

Implementation of a participatory ergonomics program in the rehabilitation of workers suffering from subacute back pain[☆]

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Abstract

This paper describes a participatory ergonomics program aimed at early return to regular work of workers suffering from subacute occupational back pain and assesses the perceptions of the participants on the implementation of ergonomic solutions in the workplace. The participatory ergonomics program was used in the rehabilitation of workers suffering from subacute back pain for more than 6 weeks, a program that was associated with an increased rate of return to work. The perceptions of the participatory ergonomics participants were assessed 6 months after completion of the ergonomic intervention through a questionnaire sent to employer representatives, union representatives and injured workers of participating workplaces. About half of the ergonomic solutions were implemented according to the perception of the participants, with a substantial agreement between respondents. © 2001 Elsevier Science Ltd. All rights reserved.

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1. Introduction

The costs and human suffering associated with occupational back pain are considerable (Webster and Snook, 1994). Several studies have demonstrated that occupational risk factors are linked to the development of low back pain in the workplace (NIOSH, 1997). In order to prevent low back pain, ergonomic interventions have been advocated to decrease the exposure of workers to these risk factors (Garg and Moore, 1992; Haag, 1992; Stobbe, 1996). Amongst the various ergonomic approaches, participatory ergonomics is an increasingly popular approach. Participatory ergonomics consists in the workers' active involvement in implementing ergo-

nomics knowledge and procedures in their workplace, supported by their supervisors and managers, in order to improve their working conditions (Nagamachi, 1995). Participatory ergonomics has been claimed to add several advantages to the traditional ergonomic intervention, including the compilation of a powerful, diverse set of skills and knowledge on which to draw (Launis et al., 1996), with the increased likelihood of successful implementation of ergonomic solutions (Imada, 1991). Participatory ergonomics interventions have been associated with a decrease in the incidence of musculoskeletal symptoms (Garg and Owen, 1992; Halpern and Dawson, 1997; Lanoie and Tavenas, 1996; McKenzie et al., 1985; Moore, 1994; Moore and Garg, 1998; Vink et al., 1995; Vink and Kompier, 1997), a decrease in work absenteeism (Garg and Owen, 1992; Laitinen et al., 1997, 1998; Lanoie and Tavenas, 1996; McKenzie et al., 1985; Moore, 1994; Moore and Garg, 1998; Vink and Kompier, 1997) and an improved psychosocial work environment (Laitinen et al., 1998).

To date, participatory ergonomics has been mostly applied to the primary prevention of back pain (Garg

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and Owen, 1992; Lanoie and Tavenas, 1996; Moore, 1994; Moore and Garg, 1998; Pohjonen et al., 1998). However, it is well known that the majority of costs associated with back pain is related to a minority of workers suffering from chronic back pain (Williams et al., 1998). In order to reduce the costs associated with long-term disability, several authors have suggested that early implementation of appropriate ergonomic modifications to the jobs of workers suffering from subacute back pain would provide a rapid return to work and thus avoid prolonged disability (Mairiaux et al., 1991; Mesnard, 1993). Subacute back pain is defined as back pain leading to an absence from regular work for more than 1 month but less than 3 months (Frank et al., 1996a). Other authors have hypothesized that the job demands of a disabled worker must be adapted to his evolving physical capacities while he is being rehabilitated, and failure to do this could result in potential relapses and prolonged work disability (Isernhagen et al., 1997; Matheson et al., 1997).

Intervention studies linking clinical and occupational management have proven to be more effective than usual care in returning back pain patients to work (Yassi et al., 1995). In a recent population-based randomized clinical trial, the authors demonstrated the effectiveness of an occupational intervention including a participatory ergonomics program to return workers with subacute back pain to their regular job (Loisel et al., 1997). When comparing back pain workers submitted to the participatory ergonomics program with those not submitted to it, return to the regular work was 1.9 times faster for the participatory ergonomics group ($p < 0.01$).

