Occupational stress and work-related unintentional injuries among Iranian car manufacturing workers

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الكرب المهني وإصابات العمل غير المقصودة بين العاملين في صناعة السيارات الإيرانية

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الخلاصة: استهدفت هذه الدراسة التي أجريت عام 2004 و 2005 عرض نموذج الكرب أثناء العمل بين العاملين في صناعة السيارات في أحد المصانع في جمهورية إيران الإسلامية، وتقييم علاقته بإصابات العمل. وقد جمعت المعطيات من 608 من العاملين الذكور (منهم 508 من العاملين المختَطَرين و100 من العاملين الذين تعرضوا لإصابات خلال السنة المنصرمة). وقد قيَّم الباحثون الكرب أثناء العمل باستخدام مَنْسَب بيليك للكرب المهني. وقد كان معدل انتشار الكرب أثناء العمل 21.3٪ وتمثَّلت مصادر الكرب الرئيسية في ضغط الوقت (78.5٪)، ونمط تقاضي الأجور والتقييم (56.4٪)، والتفاعل مع الناس والآلات (41.3٪). وكان معدل اختطار الإصابة بين الذين يعانون من الكرب أثناء العمل أعلى بدرجة يعتد بها إحصائياً منه لدى الذين لا يعانون منه (نسبة الأرجحية 2.0، بفاصلة ثقة 95٪ وتراوُح بين 1.20 و3.30). وكان الكرب أثناء العمل مسؤولاً عن 11.9٪ من جميع الإصابات المهنية في هذه المجموعة.

ABSTRACT This study in 2004 and 2005 aimed to present the pattern of job stress among car manufacturing workers in one factory in the Islamic Republic of Iran, and to assess its relationship with occupational injuries. Data were collected from 608 male workers (508 at-risk general workers and 100 with injuries in the last year). Job stress was assessed by the Belkic occupational stress index. The prevalence of job stress was 21.3%. The main occupational stressors were time pressure (78.5%), mode of payment and evaluation (56.4%), and interaction with people and machines (41.3%). The risk of injury among those with job stress was significantly higher than those without job stress (OR = 2.0; 95% CI: 1.20–3.30). Job stress was responsible for 11.9% of all occupational injuries in this group.

Stress professionnel et traumatismes non intentionnels liés au travail chez des ouvriers iraniens de l'industrie automobile

RÉSUMÉ Cette étude réalisée en 2004 et 2005 visait à présenter les caractéristiques du stress professionnel chez les ouvriers d'une usine automobile de la République islamique d'Iran, et à évaluer ses rapports avec les accidents du travail. Les données ont été recueillies auprès de 608 ouvriers (508 ouvriers exposés au risque en général et 100 ayant subi des accidents au cours de l'année précédente). Le stress au travail a été évalué à l'aide de l'***Occupational Stress Index*** (indice de stress professionnel) de Belkic. La prévalence de ce stress était de 21,3 %. Les principaux facteurs de stress étaient les contraintes de temps (78,5 %), le mode de rémunération et d'évaluation (56,4 %), et les relations avec les personnes et les machines (41,3 %). Le risque d'accident chez les sujets souffrant de stress professionnel était significativement plus élevé que chez ceux qui n'en souffraient pas (odds ratio 2,0 ; IC 95 % : 1,20 - 3,30). Le stress professionnel était responsable de 11,9 % de l'ensemble des accidents du travail dans ce groupe.

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Introduction

The incidence of occupational injuries is high in many sectors of industry, and in many developing countries the number is increasing. Yearly more than 250 million workplace nonfatal injuries and 300 000 fatal injuries occur worldwide [*1,2*]. Workplace fatal injury rates are 3–4 times greater in less economically developed countries compared to more developed countries and they are mainly unintentional [*3*]. There are about 14 100 severe occupational injuries in the Islamic Republic of Iran annually, mainly among car manufacturing workers [*4*].

