

Fatigue, Health and Well-being of Iran Railroad Locomotive Engineers and Conductors in Relation with Organizational Variables

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Abstract: This research investigated the relationship of fatigue, health, well-being and demographic variables in Iran railroad operators. 413 locomotive engineers and conductors out of 2400 were randomly selected to answer to job-organizational factors of locomotive engineers and conductors questionnaire and personal data sheet. Cronbach's alpha of questionnaire was 0.891. Its validity estimated through pilot study on 50 participants and specialist confirmation and calculated CVI (0.95). Correlation, t-test, one-way ANOVA and Tukey post hoc test were used to data analysis. Results indicated that there were significant relationship between age & personnel fatigue; well-being & salary; health & work system; fatigue, health & Well-Being with job position and work experience ($p < 0.001$). In addition there weren't found significant relationship between these variables and marital status, having child, kind of training and educational level.

Keywords: Fatigue; Health; Well-being; Locomotive engineers and conductors; railroad.

1. Introduction

We live and work in one age that large and small organizations are around us and penetrate in our lives. Many of people spend their time in their workplaces (Irannejad Parizi & Sasangohar, 2003). Organizations with their special nature, have various effects on individual. Although these effects aren't destructive and uncontrollable necessarily, may have significant effect on individual (Saatchi, 2007). Ergonomics as a science extends knowledge about human functional capabilities and

limitations and other human features regarding his/her interaction with other system components and as a practice, applies human-system technology to analyze, design and evaluation of systems to enhance safety, health, comfort, effectiveness and quality of life (Hendrich, 2003). Macro ergonomics as a socio-technical systems approach, includes design of work and organizational systems and interactions related to human-machine, human-environment and human-software (Hendrich, 1987).

Socio-technical systems involve three subsystems; social; technical and external environment that are interactive and related to organization (Hendrich, 2002). Human subsystem has three major features that are essential for work system structure design: Degree of professionalism, Demographic characteristics and psychosocial work factors. So, with respect to these items and scope of ergonomics to consider human characteristics and limitations in one hand, and features of work, work system and organization in other hand, in order to maximize coordination and fitness between these parts, this research was designed to investigate the relationship of fatigue, health and well-being of Locomotive engineers and conductors of Iran railroad company with demographic variables. In fact, this article will provide better and more understanding of relationships of above mentioned factors in the organization.

1.1. Background

Fatigue emerged as a result of insufficient rest, which muscles, internal tissues and organism central nervous system because of diminish of cellular power and energy can't do their tasks normally by use of same energy sources

(Job, 2001). WHO in its curriculum defines health and well-being as physical, mental and social health, not only lack of disease and disability (WHO, 2007). Social well-being consists of tangible, measurable, immaterial and personal consequences that improves through more social and economic development and increases individual participation in social targeted activities (Hendrich, 2002). The nature of work in some organizations like transportation, service and heavy industries must work continuously (Noyes, 2001). Nature of work and workplace variables (especially in public transportation) cause stress and also, have different effects on fatigue, health and well-being of employees. Some of these occupational characteristics that increases fatigue and diminishes health and well-being, are work pace, work repetition and shift work. Work pace in rail transportation industry (train) sometimes is fast & in some cases is low. Also, repetitive

works for employees of diverse parts of this industry such as locomotive engineers & conductors are boring and cause fatigue. Shift work is another factor that not only is a stressor, but also can effective on increasing fatigue and decreasing health and well-being. One of workplace variables that can cause stress and fatigue, is inter-personal relationships. For locomotive engineers & conductors job, variation in inter-personal relationships and necessary counteract whether with passengers or other employees (in trains and/or stations) is one of the work essentialities. So, considering inter-personal relationships, with respect to repetition of work nature and their work experience, can be effective on causing fatigue, decreasing health, well-being and be justifiable. Because of development of expansion of leisure industries, the incidence of unsocial working hours is increased (Singleton, 1989). Table 1 shows problems caused by shift work.

