Using Peak and Cumulative Spinal Loading to Assess Jobs, Job Rotation and Engineering Controls

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1. Introduction

1 Peak and cumulative forces on spinal structures have been identified as significant and statistically independent risk factors for reporting low back pain (LBP) (Norman et al., 1998). Changes to the design of work should be directed at reducing, or removing, these known risk factors. However, current field tools do not account for cumulative spinal loading explicitly so this risk factor is not easily quantified. Thus, when making change to reduce risk, the impact of any specific engineering or administrative control remains unknown.

2 Engineering controls are the preferred strategy because they diminish the exposure. As an administrative control, job rotation is often cited for reducing cumulative loading risk (Jonsson, 1988; Putz-Anderson, 1988; Vander Doelen and Barsky, 1990; Hazard et al., 1992; Wands and Yassi, 1993; Grant et al., 1997; Kuijer et al., 1999). Many other benefits, ranging from reduced work stress and absenteeism to increased production, have been ascribed to job rotation (Triggs and King, 2000). Yet rigorous scientific evidence that documents these benefits is difficult to find. It is assumed that by decreasing the amount of time the same muscle groups and joints are exposed to loading, the physical workload is reduced for any one worker. This may be the case for workers that rotate out of high demand jobs. But job rotation requires other workers to rotate into these positions increasing the number of individuals exposed to the risk factors for injury.

3 To perform such a risk analysis requires a thorough analysis of the job. Typically this involves videotaping the worker while they perform all of the tasks associated with the job. It is often necessary to video tape the worker from more than one angle to overcome the obstructed views that frequently occur due to workspace layout and/or performance of the task(s). The frequency with which each task is performed must also be document. Finally the magnitude of the loads handled or any other forces acting on the worker must also be documented. When exact values cannot be measured then estimates are utilized. The analyst must then select the appropriate tool(s), for the body region of interest, to determine if any Threshold Limit Values (TLVs) are being exceeded during the performance of the tasks. The Snook tables and NIOSH equation (Waters et al., 1993) are two of the more commonly utilized tools for assessing injury risk in the low back. The video tapes are then reviewed so that the appropriate postures, frequencies, durations and loads can be recorded. When this information is utilized with the appropriate tool then injury risk estimates are obtained. This is a time consuming task. When one considers that this must be performed for each of the jobs being utilized in a job rotation scenario then it is not surprising that such little research has been conducted.

4 It is now feasible to use a software based approach that incorporates a biomechanical model (4D Watbak, University of Waterloo, Waterloo, Canada) to evaluate the peak and cumulative loading demands for a job over an entire shift. These values are then used by the software to determine a Low Back Pain Reporting Index (LBPRI) score for that particular job (Frazer et al., 2003). The purposes of this paper are to: 1) illustrate the assessment of injury risk in two manufacturing jobs, due to peak and cumulative loading, utilizing this software based approach, and 2) illustrate the effects of job rotation, and a specific engineering intervention on reducing injury risk.

2. Methods

2.1 Software Overview

5 A brief overview of the software utilized in this study will be provided. A complete description may be found in Frazer et al. (2003). The gender, height, weight and age of the individual being evaluated are entered. To estimate the peak and cumulative loading for the job being analyzed it is necessary to enter the shift length and then break the job down into specific actions. The number of repetitions and duration of each action are then entered. A computer mannequin is then positioned in a representative posture for each action. The direction and magnitude of the forces acting on each hand, for each action, are then entered. A two dimensional, fifteen-link segment biomechanical model is then used to estimate the L4/L5 moment and reaction forces for each action. These values are then used in estimating the peak and cumulative spine loads associated with the job. The peak hand load, peak moment, peak compression and peak shear values are determined by identifying the single highest value for each parameter in the job. The cumulative moment, compression and shear are determined by using a square wave approach to calculate these integrals. Specifically, the product of each parameter (e.g. compression for an action) is multiplied by that action's duration (s / repetition) and the number of repetitions in the shift (repetitions/ shift) and then these products were summed across all of the actions associated with each job. This matches the approach utilized by Norman et al. (1998) and ensures a valid comparison to that data base.