Human error is responsible for up to 80% of occupational injuries and they are often the result of job stress [*5*]. Occupational stress is associated with many problems in the workplace [*6*]. It has been reported to be related to occupational diseases such as high blood pressure and an unfavourable cardiovascular profile [*7*], musculoskeletal disorders [*8,9*] and other health outcomes [*10–12*].

The association between job stress and work-related unintentional injuries has not been studied adequately. Previous studies have been mainly focused on particular jobs [*13–16*], and no attempt has been made to describe the association between job stress and occupational injuries among car manufacturing workers.

The aim of this study was to describe the pattern of job stress among the workers of the Iran-Saipa car manufacturing company, to explore the association between job stressors and work-related unintentional injuries, and to clarify whether job stressors affecting injury due to work accidents differ between different age groups and workers with different job experience background, educational attainment and marital status.

Methods

The study was conducted on workers aged between 18 and 65 years who were employed full-time at the Iran-Saipa car manufacturing company, one of the largest car companies in the Islamic Republic of Iran. There were 2 parts to this research: a study of the incidence of occupational injuries in the factory and a study of risk factors for job stress.

Occupation injuries

All occupational injuries occurring in the year 2004 in the Iran-Saipa company to 6199 workers at risk were registered. The injury severity coefficient (ISC) was calculated according to the number of days off work in every 1000 working hours. The injury repetitive coefficient (IRC) was measured as the number of injuries per 1 000 000 working hours and the incidence rate as the number of injured workers per 1000 exposed workers.

Stress study

Data about job stress were collected over 2004 and 2005 from 608 workers. The case group was 100 workers who had suffered at least 1 injury within the previous year, selected randomly from each month of the year proportionate to the number of occupational injuries in that month from the medical records out of 761 injured cases during this period of time. The control group was 508 at-risk general workers selected by proportional random sampling from the list of workers names according to the number of workers in each department of the company (e.g. montage, painting, etc.). Only occupational injuries needing medical treatment or first aid were included and non-occupational injuries were excluded. Those

with a background of mental disorders were excluded from the study.

Job stress was assessed by the Belkic occupational stress index (OSI) [*17*]. Eight trained interviewers completed the questionnaires. The job stress questionnaire included 56 questions with demographic details and 10 job stressor scales: time pressure, mode of payment and evaluation, interaction with people and machines, work tasks, physical working conditions, injuries at work, decision-making at work, working hours and scheduling, recent changes in working conditions and problems at work. For each item, the frequency or amount of occurrence of domains was assessed. These stressors were defined according to the OSI scales and derived from the questionnaire. Items were scored by assigning a value of 1 or 2 for "most frequently a cause of stress" to 0 for "never or rarely a cause of stress". There were 56 questions in the questionnaire and the maximum score was 112, with higher scores indicating more job stress; the minimum–maximum range of scores obtained by participants in this study was 18–72. Subjects were analysed in 2 groups, those above and those below the median score (46.5), i.e. workers with low and high job stress.

A 24-hour-urine test of creatinine, cortisol, and 17 ketosteroid levels was carried out to test the validity of OSI questionnaires among 51 subjects who were randomly selected from all the general workers. The tests were carried out in Tehran Resalat Hospital laboratory using radio-immunoassay techniques. The creatinine test was carried out to correct the stress hormone concentrations in cases of diuresis.

Analysis

The data were analysed using *SPSS* for Windows, version 11.5. The chi-squared and Mann–Whitney tests were used to identify differences between job stress and population groups. Odds ratios (OR) and 95% confidence interval (CI) were employed to show the relationship between the job stress and occupational injuries. Cronbach alpha assessed the internal consistency of measures. Multivariate analyses and Mantel–Haenszel summary test were employed to justify the associations where appropriate.

Results

There were 761 injuries for 6199 exposed workers in the study period, giving an incidence of occupational injuries in the factory of 122.8 per 1000. Overall, there were 7579 days off work in this company. The ISC and IRC were 0.64 and 38.3 respectively. There was a significant association between the monthly number of injuries and the frequency of cars produced ($P < 0.001$) (data not shown).

