LOAD AND RISK PROFILE FOR ANALYZING AND DEVELOPING PHYSICAL WORK

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Abstract: The promotion of wellbeing and qualified productivity requires good ergonomics where job demands are fitted to a worker's individual characteristics, capacities and needs. The aim of this study was to develop a descriptive profile to show analyzed workload and risk factors in postal tasks and to introduce the web application of the load and risk profile bank. The load and risk profile proved to be illustrative and can be used for identifying and analyzing work-related correct and incorrect factors and for developing ergonomics of physical jobs. The web application of the profile bank is expected to enhance the implementation of ergonomics.

1. INTRODUCTION

Wellbeing and qualified production require good ergonomics at work where job demands are fitted to a worker's individual characteristics, capabilities and needs. There are serious problems in the current working life due to rapidly changing work contexts and the adaptation of new technology associated with the ageing workforce, and increased work-related health problems, disability to work and premature exit from the working life. The lack of health and competent workers leads to unsatisfactory products and services. The promotion of wellbeing, productivity and quality of work requires the design of such work processes and tasks that are safe, and can be tailored according to worker's health and fitness. This may only be realized with ergonomics which demands continuous and systematic analyzing and innovative developing of work with a variety of measures and good practices (Price at al., 1986).

The Finland Post is a large private group of enterprises. The main categories of postal jobs are sorting, delivery and customer services which are carried out by 24 000 mainly permanent workers with the mean age of 41 years being about equally distributed according to the gender. Almost 5 % of the work time is lost due to sick leave days (261 000 sick leave days in 2005). Musculoskeletal disorders and diseases are the main reasons for the absence (45% of the sick leave days). Postal workers perform many physically demanding tasks such as lifting and carrying bulky and often heavy parcels. Each worker usually carries out a number of tasks which set different demands on his or her cardio-respiratory, musculoskeletal and psychosocial capabilities. When physical workload is liked to harmonize with respect to an individual worker it requires reliable and relevant work-site analyzes of workload factors as well as basic information on his or her physical characteristics and fitness (Louhevaara and Kilbom, 2005, Louhevaara et al., 2006).

The aim of this study was to develop a quantitative profile to illustrate analyzed workload factors and risks in physical postal work tasks, and to introduce the web application of the load and risk profile bank designed for the use of the Finland Post.

2. MATERIAL AND METHODS

For this study the experts of postal work identified 53 main postal tasks done by 66 postal workers who served as the voluntary subjects. The tasks encompassed 22 tasks in sorting of letters and other light-weight material, 11 tasks in sorting of heavy parcels, 10 tasks in postal delivery, two tasks in delivery of newspapers, four tasks in the postal transport, and four tasks in the postal customer service. Many of the subjects carried out several work tasks during a single work shift. Therefore, the total number of studied and analyzed postal tasks was 114.

The tasks were video taped an observed during actual work. The subjects were equipped with a portable cardiac monitor (Suunto t6, Finland) which recorded heart rate (HR) and heart rate variability (HRV). The HR and HRV data were analyzed by the Firstbeat PRO heartbeat analysis software (www.firstbeattechnologies.com). Local muscle load was assessed from surface electromyography (EMG) using Mega Electronics ME6000 device.
The rating of perceived exertion was enquired with a scale from 0 to 10 (Borg et al., 1985). The total and repetitive physical workload factors of the tasks were analyzed with the help of video tapings and observations applying the criteria of the Tikka and Toisto-Repe method, respectively (Lindström et al., 2005, Ketola and Laaksonlaita, 2004). The proportion of correct and incorrect items of the methods was calculated using their criteria. The relative proportion of work time for lifting, the frequency of lifting, the weight of the load and the height to be lifted was analyzed from the video tapings. Moreover, back postures were analyzed according to the criteria of the OWAS-method (Karhu et al., 1977) from the video tapings.

Based on the results the load and risk profile of eight modules was developed for postal jobs (Fig. 1 and 2). Eight key variables i.e., one for each module were selected to the profile. The scales of the key variables were fitted to the percentage scale from -100% to +100% by relating values obtained during work to maximal or peak values of the variables. For instance, both the Tikka and Toisto-Repe method include nine items. The percentage index of the Tikka and Toisto-Repe method is calculated by comparing the number of correct, partly correct and incorrect items for the maximal number of the items. The negative end-point of the scale (-100%) means the maximal incorrect i.e., completely unacceptable or improper workload and its risk is intolerable. The positive end-point of +100% means maximal correct i.e., completely acceptable or proper workload, and there is no risk or the risk is insignificant (Louhevaara et al., 2006).