6 The reporting of low back pain (LBP), based on the peak and cumulative risk factors, is predicted quantitatively using the LBPRI. The LBPRI scores range from 0.0 to 1.0 (the lower the score the better) and represents the probability of a job being classified as a 'Case Job' (one associated with a LBP report) in the Norman et al. (1998) study if a worker had been working with that particular level of exposure at a job in the automotive plant in which the database was developed. To obtain an LBPRI score the magnitude of a given risk factor (e.g. peak spinal compression) is compared to a 'dose/response' curve that plots the size of the risk factor (the dose), against the probability of the job being classified a 'Case Job' (the response). The curves were obtained from logistic regression analysis of more than 1175 assembly and assembly support tasks performed by 235 workers in an automotive assembly facility as a part of a case/ control study investigating risk factors for reporting LBP (Norman et al., 1998). The software uses individual dose/response curves to determine LBPRI score for peak (hand force, L4/L5 compression, moment and shear) and cumulative (L4/L5 moment, compression and shear) variables. In order to facilitate analysis and interpretation, the software also calculates a single score, the Combined LBPRI, which simultaneously takes into consideration the magnitude of the peak hand load, peak L4/L5 shear force and the cumulative L4/L5 moment of force.

2.2 Assessment of Injury Risk

7 Two automotive manufacturing jobs, Job A and Job B-Pre, were each analysed as illustrative examples of how peak and cumulative loading may be used to assess injury risk. These assessments were conducted as part of an analysis investigating the postural demands for a series of workstations. These jobs were specifically selected because of the considerable torso postural differences observed between them. The operator for each job performed their jobs in standing postures. Job A required the operator to work near the outside of the vehicle and involved the selection and placement of panels. Job B-Pre required the operator to work at the front door post, in the driver's foot well and in the centre of the vehicle with considerable forward bending and reaching.

8 Only the primary line operator (n=1) could be observed performing each job due to production requirements. The operators were videotaped from several view points for approximately 30 production cycles of their so that representative postures could be defined for each of the actions. The industrial engineering standard line balance assessment data was used to obtain the duration of each action for each job. Each of the parts and tools that the operators handled were weighed using a digital force gauge (DF1500, Chatillon, Raleigh, NC, USA). Forces acting on the hands were considered to be zero for activities that involve minimal hand forces

(e.g. joining connectors). It was also assumed that any support forces acting on the operators, such as leaning on the vehicle while fastening a connector, were also zero.

2.3 Assessment of Job Rotation

9 The assessment of Job A and Job B-Pre in the previous section allowed the risk of reporting LBP to be determined for a worker that might perform either job. The results of this assessment indicated that it would be beneficial to investigate possible interventions in order to reduce the risk of injury associated with Job B-Pre. Job rotation between Job A and Job B-Pre is an administrative control that might be utilized to accomplish this. But if a worker was to spend one-half of a shift performing each job, what would the risk of injury be for that worker in this "new job" that they are performing? Or in other words, how effective would this control be?

10 The common assumption in answering this question is that the risk is averaged between the two jobs. This is really a linear Time Weighted Average (TWA) which distributes the injury risk based on the percentage of time spent performing that job. For a worker spending one-half (0.5) of his shift in each job that would be:

11 New Job Combined LBPRI= LBPRI Job A*0.5 + Combined LBPRI Job B-Pre*0.5

12 This approach utilizes the risk estimates for each job individually in estimating the New Job Combined LBPRI, that is, each job has been considered separately or in isolation. However, with job rotation, the worker is required to perform all of the tasks in Job A and Job B-Pre. Therefore it is also possible to assess the risk of injury by performing an analysis utilizing the software but which now considers all of the tasks that the worker must perform over the course of the shift, that is, all of the tasks and actions for Job A and Job B-Pre must be incorporated into one new job prior to performing the analysis. This will produce a Software Approach Combined LBPRI score for the new job that can be compared to TWA approach.

13 As a result of the TWA approach uses the Combined LBPRI scores for each job and the percentage of time per shift spent performing this job it is possible to perform an analysis on a series of rotation schedules (e.g. spend 90% of a shift working Job A and 10% working Job B-Pre). Eleven job rotation schedules were constructed using this concept by adjusting, in 10% increments, the amount of time per shift a worker would spend performing Job A and Job B-Pre, respectfully. Specifically, the first schedule, 100 - 0, indicates the worker spent 100% of their time at Job A and 0% at Job B-Pre. In the 90 - 10 schedule a worker would spend 90% of their time at Job A and 10% at Job B-Pre. In the eleventh schedule, 0 - 100, the worker spends all of their time at Job B-Pre. A twelfth schedule, 99 - 1, was constructed so that the impact of having a worker spend 99% of their time at Job A and 1% at Job B-Pre could also be evaluated. Each of the twelve job rotation schedules were then analyzed using the TWA approach and the software approach.