Younger workers were more likely to be injured than older ones [mean age for the injured group was 23.5 years (SD 9.4) and for the control group was 34.1 years (SD 9.9)]. Those with less job experience were more likely to be injured than those with high job experience [mean years of current job experience among the injured group was 1.8 years (SD 1.1) and for the control group was 2.7 years (SD 1.0)].

Human errors was the main cause of occupational injuries, more than environmental limitations. Unsafe behaviour (61.6%) and unsafe situations (18.3%) were the most common causes of injuries.

All participants in the stress study were males and the mean age of all participants was 33.8 years (range 21–65 years). Table 1 shows the characteristics of the case and control groups.

Table 1 **Background characteristics of workers in the control group (at-risk of injury) and case group (suffered injury in the previous year)**

Variable	Control group (*n* = 508)				Case group (*n* = 100)				
	Mean	SD	Median	Mode	Mean	SD	Median	Mode	*P*-value
Age (years)	34.1	9.9	30	26	33.5	9.4	30	26	NS
Job experience (years)	10.4	4.5	12	12	10.9	4.3	12	12	NS
Experience in current job (years)	5.7	6.7	3	3	5.5	6.2	3	3	NS
Total work hours per week	51.9	15.7	54	54	53.9	12.3	54	54	NS

SD = standard deviation; n = total number of respondents.
NS = no statistically significant difference between means of case and control groups.

The internal consistency of the total OSI using Cronbach alpha was 0.78. The sensitivity and specificity of the OSI using the 24-hour urine examinations of creatinine, cortisol, and 17 ketosteroid were 92% and 87% respectively.

The prevalence of job stress among the control group of workers (i.e. the general sample of at-risk workers) was 21.3% (Table 2). The main occupational stressors among the workers were time pressure (78.5%), mode of payments and evaluation (56.4%), interaction with people and machines (41.3%) and the stress of work tasks (37.7%).

The prevalence of job stress among the case group of workers (i.e. those with at least 1 occupational injury during the year) was higher than the control group, 35.1%. The risk of injury among those with high job stress was significantly higher than those with low job stress (OR 2.00; 95% CI 1.2–3.3) (Table 2). The stress score among the case group was more than in the control group ($P = 0.004$).

Using the formula:

$$\%\, AP_{\exp} = \left(\frac{OR-1.0}{OR}\right) \times 100$$

overall, job stress was responsible for 11.9% (attributable risk) of all occupational injuries in this community. Using multivariate logistic analyses to justify the associations showed that among the control group, job stress was more common among less-experienced workers ($P = 0.022$) and younger groups ($P = 0.012$). However, there was no significant difference by marital status and educational status. In the case group, job stress was more common among the younger groups ($P = 0.029$) and those with less job experience ($P = 0.002$) (Table 3).

Discussion

This study was the first in the Islamic Republic of Iran and its findings might be compared to similar communities in developing countries. The prevalence of job stress in this study was 21.3%, which is very similar to Korean workers (20%) [*18*]. However, job stress was much higher (40%) among workers in the north-west of the United States but lower (10%) among workers of European Union countries [*1*].

Nowadays, many people work during "non-standard" working hours, including shift and night work, which is a recognized risk factor for health, safety and social well-being. Job stress results from the interaction of the worker and the conditions of work. It has been found that working under time pressure and stressful conditions leads to increased physiological and psychological

Table 2 **Prevalence of stress for different types of job stressors and odds ratios for total job stress score for workers in the control group (at-risk of injury) and case group (suffered injury in the previous year)**