Table 1. Common problems caused by shift work (from Helander, 2006)

Fatigue	In average, one employee that works at night, sleeps one and half an hour less than day workers.
Health-related problems	Stomach, digestive and gastrointestinal problems and more probability in infecting cardiovascular diseases
Interruption in Social life	About relationship with family, friends, work unions, meeting and other gatherings
Productivity diminish	More about knowledge-based tasks than skills-based tasks
Safety	Can increase accidents

Gastrointestinal, cardiovascular and pregnancy-related problems are common issues related to the shift work (Ku & Smith, 2010). Sparks and et al (1997) have studied twenty one researches related to work hours length and health and stated that there was positive relationship between work hours and health-related signs (physiological and psychological) so that more work hours are related to lower health level (Sparks & et al, 1997). In other study in America has done by Dembe and et al (2008) indicated that longer work hours are related to more negative effects on physical health (Dembe & et al, 2008). Glass & Fujimoto (1994) in their study found that appropriate salary payment decreases employees depression level; but with increasing working hours, depression symptoms begin to enhance especially in men (Glass & Fujimoto, 1994). Researches state that relationship between long work hours and low well-being is result of lack of enough time to recover from negative effects of long work (Van der Hulst, 2003). Chandola and et al (2008) found that chronic job stress is combined with Coronary heart disease and this relationship is significant in lower 50 years old (Chandola & et al, 2008). There are some studies that investigate relationship between different job positions, working hours and health. They showed that people who work in lower job position and longer, have lower job control and salary. Also, working in these positions aggregate negative effects of

long work hours on health (Fagan & et al, 2011). Unusual and long working hours which are harmful for all people (not mention to their position and grade), although there are some factors like individual talent, motivation and organizational culture that modify these effects (Sparks & et al, 1997). Beside, studies show that having control on working time, number of working hours and satisfaction of work schedule enhance management commitment and job satisfaction (Swanberg & et al, 2011). Sleep disruption or decrease is most common consequence of shift work that is reason of circadian rhythm disruption (Harma, 2006). In addition to this, shift work diminishes efficacy and job performance, increases error and accidents. Some researchers have shown that probability of accidents and industrial injuries at night and evening shifts are higher than day shifts (Brogmus & Maynard, 2006). Many studies on work time and work-family balance, consider weekly work hours effects; because what happens on a daily or weekly basis, has main effect on how employee coordinates work schedule and domestic schedule and participating in other personal activities (leisure and social activities with friends). Work-family conflict, decreases mental well-being, job and life satisfaction that damages family life and has negative effects on personal efficacy and productivity. Because diminish in mental well-being, causes fatigue, stress, anxiety and depression (Fagan & et

al, 2011). Comparison between shift worker and workers who are in very long shifts (like long shifts and work in upward areas such as work in mine), shows that shift work has negative effects on psychological well-being, and satisfaction of domestic life is more critical for people who are in very long shifts (Fagan & et al, 2011). Tabatabaei & et al stated that age, education, work experience, salary and kind of shift work have significant relationship with general health, but variables such as job stress and satisfaction aren't significantly related to type of shift work (Tabatabaei & et al; Tabatabaei & Gharanjiki, 2011).

An investigation on demographic variables, fatigue and drivers accidents has done by Milia and et al (2011) indicated that there is a general consensus on fatigue of staff in the workplace is cause of interaction between circadian rhythm, sleep and job/task main processes. In addition, factors like job characteristics and work schedule due to increasing fatigue (Milia & et al, 2011). Altun and et al in their study stated that smoking is significantly related to gender and socio-economic status. Also, marital status is related to enough sleep, appropriate working time length (Altun & et al, 2011). Junghaenel (2011) stated that level of fatigue is higher in women, single, young and people with lower education (Junghaenel & et al, 2011). In one study on psychological well-being and demographic variables and educational performance of university students suggested that gender and education in first and last years of education, are related to well-being but marital status isn't (Tabe Bordbar & et al, 2011). In other research with title of relationship between demographic variables and mental well-being and happiness indicated that age and job have significant relationship with subjective well-being and happiness, in contrast of gender and marital status (Hashemian & et al, 2007).