2.4 Assessment of an Engineering Intervention

14 Implementing an engineering control is another possible approach for reducing the risk of injury associated with Job B-Pre. The specific intervention proposed in this situation was the installation of a shallow trench next to the assembly line so that the worker could stand more upright. To determine how effective this proposed intervention might be a mock up was created. The mock up, termed Job B-Post, was constructed 'after hours' at another position along the assembly line where the line height was substantially greater than at Job B-Pre. This allowed a variable height platform to be utilized so that the worker could be raised to an appropriate height. This also allowed the production process to be simulated so that the worker could utilize all of the parts and tools they normally worked with.

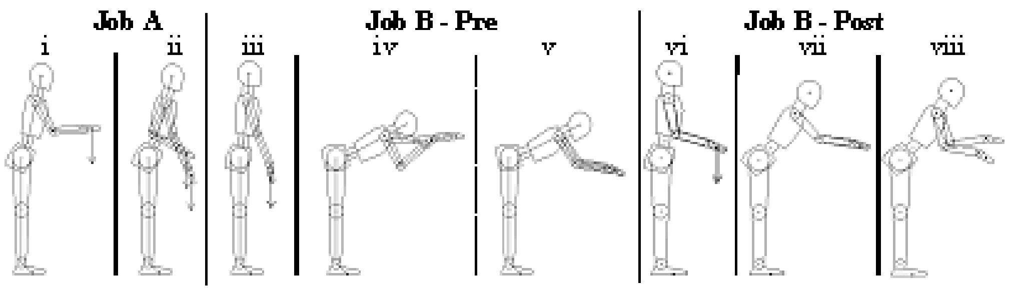
3. Results

3.1 The Job Demands

15 The cycle time for the automotive manufacturing operation was 67 s and the daily production target was 364 vehicles, over a shift of 7 hours and 14 minutes (excluding breaks). A 50th percentile male (76 kg, 1.74 m) was utilized for the analysis of Job A, Job B-Pre and Job B-Post. Based on the video recordings and the industrial engineering line balance sheet, Job

A required four tasks (each task consisting of several actions) to be performed that ranged in duration from 1 to 30 s. The torso flexion ranged from 5° to 16°. Job B-Pre required 14 tasks (each task consisting of several actions) ranging from 2 - 16 s in duration. The torso flexion ranged from 5° to 65°. The postures associated the peak demands, as determined by positioning the computer mannequin to match the average posture identified by observing the video tape of the multiple production cycles, are identified in Figure 1.

Figure 1. The postures associated with the peak hand and spine loads, listed in Table 1, for Jobs A, B-Pre and B-Post



For Job A, posture i) was associated with the peak hand forces, compression and moment while posture ii) produced the peak shear.
For Job B-Pre, the peak hand load occurred in posture iii), while posture iv) produced the peak moment and compression, and posture v) produced the peak shear.
For Job B-Post, the peak hand load occurred in posture vi), while posture vii) produced the peak moment and compression, and posture viii) produced the peak shear. The moment, compression and shear values were calculated about L4-L5.

3.2 Assessment of Injury Risk

16 The peak and cumulative spinal loading parameters, and their respective LBPRI scores, are presented in Table 1. In performing Job A for 100% of a shift the worker studied would have a Combined LBPRI score of 0.46. If they were to work only at Job B-Pre the Combined LBPRI score would be 0.81. The increase in Combined LBPRI score is due to the larger peak hand load, peak shear force and cumulative moment associated with Job B-Pre (Table 1). Based on the Combined LBPRI score, Job B-Pre is much more demanding than the Job A, the preferred job, and the Combined LBPRI of 0.81 indicates a high probability of LBP being reported due to the demands of this job.