Type of stress	Control group (*n* = 508) % with high stress	Case group (*n* = 100) % with high stress	OR (95% CI)	*P*-value
Time pressure	78.5	85.0	1.55 (0.83–2.92)	NS
Work tasks	37.7	66.0	3.21 (2.00–5.17)	< 0.001
Recent changes in working conditions	12.0	53.0	8.26 (5.00–13.67)	< 0.001
Interaction with people and machines	41.3	50.0	1.42 (0.90–2.23)	NS
Physical working conditions	20.7	40.0	2.55 (1.58–4.12)	< 0.001
Mode of payment and evaluation	56.4	22.0	0.22 (0.13–0.37)	< 0.001
Working hours and scheduling	11.4	16.2	1.50 (0.78–2.83)	NS
Decision-making at work	12.5	16.0	1.34 (0.71–2.52)	NS
Work injuries and accidents	14.3	15.2	1.07 (0.56–2.02)	NS
Problems at work	4.0	16.2	4.63 (2.15–9.94)	< 0.001
Total stress	21.3	35.1	2.00 (1.20–3.30)	0.004[a]

[a]***Stratified analyses (Mantel–Haenszel summary for all strata (OR = 1.43; 95% CI: 1.24–1.72,*** P ***< 0.001).***
n ***= total number of respondents; OR = odds ratio; CI = confidence interval; NS = not significant.***

reactions [*15,16,19*] and a worse health condition [*19–23*]. Stressful job events and work tasks are associated with a low quality of work life. Zautra et al. found that workers tend to stay at work even if the job is stressful when the work, tasks are interesting [*21*]. Suitable preventive and interventional measures are required to ensure that the worker can cope satisfactorily. These are based mainly on the organization of shift schedules according to ergonomic criteria and on specific modes of payments and evaluation and work tasks. Differences in individual characteristics such as personality, age, job dissatisfaction, work experience and education level are associated with job stress and occupational injuries as shown by other studies [*1,15,16*]. Although more research is needed, our study showed that stressful working conditions interfere with safe work practices and set the stage for injuries at work, particularly among younger workers and those with less job experience who are more at-risk of job stressors. Stress management treats only the symptoms of the problem not the causes. Therefore efforts to control risk factors and promote quality of work life at the worksite are also important.

In conclusion, human error is one of the major factors of occupational injuries that result from job stress. It highlights the importance of the problem and reinforces job stress prevention programmes as a priority in occupational injury prevention. Intervention studies to recognize the implications for occupational injury prevention among those who are more at-risk of occupational stress are recommended.

The effort to increase job safety in car manufacturing companies needs to go beyond risk behaviour and risk perception of

Table 3 **Prevalence of job stress by educational attainment, marital status, age group and job experience for workers in the control group (at-risk of injury) and case group (suffered injury in the previous year)**

Variable	Control group (*n* = 108[a]) No. with stress	%	*P*-value[b]	Case group (*n* = 33) No. with stress	%	*P*-value[b]	*P*-value[c]
Educational attainment			NS			NS	
Primary	12	13.2		3	17.6		NS
Middle	4	9.8		20	44.4		< 0.001
High school	58	23.6		5	55.6		0.029
University	26	28.6		5	21.7		NS
Marital status			NS			NS	
Single/divorced/separated	27	23.1		7	26.9		NS
Married	73	20.7		26	38.2		0.002
Age (years)			0.012			0.029	
< 25	12	18.2		1	7.7		NS
25–35	54	25.2		22	44.9		< 0.001
36–45	16	21.3		8	47.1		0.03
> 46	7	9.6		2	13.3		NS
Job experience (years)			0.022			0.002	
< 1	3	7.0		7	70.0		< 0.001
1–5	46	24.6		20	41.7		0.019
6–10	25	27.5		5	31.3		NS
> 11	26	17.6		1	5.0		NS

[a]***Figures are less than the total due to missing responses.***
[b]***Using multivariate logistic analysis to justify associations between case and control groups.***
[c]***Significant differences between cases and controls.***
n ***= total number of respondents with high stress; NS = not significant at 5% level.***

workers, particularly for younger and less experience workers. Job stress should be recognized as a main factor of occupational injuries among car manufacturing workers. Full commitment and participation of all managers at all levels and also behavioural and environmental modifications in the factory line are a start in promoting safety and injury prevention.