1.2. Objectives

The main objective of present research was to study the relationship between demographic variables and fatigue, health and social well-being of Iran railroad locomotive engineers and conductors. The main hypotheses of this

research were: There are differences in staff fatigue (H1), health (H2) and social well-being (H3) in respect of age, marital status, having child, work experience, education, job position, mean salary and kind of vocational training. There are relationship between workers job satisfaction and selected demographic variables like age, marital status, having child, work experience, education, job position, mean salary and kind of vocational training (H4).

2. Materials and Methods

This research was a descriptive and cross-sectional survey. Statistical population included all (2400) Iran railroad locomotive engineers and conductors in 2012. Sample group were 413. In fact, 500 questionnaires distributed among sample group that 413 ones have returned completely. Two questionnaires were used for collection data: (1) Questionnaire of Personal-Occupational Information: it was consisted of 10 questions. (2) Job-organizational factors of locomotive engineers and conductors: it has provided by Ku and Smith (2010). It was modified by researchers according to the goals of this study and had five subscales. Its Cronbach's Alpha coefficient was 0.89 through one pilot study and its reliability confirmed by some of the psychometrics and content validity index (CVI) was calculated $r=0.95$. Descriptive statistics, correlation co-efficient, t-test, one-way ANOVA and post hoc Tukey test were used to analyze data.

3. Results

Table No. 2 shows demographic variables of participants. All of locomotive engineers and conductors in Iran railway were men. The majority of sample group were (%46.61) 30-39 years, %92 married, %80 had child/ children, majority of them had diploma (%41.89), %61 were locomotive conductors, %42.2 at the range of 10-19 years and %25.9 at 3-9 years of work experience, %84 were trained and 16% untrained, majority of them with 300-370 and %96.1 in assigned train.

Table 2. Descriptive statistics of demographic variables

Variable	N	Percentage	M	SD	Variable	N	Percentage	M	SD
Gender	413	100%			Job position	413	100%		
Man	413	100%			Conductor	252	61%		
Woman	0	0			Engineer	161	39%		
Age	343	83.05%			Work experience	413	100%		
20-29	11	2.67%	39.40	7.701	3-10	107	25.9%	18.81	59.27
30-39	192	46.61%			11-20	174	42.2%		
40-49	104	25.25%			21-27	91	22%		
50 and more	36	8.73%			Over 27	41	9.9%		
Marital status	413	100%			Passed training	413	100%		

Single	33	8%	Technical	347	84%
Married	380	92%	Safety & health	-	-
Having children	413	100%	Both	66	16%
Had children	333	80.6%	Salary	413	100%
Lack of children	80	19.4%	500-700	8	1.9%
Education	413	100%	700-900	121	3.29%
Diploma	173	41.89%	900-1100	151	36.6%
Upper diploma	120	29.08%	More than 1100	133	32.2%
BSc	112	27.12%	Work system	413	100%
MSc and upper	8	1.01%	Assigned train	397	96.1%
			Extra boards	11	2.7%
			Pools	5	1.2%

Table 3. Pierson correlation coefficient between age, fatigue, health and social well-being of employees

Variable	Sig.	Age	Fatigue	Health	Well-being
Age	0.007	1	0.132	-0.021	0.014
Fatigue	0.007	0.132	1	-	-
Health	0.679	-0.021	-	1	-
Well-being	0.774	0.014	-	-	1

As it has shown in Table No. 3, although there was found low relationship between employees fatigue and their ages ($r=0.132$, $p=0.007$), this relationship was significant. In other word, fatigue increases with enhancing age. In addition, with respect to $r=-0.021$

($p=0.679$) and $r=-0.014$ ($p=0.774$), there weren't significant correlations between employees health and well-being and their ages, respectively.