Table 1. **The peak and cumulative spinal loading parameters, and their associated LBPRI scores**

Spinal Loading Parameter			Job		
			A	B-Pre	B-Post
Peak	Compression	(N)	1356	2243	1739
		LBPRI	0.28	0.36	0.31
	Moment	(N.m)	56	124	85
		LBPRI	0.27	0.38	0.32
	Hand Load	(N)	29	50	50
		LBPRI	0.34	0.35	0.35
	Shear	(N)	118	362	229
		LBPRI	0.21	0.41	0.29
Cumulative :	Moment	(MN.m.s)	1.00	1.48	1.00
		LBPRI	0.71	0.88	0.71
Combined LBPRI			0.46	0.81	0.54

The cumulative moment about L4/L5 is integrated over a 7 hour and 14 minute shift. The Combined LBPRI is calculated using the magnitudes of the peak hand load, peak shear and cumulative moment as inputs

3.3 Job Rotation

17 For each of the simulated job rotation schedules that were analyzed the Software Approach always produced an LBPRI score that was greater than the TWA Approach (Figure 2). As the amount of time spent working in Job B-Pre increased the differences between the

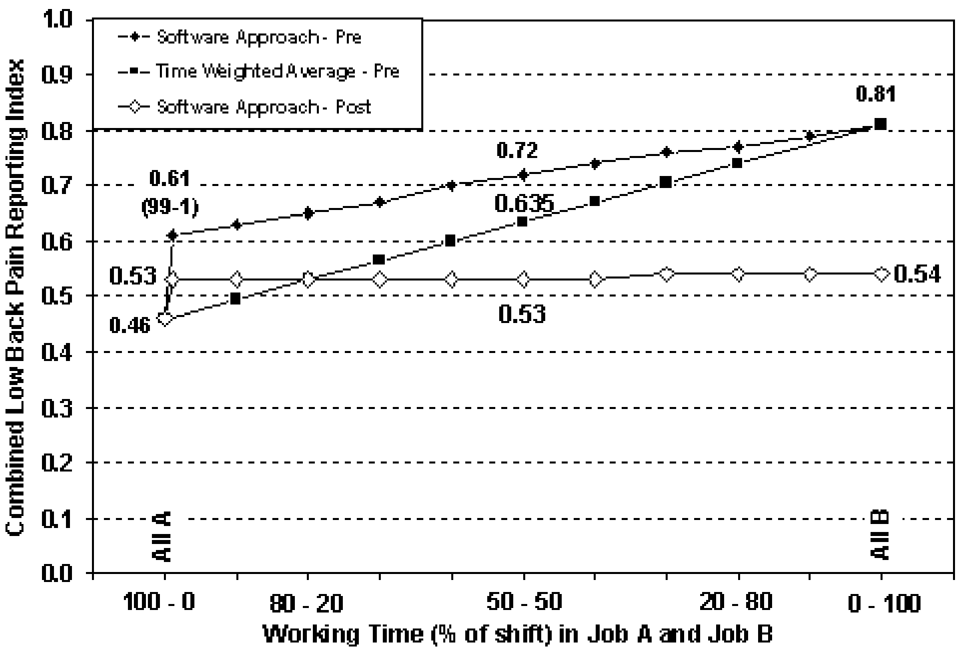
two approaches decreased. When the worker spent one-half of their time at each job (50 - 50 schedule) the TWA Approach produced a score of 0.635 (0.46*0.5 + 0.81*0.5) which represents a relative increase in risk of 39% compared to working only at Job A. The Software Approach produced an LBPRI score of 0.72 which represents a relative increase of 57% in the risk of reporting low back pain compared to working only at Job A (Figure 2). If a worker was in Job B-Pre and rotated to Job A for one-half of their shift the TWA Approach produced a relative decrease of 21%. However, when analyzed with the Software Approach the relative decrease was just 11% (Figure 2).

18 The biggest difference between the two approaches occurred with the 99 - 1 schedule. For this schedule the TWA approach calculated a Combined LBPRI score of 0.46. However, with the Software Approach the Combined LBPRI was 0.61, a relative increase of 33%. This increase in Combined LBPRI occurs because the worker has now become exposed to greater peak hand forces and peak shear forces (Table 1). The 1% exposure to Job B-Pre was not enough to increase cumulative loading.

3.4 Engineering Intervention

19 The engineering intervention reduced the Combined LBPRI from 0.81 for Job B-Pre to 0.54 Job B-Post. As a result of the intervention, the worker stands more upright (Figure 1) which contributes to a reduction in both peak shear force and cumulative moment (Table 1).