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References

1. ***Leading work-related diseases and injuries***. Atlanta, Georgia, National Institute for Occupational Safety and Health, 2001.
2. ***Yearbook of labour statistics***. Geneva, International Labour Organization, 2002.
3. ***The world health report 2002***. ***Reducing risks, promoting healthy life***. Geneva, World Health Organization, 2002:190.
4. Akbari ME, Naghavi M, Soori H. Epidemiology of deaths from injuries in the Islamic

Republic of Iran. ***Eastern Mediterranean health journal***, 2004, 12(3/4):382–90.

5. Murphy LR. Occupational stress management: review and appraisal. ***Journal of occupational psychology***, 2002, 57:1–15.
6. Stacciarini JM, Troccoli BT. Occupational stress and constructive thinking: health and job satisfaction. ***Journal of advanced nursing***, 2004, 46(5):480–7.
7. Greiner BA et al. Occupational stressors and hypertension: a multi-method study using observer-based job analysis and self-reports in urban transit operators. ***Social science and medicine***, 2004, 59(5):1081–94.
8. Huang GD, Feuerstein M, Sauter SL. Occupational stress and work-related upper extremity disorders: concepts and models. ***American journal of industrial medicine***, 2002, 41(5):298–314.
9. Stanfeld SA. The problem with stress: minds, hearts and disease. ***International journal of epidemiology***, 2002, (31):1113–16.
10. Landsbergis PA et al. ***Job stress and heart diseases: evidence and strategies for prevention.*** Geneva, International Labour Organization, 1993:1–13.
11. Wilkins K, Beaudet MP. Work stress and health. ***Health reports***, 1998, 10(3):47–62.
12. Fauvel JP et al. Perceived job stress but not individual cardiovascular reactivity to stress is related to higher blood pressure at work. ***Hypertension***, 2001, 38(1):71–5.
13. Chen W et al. [An exploratory study on occupational stress and work-related unintentional injury in off-shore oil production]. ***Zhonghua liu xing bing xue za zhi***, 2002, 23(6):441–4 [in Chinese].
14. Salminen S et al. Stress factors predicting injuries of hospital personnel. ***American journal of industrial medicine***, 2003, 44(1):32–6.
15. Li CY et al. Job stress and dissatisfaction in association with non-fatal injuries on the job in a cross-sectional sample of petrochemical workers. ***Occupational medicine (London)***, 2001, 51(1):50–5.
16. Murata K, Kawakami N, Amari N. Does job stress affect injury due to labor accident in Japanese male and female blue-collar workers? ***Industrial health***, 2000, 38(2):246–51.
17. Belkic K et al. Mechanisms of cardiac risk among professional drivers. ***Scandinavian journal of work, environment and health***, 1994, 20:73–86.
18. Rhee KY. Psychological stress in the Korean work life. A study based on the job strain model. ***Asian Pacific newsletter***, 1999:1–2.
19. Wahlstrom J et al. Influence of time pressure and verbal provocation on physiological and psychological reactions during work with a computer mouse. ***European journal of applied physiology***, 2002, 87(3):257–63.
20. Costa G. Shift work and occupational medicine: an overview. ***Occupational medicine (London)***, 2003, 53(2):83–8.
21. Zautra AJ, Eblen C, Reynolds KD. Job stress and task interest: two factors in work life quality. ***American journal of community psychology***, 1986, 14(4):377–93.
22. Bull N, Riise T, Moen BE. Work-related injuries and occupational health and safety factors in smaller enterprises—a prospective study. ***Occupational medicine (London)***, 2002, 52(2):70–4.
23. Davis KG, Heaney CA. The relationship between psychosocial work characteristics and low back pain: underlying methodological issues. ***Clinical biomechanics***, 2000, 15(6):389–406.