However, beyond the effectiveness of the participatory ergonomics program on return-to-work, it is not known if such a program was perceived by the participants as having actually led to ergonomic modifications of the worker's job. The present paper presents a detailed description of the participatory ergonomics program used in this study, evaluates the perceptions of participants on the implementation of ergonomic solutions in the workplace and assesses the reasons for implementation or non-implementation.

2. Study context

The present study was part of a population-based randomized clinical trial on management of subacute back pain (Loisel et al., 1997). The main objective of the trial was to assess the effectiveness of a comprehensive model of management of occupational back pain, linking a clinical and rehabilitation intervention and an occupational intervention including the participatory ergonomics program. The aim of the model was to propose, early in the back pain disability process, integrated interventions directed at both the worker and the workplace

(Loisel et al., 1994). A specialized multidisciplinary back pain clinic comprising a clinical and an ergonomic team, had early intervention to reduce prolonged disability as the main objective. To avoid unnecessary efforts and costs for the 70% of workers who return to work before 4 weeks, recruitment of workers in the back pain clinic began at the 4th week of absence from work. The multidisciplinary team was responsible for the implementation of the various clinical and ergonomic interventions and for making consensus to counsel the worker's attending physician on the final worker's outcome: return to regular work, return to the regular work tasks but improved through the ergonomic intervention, or if not possible, because the back disease was not compatible with the job and because the job tasks could not be improved through ergonomics, vocational rehabilitation.

This study was set up in the vicinity of Sherbrooke, a 100,000 inhabitants town in the province of Quebec, Canada. All workplaces with more than 175 workers and located in a radius of 30 km from the study back pain clinic were eligible to the study. Half of the eligible workplaces were randomized to receive a participatory ergonomics program applied to the job tasks of any worker subsequently declaring a work-related back pain episode. Workers from these workplaces received the participatory ergonomics intervention when they were absent from regular work for 6 weeks due to a back pain episode occurring in the workplace. Regular work was defined as the identical or similar work as prior to the onset of the work-related back pain. Workers returning to "light duties" were not considered as having returned to regular work until they resumed their usual job. To be included in the study, back pain workers had to be between 18- and 65-years old, and suffering from a back pain episode compensated by the Quebec Workers Compensation Board. Workers suffering from severe accidents (e.g. vertebral fractures) were excluded. Half of the back pain workers were randomized to also receive a clinical intervention. Recruitment of back pain workers was carried out from September 1991 to December 1993. Only workers who actually participated in the ergonomic intervention were included in the analyses. The study was approved by the Ethics Committee of the Sherbrooke University Hospital and all participating workers signed the approved consent form.

3. Description of the participatory ergonomics program

Though primary prevention of back pain is the logical approach, authors have questioned its cost-effectiveness and its capacity to prevent back pain (Frank et al., 1996b). As was described in the introduction, the goal of the comprehensive back-pain-management program, including the participatory ergonomics program, was to prevent the costly problem of prolonged disability

occurring in some workers absent from work for occupational back pain. So, the participatory ergonomics program was implemented in a rehabilitation (not prevention) context. An agreement was first concluded between the employers, the unions (when existing) and the research team. Under the terms of the agreement, each participating workplace accepted to: (1) set up a core participatory work group at the beginning of the study; (2) allow the development of a participatory ergonomics intervention led by the study ergonomist for eligible occurring back pain cases; and (3) receive the recommendations made by the participatory ergonomics group in order to improve the injured worker's work tasks. However, the employer was at liberty to implement these ergonomic recommendations or not.

Before the recruitment of back pain workers, one employer representative and one union representative in each workplace were invited to a two-day participatory ergonomics training course. Course topics included the basics of back anatomy and function, risk factors for back pain, cognitive aspects of work activity, principles of ergonomic analysis of work activity, principles of changes to tasks lay out, the theoretical basis of the participatory process, and examples of job analysis and job task modification.