Figure 2. The Combined LBPRI scores



As a result of job rotation, calculated pre and post engineering intervention using a time weighted average model and a software approach for different combinations of working times on Jobs A and B.
The Combined LBPRI for Job A is 0.46.
Analysis using the biomechanical model revealed that pre-intervention, spending 99% of the shift working Job A and simply 1% performing Job B-Pre increased the LBPRI from 0.46 to 0.61 (33%).
Analysis of a 50-50 job rotation schedule, with the software approach, shows the Combined LBPRI to be 0.72, a 57% increase for the worker in Job A and an 11% decrease for the worker in Job B-Pre. The intervention decreased the LBPRI for Job B 33%, from 0.81 (Pre) to 0.54 (Post)."

20 The benefits of this intervention are even more pronounced when job rotation is considered. Assessing the twelve rotation schedules utilizing Job A and Job B-Post reveals that a much more uniform risk exposure occurs. As shown in Figure 2, a step increase still occurs in Combined LBPRI score, from 0.46 to 0.53, with the 99%-1% rotation schedule. This reflects the increase in peak hand load and L4/L5 shear force experienced with Job B-Post (Table 1). However, the risk for the other schedules remains constant at 0.53 - 0.54.

4. Discussion

21 The software based approach presented in this paper is one method for incorporating peak and cumulative loading in the assessment of jobs for the risk for reporting low back pain. Peak and cumulative loading measure different demands of a job (Norman et al., 1998) so it is critical that both types of risk factors be accounted for.

22 Reducing low-back injury via job rotation &/or engineering controls.

23 The implementation of job rotation does not always reduce risk of reporting low back pain. With the rotation simulated in this study, both pre and post job redesign, the risk of reporting low back pain decreased when rotating out of Job B and into Job A. However, the risk increased when rotating out of Job A and into Job B. This finding may be implicitly understood by those that recommend job rotation as a method for reducing musculoskeletal risk of injury by spreading out, or diluting, the exposure. However, for those that implement, or participate in, job rotation this finding is extremely important. Indeed, while a ‘full rotation’ strategy might evenly distribute cumulative load, raising if for some workers, lowering it for others, it also exposes all workers to the highest peak load.

24 The redistribution of the risk for reporting low back pain was not uniform in this example. Pre-intervention, the increase for those rotating into the higher risk job was substantially greater than that which might have been predicted by simply averaging the risk, as the TWA approach does. This change occurs because of the effects of combining tasks which influenced both peak and cumulative tissue loading and the interaction of these risk factors. Although job rotation results in a decrease in the cumulative L4-L5 moment, the workers are now exposed to the peak hand load and reaction shear associated with Job B-Pre. The TWA approach was not sensitive to this. The results indicate that the subjective prediction of the effects of job rotation on injury risk should be held with some skepticism.

25 The net increase in risk with the software approach occurs because combining tasks affects both peak and cumulative tissue loading exposure. For the worker in Job B, rotating to Job A reduces only one of the three risk factors. The cumulative L4-L5 moment decreases but the peak hand force and shear force to which the worker was exposed during their shift are not altered. The decrease in Combined LBPRI score reflects the decreased cumulative load. For the worker in Job A that rotates to Job B, all three risk factors increase due to working at the more demanding job. These findings support the observation of Keyserling et al. (1991) who indicated that job rotation by itself only changes the cumulative daily exposure but not alter other generic risk factors (e.g. awkward postures, repetition) to which a worker is exposed.

26 The analysis using the software approach facilitated the development of an engineering control by quantifying which of the risk factors were particularly problematic for Job B-Pre. A specific design change, which allowed workers to stand more upright, reduced the peak L4/L5 reaction shear and the L4/L5 cumulative moment. This lead to a substantial reduction in the Job B-Post Combined LBPRI. The beneficial risk reduction produced by implementing the engineering control would be delivered to any worker that performs this job (Figure 2), especially those workers that might be involved with job rotation. The post intervention job rotation analysis involved only a modest 15% increase in the risk of reporting low back pain for those that rotate from Job A to Job B-Post, no matter which rotation schedule might be implemented.

27 The observations regarding job rotation are especially important given the popularity of citing it as a risk reduction mechanism (Jonsson 1988, Vander Doelen and Barsky 1990, Hazard et al. 1992, Wands and Yassi 1993, Grant et al. 1997, Kuijer et al. 1999). As an administrative control for reducing injury risk, job rotation may actually be less effective than assumed. Although there are many advantages and disadvantages associated with job rotation (Triggs and King 2000), the effect of rotation on injury risk should be fully appreciated when determining if job rotation is to be implemented.

