. 1 The relationship between job stress and experience

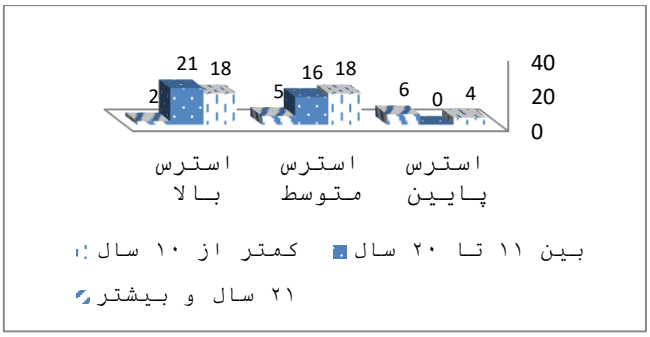

Fig.1.the relationship between job stress and experience

1.5.2. **Second hypothesis**: There is a significant relationship between job stress and education.

According to table 4.5, job stress was low in all the staff with less than bachelor education. In the staff with bachelor degree, 5.9% had low stress, 51.5% had medium levels of stress and 42.6% had high levels of stress. In the staff with master degree or even higher level, 30% had low stress, 20% had medium stress and 50% had high stress. K^2 is 14.25 with 0.007 significance which was less than 0.01. In other words, staff with higher level of education had higher job stress. Φ coefficient is 0.398 which indicate that the relationship between these two variables is of medium degree. H_0 can be approved at 95% confidence and H_1 is rejected. Then, the hypothesis is approved.

Table 4.5 Relationship between job stress and education

Education		Stress status			Total
		low	medium	high	
Lower than bachelor	Number	2	0	0	2
	Percentage	100%	0%	0%	100%
Bachelor	Number	4	35	29	68
	Percentage	5.9%	51.5%	42.6%	100%
Master or more	Number	6	4	10	20
	Percentage	30%	20%	50%	100%
Total		10	39	41	90
		11.1%	43.3%	45.6%	100%
آماره		K^2		F	significance
		14.25		0.398	0.007

Fig.2 The relationship of job stress with education

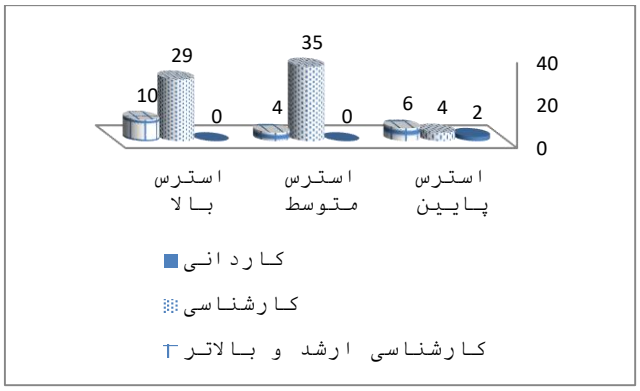

Fig.2 The relationship of job stress with education

As the parameters outside of the work environment considerably affects the individual's stress, job problems are the most prevalent stressors [17]. Lasarus and Levalo considered the role of emotions important due to quick reaction to stressors in job stress [18]. Researches by Giorgi et al., Pasadkov et al., Guilbola et al. demonstrated that heavy tasks (both in quantity and intensity), low control (job autonomy, extent of decisioning), lack of support from managers and colleagues (difference among colleagues, managers and organization), ambiguity and contradictions (when staff have contradictory and ambiguous tasks) all are highly involved job stress [19, 20].

The result of the research based on SPSS processing of data demonstrated that the variable staff welfare and support has the most influence on the job stress, while the variable participation in programming and decision taking has the least effect. Principles of respect and communication, job security and motivation and justice are among the second to fourth rank.

But AHP analysis demonstrated that participation in planning and decision taking has the major role in suppressing stress in nurses, when experts' criteria (including interference expenses, duration and coordination with organizational regulations) were implemented. Job motivation, justice and staff welfare were among other job stressors.

Final weight =Σ (weight of the choice with respect to the criteria×weight of the criteria)

$W_A = (0.23 \times 0.62) + (0.3 \times 0.13) + (0.56 \times 0.25) = 0.322$

$W_B = (0.05 \times 0.62) + (0.07 \times 0.13) + (0.27 \times 0.25) = 0.108$

$W_C = (0.16 \times 0.62) + (0.17 \times 0.13) + (0.1 \times 0.25) = 0.146$

$W_D = (0.56 \times 0.62) + (0.46 \times 0.13) + (0.07 \times 0.25) = 0.425$

$W_A = 0.322$ $W_B = 0.108$ $W_C = 0.146$ $W_D = 0.425$

$W_D > W_A > W_C > W_B$

W_D: participation in planning and decision

W_A: Job security and motivations

W_C: Justice

W_B: Staff support and welfare

It is noteworthy that the results of the present research have been obtained under climatic, cultural and political conditions of Iran as well as internal regulations governing Islamic Azad University which is considered as a private sector. The result may be different in other countries.

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