Table 4. Mean differences of fatigue, health, social well-being by marital status, having children, job position & T.V.T. courses

Variable	Source of changes	Levels	M	SD	T	df	sig
Marital status	Fatigue	Single	41.1212	8.91543	-1.950	35.549	0.059 *
		married	44.2291	7.03804			
	Health	Single	38.4080	10.44814	0.775	411	0.439
		married	37.0138	9.87070			
Social Well-being	Single	24.4938	4.11644	-0.090	75.056	0.928	
	married	24.5744	10.36899				
Having children	Fatigue	Had children	44.3545	6.87462	1.891	105.298	0.061
		Lack of children	42.4250	8.47898			
	Health	Had children	36.8991	9.75097	-0.946	411	0.345
		Lack of children	38.0664	10.75097			
	Social Well-being	Had children	24.5203	10.91385	-0.310	297.773	0.757
		Lack of children	38.7666	4.69563			
Job position	Fatigue	Conductor	43.1750	8.25959	-3.239	410.614	0.001 **
		Engineer	45.2811	4.95156			

Passed training	Health	Conductor	38.4708	10.54507	3.748	386.318	0.000 **
		Engineer	34.9536	8.38077			
	Social Well-being	Conductor	25.4240	8.96604	2.099	275.510	0.037 **
		Engineer	23.1864	11.39435			
	Fatigue	Technical	43.9689	7.20518	-0.076	411	0.939
		Technical & Safety & health	44.0430	7.49091			
Health	Technical	37.1618	9.92248	0.172	411	0.864	
	Technical & Safety & health	36.9332	9.93048				
Social Well-being	Technical	24.8170	10.35845	1.394	112.526	0.166	
	Technical & Safety & health	23.2587	7.87538				

Table No. 4 reveals t-values and significant levels ($\alpha_1=0.059$, $\alpha_2=0.439$ & $\alpha_3=0.928$) and shows that in contrast of fatigue, there wasn't significant difference between staff health, well-being and their marital status. Similarly, by attention to t values and significant levels ($\alpha_1=0.061$, $\alpha_2=0.345$ & $\alpha_3=0.757$) there weren't significant difference between fatigue, health and well-being and having/not having children. Table No. 4 shows that there were significant relationship ($p<0.05$)

between fatigue, health and well-being and their job positions with respect to significant levels, respectively ($\alpha_1=0.001$, $\alpha_2=0.000$ & $\alpha_3=0.037$); so, engineers had better health & well-being level than conductors. In addition, there weren't found to be significant relationship ($p<0.05$) between fatigue, health and well-being and T.V.T. courses ($\alpha_1=0.939$, $\alpha_2=0.864$ & $\alpha_3=0.166$).

Table 5. One Way Analysis of Variance between groups comparisons of fatigue, health, social well-being with respect of their education

Variable	Source of changes	Sum of squares	Df	Sum of mean	F	Sig.
fatigue	Between groups	152.989	2	76.496	1.462	0.233
	In groups	21457.171	410	52.335		
	Total	21610.160	412			
Health	Between groups	374.321	2	187.160	1.913	0.149
	In groups	20104.185	410	97.815		
	Total	40478.506	412			
Social Well-being	Between groups	89.278	2	44.639	0.444	0.642
	In groups	41201.745	410	100.492		
	Total	41291.023	412			

As Table No. 5 shows, F-value and significant levels ($\alpha_1=0.233$, $\alpha_2=0.149$ & $\alpha_3=0.642$), there weren't found statistically relations between fatigue, health and well-being with respect of staff education.

Table 6. One Way Analysis of Variance between groups comparisons of fatigue & health with respect of work experience (W.E.)

Variable	WE (I)	WE (J)	Mean difference (I-J)	Standard error	Inter group Sig.	F	Sig.
Fatigue	3-10	11-20	-0.99537	0.87859	0.669	4.510	0.004
		21-27	-0.42556	1.1981	0.976		
		Over 27	-4.67991	1.31355	0.002		
	11-20	3-10	0.99537	0.87859	0.669		
		21-27	0.56981	0.92518	0.927		

	Over 27	- 3.68454	1.24152	0.017*		
Health	21-27	3-10	0.42556	1.01981	0.976	
		11-20	- 0.56981	0.92518	0.927	
		Over 27	- 4.25436	1.34516	0.009	
		3-10	4.67991	1.31355	0.002**	
		11-20	3.68454	1.24152	0.017	
		21-27	4.25436	1.34516	0.009**	
		11-20	1.53787	1.20222	0.557	
		21-27	-2.93794	1.26597	0.153	
		Over 27	1.76437	1.69883	0.760	
		3-10	-1.53787	1.20222	0.557	
		21-27	-4.47581	1.26597	0.003**	
		Over 27	0.22649	1.69883	0.999	4.566 0.004
	21-27	3-10	2.93794	1.26597	0.153	
		11-21	4.47581	1.84065	0.003**	
		Over 27	4.70230	1.34516	0.053*	
	Over 27	3-10	4.67991	1.79740	0.760	
		11-20	3.67454	1.69883	0/999	
		21-27	4.25436	1.84065	0.053	