The study ergonomist initiated the participatory process for each back pain case resulting in a 6 weeks absence from regular work. This process included the following four steps (Table 1):

Step 1: The ergonomist met the worker at the back pain clinic to collect data on personal characteristics: anthropometric data, occupational history and past history of musculoskeletal disorders. The worker and his/her supervisor each completed a written description of job tasks. Questions on the back pain accident and on job organization and tasks were also asked. The worker's workplace medical file and the description of any past work accidents were consulted when such records existed.

Step 2: The ergonomist organized a meeting in the workplace with the participatory ergonomics workgroup composed of: the injured worker, his/her supervisor, the previously trained employer and union representatives, and the ergonomist himself. Objectives of this meeting were to: (1) compare and reconcile the worker's and supervisor's descriptions of job tasks; (2) draw up a preliminary list of the tasks associated with risk factors for back pain; (3) establish a detailed description of the back accident; (4) identify general workplace characteristics and practices (with written workplace data if available): history of job, economic situation of company, personnel management practices assessed with worker turnover, absenteeism, accident rate, claims concerning work conditions; (5) identify work organization and job demands (quantity, quality, pace, variability of production) related to the injured worker's tasks, with special consideration to biomechanical risks for the back.

Table 1

Summary of the four successive steps of the participatory ergonomics intervention, implemented for eligible workers after 6 weeks of absence from their regular work

	Actions	Main objectives
Step 1	Worker's interviewed by the study ergonomist	Collect data on occupational history Worker's perception of job tasks
	Consultation of workplace files on workers and work tasks	Collect data on past accidents and on the worker's tasks
Step 2	Meeting of ergonomist + worker + supervisor + union	Conciliate job task description Study work situation Draw up preliminary list of tasks at risk for the back
	Visit of job site and observation of job tasks (performed by co-worker) (simple tools + video)	Tasks at risk for the back Loads, distances, work cycles times
	Preparation by ergonomist of a draft report of the "true work situation"	Prepare Step 4
Step 4	Meeting of the participatory work group (ergonomist + worker + supervisor + employer and union representatives)	Identification of solutions to improve work tasks
	Employer is at liberty to implement or not solutions	Set timetable for possible implementation Appoint a person for follow-up Ergonomist completes and send a full report to employer

Step 3: The ergonomist visited the job site and observed the injured worker's usual work tasks performed by another worker in the presence of the injured worker. When the job included many work tasks, the tasks perceived by the ergonomics workgroup as responsible for the work accident were preferentially observed. Ergonomic factors potentially linked to back pain occurrence were evaluated. Job strategies and methods were discussed with the observed and injured workers. Loads to be handled (including tools), distances to be covered and

work cycle times were measured. Sketches of workstations (there might be several workstations for the same worker) including the dimensions and location of equipment were drawn. Only simple tools were used for these analyses: paper, pencil, dynamometer, scale, measuring tape and stopwatch. A video camera and tape recorder were often used to record the work situations, especially those with quick and repetitive movements and postural changes. When a job included many task variations, estimates of risk factors were also based on workers' interviews and company documents. When the work tasks were carried out in teamwork (e.g., team of caregivers on hospital ward), a meeting was held with the team to ascertain the other workers' perception of job demands. The ergonomist was then able to write a draft report that included descriptions of the worker's personal and occupational characteristics, his work tasks and suggestions for improvement of these work tasks. The description of the work tasks was intended to give the participatory ergonomics group a picture of the "actual" work situation, which could contrast with the existing "theoretical" job description. This draft version was first discussed with the injured worker and the supervisor and then sent to the members of the participatory group. A meeting of the group was then scheduled.

Step 4: The participatory work group met to identify improvements of the work tasks. One or two meetings lasting 2 h were necessary to fulfill the following objectives: (1) explain the draft version of the ergonomic report; (2) reach a consensus on the high risk job tasks needing improvement; (3) develop solutions to improve these work tasks with specific steps to be taken by the employer to implement them; (4) evaluate the feasibility of these solutions and establish priorities based on the seriousness of the risk, anticipated costs, possible impact on other work tasks, technical difficulties, availability of expertise in the workplace and other workplace priorities; (5) set a timetable and appoint a person to oversee the follow-up. A final report was written by the ergonomist, sent to the participants and presented to management in the following 15 days. Final acceptance and implementation of these solutions was the employer's responsibility, and he could disregard any or all of them.