A specific web application of the load and risk profile bank was designed to help the implementation of the obtained data for planning and developing various postal work processes (Fig. 1 and 2).

3. RESULTS

3.1 Load and risk profile

The eight modules and key variables of the load and risk profile for postal jobs are the following (Fig. 1):

1) Total physical load
   Key variable: Percentage of the correct, partly correct and incorrect items according to the index of the Tikka method.
2) Repetitive load
   Key variable: Percentage of the correct, partly correct and incorrect items according to the index of the Toisto-Repe method.
3) Cardio-respiratory load
   Key variable: Percentage of the work time spent at the levels >30% and <30% of the maximal metabolic equivalent (MET).
4) Local muscle load
   Key variable: Percentage of the side difference of the total EMG strain emphasized by the number of the measured muscles.
5) Load of the manual materials handling
   Key variable: Percentage of the frequency of lifts with the load of ≤ 2 kg and > 2 kg as related to the peak frequency of 20 lifts in a minute.
6) Load of the work postures on the back
   Key variable: Percentage of the straight postures of the back and the combined proportion of the bent forward, twisted and bent forward and twisted postures of the back.
7) Perceived load
   Key variable: Percentage of the ratings of perceived exertion ≤ 3 and > 3 as related to the total number of inquired ratings.
8) Psycho-physiological load
   Key variable: Percentage of stress and recovery at work as related to the total work time.

The load and risk profiles showed that analyzed postal jobs involved a variety of tasks which had a high static and also repetitive type of load on the back, shoulders and upper limbs. Dynamic load on the cardio-respiratory system was common due to walking, carrying, pushing and pulling during the sorting, transporting and delivery of postal items. Psycho-physiological load and stress were common in postal tasks.

3.2 Load and risk profile bank

The web application of the load and risk profile bank was designated for the use of the Finland Post aiming at controlling and optimizing physical workload in postal jobs. The main aim of the load and risk profile bank is to help to design and redesign versatile and meaningful postal jobs which consist of a balanced combination of several postal tasks. It is assumed that correct physical workload for each postal worker will decrease Figure 1. The front page of the web application of the load and risk profile bank where is also shown the key variable "Total physical workload index" of the first and non-optional module of the load and risk profile.
Figure 2. The optional seven modules of the load and risk profile of the postal tasks. The selection of the optional modules is based on the results of the first module "Total physical load" and will be done in the collaboration with a client.

Workload factors: Mechanical sorting of parcels - Slide sorting

1. **Repetitive load**
   - 10%
   - Correct load
   - +40%

2. **Cardio-respiratory load**
   - 0%
   - Correct load
   - +100%

3. **Local muscle load**
   - 26%
   - Correct load
   - +70%

4. **Load of the manual materials handling**
   - 26%
   - Incorrect load
   - +4%

5. **Psycho-physiological load**
   - 66%
   - Correct load
   - +0%

6. **Load of the work postures on the back**
   - 5%
   - Incorrect load
   - +95%

7. **Perceived load**
   - 35%
   - Correct load
   - +66%

† Workload factor contains a risk factor, which requires special attention. Additional information can be found from reports.

musculoskeletal disorders and diseases, and sick-leave days. The web application of the load and risk profile bank encompasses the following primary functions (Fig. 1):
4. DISCUSSION AND CONCLUSIONS

The present work-site methods based on the recording of bio-signals, video tapings and observations seemed to be relevant and feasible but quite time consuming and required a high level of scientific competence. The preliminary results and experiences suggest that the load and risk profile is illustrative and can be used for identifying and analyzing correct and incorrect work-related factors and for optimizing workload according to the physical characteristics and capabilities of an individual postal worker. Probably the web application of the load and risk profile bank enhances the implementation of obtained results and ergonomics.

It is anticipated that the load and risk profile and the profile bank web application can be used for the following purposes:
- To improve ergonomics of single work tasks
- To plan jobs which include balanced physical load with the number of different work tasks
- To plan suitable jobs for aged and/or impaired workers or after a long sick leave
- To focus the pre-employment health screening for physically demanding tasks
- To assess individual physical load and strain when needed
- To evaluate effects of the developmental measures and re-design processes of the jobs
- To familiarize for work tasks

The development of the web application of the load and risk profile and profile bank will be continued when adequate feedback from their implementers will be available. Also the testing of the usability of various intelligent garments and measuring techniques will be continued for improving the reliability and feasibility of the recordings of bio-signals under demanding field conditions.

Acknowledgements. This study was supported financially by the Finnish Work Environment Fund and Finland Post Group's Foundation for Wellbeing at work.

5. REFERENCES


www.meltd.fi (22 August 2007).