F values and levels of confidence ($\alpha_1=0.004$, $\alpha_2=0.004$) have showed in Table No. 6. Mean differences between fatigue, health and work experience (W.E.) of employees were found to be significant ($p<0.05$). In

other word, level of fatigue in staff who have over 27 years W.E. is higher than other groups; and health mean of staff with 21-27 years WE is higher than others.

Table 7. One Way Analysis of Variance between groups comparisons of social well-being with respect of work experience

Variable	Source of changes	Sum of squares	df	Sum of mean	F	Sig.
Social Well-being	Between groups	199.579	3	44.526	0.662	0.576
	In groups	41091.444	409	100.468		
	Total	41291.023	412			

F-values and $\alpha=0.576$ have revealed in Table No. 7 that mean differences of well-being between groups with different work experiences, was not found to be significant.

Table 8. Mean differences and between groups comparisons of fatigue & Social well-being with respect of salary

Variable	W.E. (I)	W.E. (J)	Mean difference (I-J)	Standard error	Inter group Sig.	F	Sig.
fatigue	500-700	700-900	-4.73760	2.62638	0.273	2.833	0.038*
		900-1100	-4.89397	2.61015	0.240		
		Over 1100	-6.37633	2.61902	0.072		
	700-900	500-700	4.73760	2.62638	0.273		
		900-1100	-0.15637	0.87782	0.998		
		Over 1100	-1.63872	0.90386	0.269		
	900-1100	500-700	4.89397	2.61015	0.240		
		700-900	0.15637	0.87782	0.998		
		Over 1100	-1.48236	0.85555	0.308		

Social well-being	Over 1100	500-700	6.37633	2.61902	0.072	2.986	0.031*
		700-900	1.63872	0.90386	0.269		
		900-1100	1.48236	0.85555	0.308		
	500-700	700-900	-0.92893	3.62643	0.994		
		900-1100	1.73260	3.60601	0.963		
		Over 1100	2.65689	3.61827	0.883		
	700-900	500-700	0.092893	3.62843	0.994		
		900-1100	2.66153	1.21273	0.126		
		Over 1100	3.58582	1.24871	0.022*		
	900-1100	500-700	-1.73260	3.60601	0.963		
		700-900	-2.66153	1.21273	0.126		
		Over 1100	0.92429	3.61827	0.863		
Over 1100	500-700	-2.656889	3.61827	0.883			
	700-900	-3.58582	1.24871	0.022*			
	900-1100	-0.92429	1.18197	0.863			

According to Table No. 8, ($F_1=2.833$, $F_2=2.986$ and $\alpha<0.05$), there were found significant differences between staff fatigue & social well-being with respect of their salary. Fatigue level of group by over 500

dollars is higher than others. In addition, there was significant difference between social well-being of staff with respect to their salary. So that, social well-being is higher between group with 234-300 dollars than others.

Table 9. Mean differences and between groups comparisons of health with respect of salary

Variable	Source of changes	Sum of squares	Df	Sum of mean	F	Sig.
Health	Between groups	340.380	3	113.460	1.156	0.326
	In groups	40138.126	409	98.137		
	Total	40478.506	412			

F-values and $\alpha=0.326$ have showed in Table No. 9 that mean difference between groups with different salary, was not found to be significant.

Table 10. Mean differences and between groups comparisons of fatigue and social well-being of staff with respect of their work system

Variable	Source of changes	Sum of squares	df	Sum of mean	F	Sig.
Fatigue	Between groups	135.854	2	67.927	1.296	0.275
	In groups	21438.449	409	52.417		
	Total	21574.304	411			
Social well-being	Between groups	40648.906	2	276.469	2.782	0.063
	In groups	40648.906	409	99.386		
	Total	41201.844	411			

$F_1=1.296$, $F_2=2.782$ and significant levels ($\alpha_1=0.275$ & $\alpha_2=0.326$) in Table No. 10 revealed that there weren't significant differences between fatigue, social well-being and their work systems.