5. Limitations

28 There are several limitations to this study which need to be addressed. The first is that the two jobs selected for analysis do not necessarily follow the general principle of job rotation. The goal of job rotation is to alleviate the physical fatigue and stress for a particular set of

muscles by rotating employees among other jobs that use primarily different muscle groups (US Department of Labor, 1993). In this study the low back musculature was involved with both jobs although to a much greater extent in Job B-Pre. This illustrates the challenge of finding jobs, especially in a production environment, in which the low back is not involved. Also, not all rotation schedules are developed with this purpose in mind. For some companies, job rotation is an inherent part of the corporate culture (Freiboth et al., 1997; Cosgel and Miceli et al., 1999). The results of the present study may be particularly relevant for these groups.

29 The study was restricted to observing a single operator performing each job. Although this permitted the illustrative examples for job rotation and the engineering intervention to be analyzed, ideally, additional operators would have been included. This would have produced variability in the Combined LBPRI scores and perhaps changed the actual estimate for each of the jobs. However, it would not have affected the general findings regarding each of the specific interventions investigated. The study was also restricted by not being able to sample operators for a longer period of time. There is certainly a degree of variability in low back loading over the course of the day some of which would be associated with changes in working posture. Longer sampling periods would have allowed differences in posture to be quantified and this effect to be further assessed. Also, a tissue's "loading versus" history is an important aspect in determining tolerance levels. Although this information is an implicit component of the data collected by Norman et al., (1998) which produced the LBPRI dose-response curves, there is currently not a method for explicitly taking these factors into consideration.

30 Utilizing a mock up allowed the impact of the proposed engineering intervention to be evaluated. It must be remembered that working in a mock up is certainly less realistic than performing work while the production process is ongoing so it is possible that any of the postural improvements observed in the mock up may not be as great if the intervention is adopted. However, even if the gains were not as great as observed in the mock up the intervention would still serve to decrease the risk for all workers that perform that job. Being able to quantify this improvement makes a stronger case for making the change.

31 A static analysis was performed because it was not feasible to measure dynamic hand forces in this environment. If this data had been available they could have been entered into the software program and the biomechanical model would have performed a quasi-dynamic analysis. Also, A two dimensional analysis was selected because the jobs required very little twisting of the torso and for most of the tasks it was possible to video the upper body in the sagittal plane. While it was technically feasible to perform a three dimensional analysis in order to obtain more accurate spinal loading estimates it was anticipated that any over or under estimates would have been uniformly distributed and would not have severely impacted the risk estimates or the comparisons.

32 Finally, the estimates of the L4/L5 compression, shear and moments of force are dependent upon the validity of the model used to make them. Currently it is not possible to perform a direct validation of these variables via in vivo measurements of the same variables, in the same units. Therefore, the biomechanical model used in this study has attempted to incorporate as much anatomical and physiological content validity as possible in an industrial usable version.

33 In the assessment of injury risk it is not sufficient to only consider the impact of a single peak. The cumulative effect of many small peaks that are held for long durations and/or performed many times in a shift must also be considered. Therefore, both peak and cumulative loading must be considered so that both risk of injury and consequences of administrative and engineering controls may be properly quantified.

Bibliographie

Cosgel, M.M., Miceli, T.J. (1999). Job rotation: cost, benefits and stylized facts, *Journal of Institutional and Theoretical Economics*, 155, 301-320.

Frazer, M.B., Norman, R.W., Wells, R.P., Neumann, W.P. (2003). The effects of job rotation on the risk of reporting low back pain. *Ergonomics*, 46, 904-919.

Freiboth, M., Frieling, E., Henniges, D., Saager, C. (1997). Comparison of different organisations of assembly work in the European automotive industry, *International Journal of Industrial Ergonomics*, 20, 357-370.

Grant, K.A., Habes, D.J., Bertsche, P.K. (1997). Lifting hazards at a cabinet manufacturing company: evaluation and recommended controls. *Applied Occupational and Environmental Hygiene*, 12, 253-258.

Hazard, L., Mautz, J., Wrightsman, D. (1992). Job rotation cuts cumulative trauma cases. *Personnel Journal*, 71, 29-32.

Jonsson, B. (1988). Electromyographic studies of job rotation. *Scandinavian Journal of Work, Environment & Health*, 14 (suppl 1), 108-109.