It has to be underlined that in all cases, following the philosophy of participatory ergonomics, the injured workers and the employers' and unions' representatives were deeply involved in the process of work redesign (back injury did not prevent workers' participation to the workgroups).

4. Evaluation of the perceptions of participants on solution implementation

Perceptions of the participatory ergonomics participants were assessed in the following way. A questionnaire

on the implementation of solutions was developed by the research team. For each back pain case, a copy of the questionnaire with a copy of the proposed solutions was sent to the employer representative, the union representative and the injured worker 6 months after completion of the participatory intervention. Participants were asked if each solution was totally, partially or not implemented. Participants were also asked if the program increased awareness of back risk factors in their workplace. Since employers were ultimately responsible for solution implementation, employer representatives were asked why solutions were partially or not implemented. A research assistant not involved in the ergonomic interventions ensured appropriate completion of the questionnaire. Data on the characteristics of the participating workplaces and the workers' characteristics were also collected. Data were compiled and entered in a database (Acius Fourth Dimension).

The level of implementation of the solutions (no implementation, partial implementation, full implementation) was estimated on the basis of three distinct frequency tables for the employer representatives, union representatives, and injured workers. Agreement was measured by the Cohen's κ coefficient of agreement for nominal scales (Cohen, 1960). Agreement on solutions were evaluated between pairs of respondents. κ coefficients were interpreted following the Landis and Koch criteria (Landis and Koch, 1977): < 0.10 = poor agreement; 0.10 – 0.20 = slight agreement; 0.21 – 0.40 = fair agreement; 0.41 – 0.60 = moderate agreement; 0.61 – 0.80 = substantial agreement; > 0.80 = almost perfect agreement. Analyses were performed using SPSS/WINDOWS ver 6.1 software.

5. Results on solution implementation

Thirty one of the 35 eligible workplaces agreed to participate in the trial. Sixteen workplaces were randomized to the participatory ergonomics intervention. The study population was derived from six manufacturing plants, four health care institutions and six service companies, for a total of 10,418 workers. Before subjects recruitment, employer and union representatives of all 16 workplaces received the preliminary ergonomic training given in two sessions.

From these 16 workplaces, 58 back pain workers accumulating 4 weeks of absence were randomized to the ergonomic program. Ten of them returned quickly to their regular work (before 6 weeks), and therefore were not eligible for the ergonomic intervention. Eleven other cases did not receive the ergonomic intervention for the following reasons: 5 workers refused the intervention, 2 workers were assigned to a new regular job, 1 worker was belatedly refused compensation by the WCB and work conflicts explained 3 other cases. Overall, 37 back pain workers received the participatory ergonomics

Table 2

Age, sex and type of job of the 37 back pain workers included in the study

Age (years)	<i>n</i> (Mean \pm SD)
Males	19 (41.2 \pm 7.2)
Females	18 (41.3 \pm 6.9)
Type of job	<i>n</i>
Full time	23
Part time	11
On call	3

Table 3

Distribution of job titles of the 37 workers

Health care Institutions	Nurse (4) ^a
	Nurse assistant (2)
	Orderly (9)
	Sanitary worker (1)
	Radiology technician (1)
	Food service employee (4)
	Cafeteria employee (2)
Clerk (1)	
Manufacturing Plants	Welder (1)
	Forklift operator (1)
	Fixed machine operator (1)
	Press-roll operator (1)
	Brine operator (1)
	Mixer operator (1)
	Inspector-warehouseman (1)
	Telephone wiring technician (1)
Packer (1)	
Service Industry Companies	Bus driver (1)
	Apprenticeship technician (1)
	Laboratory maintenance technician (1)
	Adapted transport driver (1)

^aNumber of workers in parentheses.

intervention. This number of workers is slightly different from the number found in the original study ($n = 47$) (Loisel et al., 1997) for the two following reasons: (1) some workers were withdrawn from the main analyses of the randomized trial because they were included too early or too late in the study but these criteria were not judged to be of important influence for the present study; (2) only workers who actually participated in the ergonomics intervention were included in the analyses. Characteristics of the 37 workers are found in Table 2. Twenty-one job titles were represented by these 37 workers (Table 3). The 37 ergonomic interventions were carried out in 9 workplaces in three sectors: 24 in health care, 9 in manufacturing and 4 in service industries (Table 4).