Table 11. Mean differences and between groups comparisons of health with respect of work system

Variable	WE (I)	WE (J)	Mean difference (I-J)	Standard error	Inter group Sig.	F	Sig.
Health	Pools	Extra board	2.60000	5.30590	0.876	11.03	0.000*
		Assigned train	-10.17107	4.35944	0.052*		
	Extra board	pools	-2.60000	5.30590	0.876		
		Assigned	-12.77107	3.10170	0.000		

	train			
Assigned train	pools	10.17107	4.35944	0.052*
	Extra board	12.77107	3.10170	0.000

As shown in Table No. 11, $F=11.034$ ($p<0.05$), mean differences in staff health with respect to their work systems were found significant. Therefore, health level of employees who work in assigned trains, was higher than others.

4. Discussion

This study showed that in contrast of health and social well-being, there was positive and significant relationships between fatigue and age ($p<0.05$). In addition, there weren't statistical differences between fatigue, health and social well-being with marital status, having children, job position, passed trainings & their educational level. Level of fatigue, health & social well-being has significant relationship with employee's job position. So that, fatigue is higher and health and social well-being are lower for locomotive engineers in comparison with conductors. Fatigue and health were related to work experience (W.E.). Fatigue level was higher in group with W.E. of over 27 years than others and health status is higher in staff by 21 to 27 years WE and lower in staff by over 27 years WE than others. Also, social well-being was significantly related to salary. Therefore, social well-being level was higher in workers who gave 700-900 dollars than others. There was significant relationship between health and work systems, it's level was better in employees who work in assigned trains than others.

The results of present research were in adverse with the results of Glass & Fujimoto (1994) in study of health and depression in America on relationship between appropriate salary and depression decrease and Chandola and et al (2008) in positive relationship between age and health. In addition, the findings of this research were similar with the findings of Milia and et al (2011) in study of relationship between demographic variables, fatigue and driving accidents in America, Altun (2011) on demographic variables and teachers health behavior, Junghaenel and et al (2011) on demographic variables related to fatigue, Tabe Bordbar and et al in study of comparison of psychosocial well-being in university students with respect to demographic variables and educational performance and Hashemian and et al (2007).

It can be concluded that age is an important factor in fatigue of staff (locomotive engineers and conductors). It means that these two variables have positive correlation with each other and with increasing of age, enhances their fatigue. So, with respect to the nature of their job, we can consider the age as a dominant factor in recruitment of employees. The results of this research show, locomotive engineers' fatigue is higher than conductors. Behind reason of this can be high span and amount of engineers'

responsibility and their job specifications such as decision-making, supervisory, spread social network and finally among –group relationship. Also, this fact may create higher mental work load that imposes higher fatigue (physical or fatigue) level.

Moreover, work experience (W.E.) has significant effect on fatigue and health of employees. According to the results, staff with WE of more than 27 years have lower level of fatigue and health in comparison with staff by 21 to 27 years W.E. Here it concludes that the nature of locomotive engineers and conductors' job can be categorized as difficult jobs. Therefore, two suggestion present to these jobs: first, locomotive engineers and conductors who have more than 27 years WE, assign to fixed executive or managerial tasks of central organization to use their experience, optimally. Because of decreasing of their quality of work as a result of lower health and more fatigue observed among staff, it can negatively affect organizational productivity. Second, this group of staff can be as beneficiary of retirement for harmful and difficult jobs.

Other considerable point is that locomotive engineers and conductors with less than 500 dollars salary, have lower social well-being than staff with more than 500 dollars salary. The reason is that staff with lower salary, spend less hours in their workplaces and have more additional time to spend time with families and make social relationships and interactions in comparison with higher salary staff. So, gaining more salary, spending more work hours and less social activities, those in turn, less leisure and domestic times, leads to lower social well-being level.

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