Keyserling, W.M., Armstrong, T.J. et Punnett, L. (1991). Ergonomic job analysis: a structured approach for identifying risk factors associated with overexertion injuries and disorders. *Applied Occupational and Environmental Hygiene*, 6, 353-363.

Kuijer, P.P.F.M., Visser, B., Kemper, H.C.G. (1999). Job Rotation As A Factor In Reducing Physical Workload At A Refuse Collecting Department. *Ergonomics*, 42, 1167-1178.

Norman, R., Wells, R., Neumann, P., Frank, J., Shannon, H., Kerr, M. et le groupe OUBPS (Ontario Universities Back Pain Study) (1998). A comparison of peak versus cumulative physical work exposure risk factors for the reporting of low back pain in the automotive industry. *Clinical Biomechanics*, 13, 561-573.

Putz-Anderson, V. (1988). Cumulative trauma disorders: a manual for musculoskeletal diseases of the upper limbs. London: Taylor & Francis.

Triggs, D.D., King, P.M. (2000). Job rotation: an administrative strategy for hazard control. *Professional Safety*, 45, 32-34.

US Department of Labor (1993). Ergonomics program management guidelines for meatpacking plants. *Occupational Safety and Health Administration Publication No. 3123,* Occupational Safety and Health Administration, Washington, D.C.

Vander Doelen, J.A., Barsky, S.J. (1990). Repetitive strain injury within the meat-processing industry. *Occupational Health in Ontario*, vol. 11, pp. 154-167.

Wands, S.E., Yassi, A. (1993). Modernization of a laundry processing plant: is it really an improvement? *Applied Ergonomics*, 24, 387-396.

Waters, T.R., Putz-Anderson, V., Garg, A., Fine, L.J. (1993). Revised NIOSH Equation for the design and evaluation of manual lifting tasks. *Ergonomics*, 36, 749-776.

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Droits d'auteur

Résumés

Peak and cumulative forces on spinal structures have been identified as significant and statistically independent risk factors for reporting low back pain (LBP). This paper describes a software based approach which utilizes these risk factors to quantitatively predict the reporting of LBP by utilizing a Low Back Pain Reporting Index Score (LBPRI). Two automotive manufacturing jobs were assessed utilizing this approach and these results were utilized in the development of a specific administrative and engineering control. Analysis of the jobs with the controls in place indicated that the administrative control, job rotation, was less effective than assumed and produced an overall increase in the risk of reporting LBP. The engineering control resulted in an overall decrease in the risk of reporting LBP and this beneficial risk reduction would be delivered to any worker that performed this job. The results of this study indicate that both peak and cumulative loading must be considered in order to properly appreciate the risk of injury and the consequences associated with the implementation of administrative and engineering controls.

Utilisation des charges maximales et cumulatives sur la colonne vertébrale pour évaluer les emplois, la rotation des emplois et les contrôles techniques

Il a été démontré que les forces maximales et cumulatives exercées sur les structures de la colonne vertébrale constituent des facteurs de risques significatifs et statistiquement indépendants pour la déclaration de douleurs au dos. Le présent document décrit une approche logicielle qui utilise ces facteurs de risques pour prédire de façon quantitative la déclaration de douleurs au dos à l'aide d'un pointage des indices de déclaration de douleur au dos, ou pointage IDDD. On a évalué deux emplois dans le secteur de la fabrication automobile avec cette approche, puis on a élaboré au moyen des résultats obtenus un contrôle spécifique de nature administrative et technique. En analysant les emplois avec les contrôles en place, on a constaté que le contrôle administratif utilisé, soit la rotation des emplois, était moins efficace que prévu et engendrait une augmentation globale du risque de déclaration de douleur au dos. La mise en place d'un contrôle technique a fait diminuer globalement le risque de déclaration de douleur au dos, et ce, pour tout travailleur occupant le poste en question. Les résultats de cette étude indiquent qu'il faut considérer à la fois les charges maximales et les charges cumulatives afin d'évaluer adéquatement le risque de blessures et les conséquences associées à la mise en place de contrôles techniques et administratifs.

Entrées d'index

Mots-clés : rotation des emplois, bas du dos, modèle biomécanique, contrôle administratif, contrôle technique
Keywords : job rotation, low back, biomechanical model, administrative control, engineering control