A total of 226 different ergonomic solutions for job task improvements were proposed to the employers by the 37 participatory ergonomics work groups. The median number of solutions per worker was 6, with a range

Table 4

Characteristics of the workplaces with number of back pain workers included in the study

	Number of employees	Number of back pain worker
Health care Institutions	2400	10
	1313	2
	450	5
	234	7
Manufacturing Plants	600	6
	305	2
	210	1
Service Industry Companies	643	2
	230	2
Total	6385	37

of 1–11 solutions per worker. According to the research ergonomist, the following risk factors were targeted by these solutions: posture (123 solutions), excessive use of strength (69 solutions), safety hazards (27 solutions) and environment (7 solutions). These solutions were aimed at the following fields: equipment (64 solutions), job site lay-out (63 solutions), task content (35 solutions), work organization (27 solutions), education/training (24 solutions) and other fields (13 solutions).

Of the 226 solutions, 60.2% were totally or partially implemented according to the employer representatives, 45.1% according to the union representatives and 41.5% according to the injured workers (Table 5). The highest level of agreement assessed with the κ coefficient was between union representatives and injured workers ($\kappa = 0.75$), while agreement between employer representatives and injured workers was lower ($\kappa = 0.67$). The lowest level of agreement was between employer and union representatives ($\kappa = 0.64$). However, all κ coefficients were above 0.60, which indicates a substantial level of agreement between pairs of respondents (Landis and Koch, 1977). When analyzing the implementation of the solutions per activity sector, the percentage of implementation was similar in the healthcare sector (60% employers; 41% unions; 37% workers) and in the manufacturing sector (55% employers; 50% unions; 44% workers). However, implementation of solutions was higher following employers and unions responses in the services sector (75% employers; 70% unions; 74% workers).

When employer representatives were asked why solutions were partially implemented, the following reasons were given: disruption of work procedures (53%), costs (19%), technical difficulties (10%), modification of the injured worker's job type (10%), limited company resources (for example human resources, motivation of the employer) (4%), influence on other job sites (3%), and

Table 5

Percentage of totally, partially and not at all implemented ergonomic solutions ($n = 226$), as reported by employers' representatives, unions' representatives and injured workers

	Completely implemented (%)	Partially implemented (%)	Not implemented (%)	Don't know (%)	Completely or partially implemented (%)
Employer representatives	32.8	27.4	35.4	4.4	60.2
Union representatives	24.3	20.8	38.5	16.4	45.1
Injured workers	27.2	14.3	36.4	22.1	41.5

Table 6

Perception of awareness about back pain risk factors in the workplace following the participatory ergonomics program (37 workgroups)

	Increased awareness	No change in awareness	Don't know
Employer representatives	25 (68%)	9 (24%)	3 (8%)
Union representatives	28 (76%)	7 (19%)	2 (5%)
Injured workers	20 (54%)	8 (22%)	9 (24%)

other reasons (1%). However, the employer representatives indicated that they intended to complete the implementation of 62% of these partially implemented solutions. When asked why solutions had not been implemented, the following reasons were given by the employer representatives: disruption of work procedures (42%), modification of the injured worker's job type (17%), technical difficulties (11%), work conflicts (10%), costs (6%), company reorientation (5%), limited company resources (1%), influence on other job sites (1%), and other reasons (7%).

Finally, 68% of the employer representatives, 76% of the union representatives and 54% of the injured workers indicated that the ergonomic program had led to an increased awareness of back pain risk factors in the workplace (Table 6).

6. Discussion

The fact that none of the workplaces randomized to the ergonomic intervention dropped out of the study and that only 10% of the workers declined participation seems to indicate a good acceptance of such a process by most workplaces and workers. About half of the solutions were implemented as reported by the respondents. This proportion is similar to the one found in other participatory ergonomics studies (Garmer et al., 1995; St-Vincent et al., 1998; Westlander et al., 1995; Wilson, 1995). Several reasons could explain why solutions were partially or not implemented. In order to recruit the eligible workplaces, extensive explanations on the aims and functioning of the model were given by the study team to management and unions of these workplaces.

However, despite the agreement signed by the employers and unions of the participating workplaces with the study team, middle management (e.g. supervisors, production managers) was generally not informed of this agreement, which could have led to partial or non-implementation of some solutions. Also, other factors not assessed in the study may have influenced the implementation of solutions: previous involvement of the company in health and safety management, the existence of competing priorities in the workplace, or mistrust between workers and employers.

Although agreement was substantial between participants on the implementation of solutions, several reasons could explain the discrepancies found between participants. In order to project a positive corporate image to the researchers, employer representatives could have overestimated the actual implementation of solutions. However, they could also have been more informed of ergonomic modifications, since they were responsible for their implementation. Some workers were not returned to their regular work tasks at the time of follow-up and this may explain the high percentage of "don't know" responses (22.1%) from the workers (Table 5). When only assessing the responses of the workers returned to their regular work 6 months after their work accident, the percentage of "don't know" responses drops to 8.9%.

It was interesting to note that the potential impact of ergonomic changes on company work methods outweighed costs as the major reason for partial or non-implementation of solutions. These results confirm the notion that upper management must be aware and understand the value of proposed ergonomic changes if these are to be implemented (Garmer et al., 1995; Pohjonen et al., 1998; Vink et al., 1995; Wilson, 1995). The results concerning the increased awareness of back pain risk factors in the workplace following the participatory ergonomics program would seem to confirm the potential impact of such a program on the primary prevention of occupational back pain (Albers et al., 1997). However, this has to be confirmed in future studies.

As the main objective of the randomized trial was to assess the global effectiveness of the clinical and the occupational programs and as the great effectiveness of the occupational intervention was not foreseen, an in-depth evaluation of the ergonomic program was not

planned. For this reason, assessment of implementation of solutions was made by questionnaire rather than by workplace visits by ergonomists which could have provided a more precise and valid picture of solutions actually implemented in the workplaces. However, the substantial agreement between the participants brings confidence in the implementation results.

Although the duration of the interventions was limited from 5 to 13 h in each workplace (excluding the training program, time for report writing and organization of the intervention), the participatory process was efficient at quickly identifying relevant information. However, this short duration may have precluded an in-depth analysis of work organizational risk factors. Psychosocial factors in the workplace, which are increasingly recognized as linked to back pain occurrence or persistence (Bigos et al., 1991), were not dealt with in a structured way during the ergonomic interventions. However, they were informally discussed within the work groups or during individual interviews with the study ergonomist, and some solutions indirectly addressed these factors.

The relatively large number of solutions that seemed to have been implemented suggests that these modifications could have been associated with the quicker return to regular work observed in the workers receiving the ergonomic intervention than in those not receiving it (Loisel et al., 1997). However, these results could be mainly due to the additional attention paid to the injured workers in their workplace rather than to the content of the ergonomic modifications. Even if this is the case, the potential improvement in work relationship through the ergonomic intervention is an interesting by-product in itself. Moreover, these modifications probably benefited co-workers working at the same job site, which could have had a potential impact on the primary prevention of back pain.

7. Conclusion

The objective of this newly developed model of back pain management was to influence both the physical capacities and work demands of workers absent from regular work due to back pain, in order to allow a quicker and safer return to regular work. This participatory ergonomics program was intended to generate appropriate ergonomic solutions that would modify the work demands to better match the worker's reduced capacity. The program seemed to successfully modify their job tasks.

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