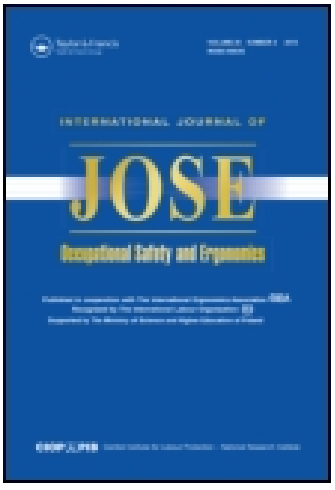

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Application of a Screening Method in Assessing Occupational Safety and Health of Computer Workstations

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Employers and workers need concrete guidance to plan and implement changes in the ergonomics of computer workstations. The Näppärä method is a screening tool for identifying problems requiring further assessment and corrective actions. The aim of this study was to assess the work of occupational safety and health (OSH) government inspectors who used Näppärä as part of their OSH enforcement inspections (430 assessments) related to computer work. The modifications in workstation ergonomics involved mainly adjustments to the screen, mouse, keyboard, forearm supports, and chair. One output of the assessment is an index indicating the percentage of compliance items. This method can be considered as exposure assessment and ergonomics intervention used as a benchmark for the level of ergonomics. Future research can examine whether the effectiveness of participatory ergonomics interventions should be investigated with Näppärä.

computer health safety ergonomics inspectors legislation screening

1. INTRODUCTION

1.1. Safety and Health in Computer Work

Finnish decree No. 1405/1993 considers the occupational safety and health (OSH) demands associated with computer work [1]. This decree implements Directive 90/270/EEC [2]. The Finnish enforcement legislation stipulates that OSH authorities monitor compliance with the provisions of OSH legislation for employees doing computer work [3]. The Finnish occupational health care (OHC) act stipulates that occupational health care professionals shall through their actions and methods focus on the work, the working environment, and the workplace community of the employees [4].

There are ergonomics checklists available for analyzing OSH at computer workstations. The information these checklists provide is valuable and, to our knowledge, OSH inspectors in the UK and the USA use ergonomics checklists to assess computer workstations. For example, in the UK, the Health and Safety Executive (HSE) has guidelines for individuals who work with visual display units and their employers [5]. HSE has proposed some simple adjustments that computer users can make to workstations to make them more comfortable and easy to use. In the USA, the checklist of the Occupational Safety and Health Administration helps to create a safe and comfortable computer workstation and, e.g., it identifies the areas for improvement

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in posture, component placement, and working environment [6].

The Finnish screening method Näppärä was developed to harmonize the enforcement practices to be applied between OSH inspectorate agencies and between individual inspectors with respect to computer workstations and the working environment.

1.2. Näppärä

Näppärä, a method for assessing ergonomics in computer work, is a rapid screening tool for identifying problems that require further assessment and corrective actions. The questions and observations are dichotomous, in other words, the respondent is either in compliance or noncompliance. The items labeled as *noncompliance* are subject to further actions. One output of the assessment is an index indicating the percentage of compliance items out of the total of all items. This index can be considered as exposure assessment and ergonomics intervention used as a benchmark for the level of ergonomics. The advantage of this method is that it is rapid and simple to use, and the findings clearly highlight aspects requiring intervention. This index can be used as a benchmark for the level of ergonomics in every office. The method has been developed in conjunction with researchers, OHC professionals, OSH inspectors, and computer operators. The project was instigated by Finland's OSH government administration together with researchers from the Finnish Institute of Occupational Health. The method is based on observations and interviews of computer operators; it consists of 12 items of observation and 13 questions answered in five sections: workspace, working environment, posture, furniture and equipment, and work orientation and guidance. The objects of the assessment are intended to inform companies with computer workstations about the principles they can expect to be required by OSH inspectors. Each object is illustrated with a number of criteria to amplify the meaning of the overriding principle, and to provide guidance about its application. These illustrations are not meant to include all possible applications of that principle.

2. AIM OF THE STUDY

The aim of this study was to assess OSH government inspectors' work on the ergonomics of computer work using Näppärä as part of their OSH enforcement inspections. This study explores quantitative assessments of ergonomics in computer work carried out by the OSH government inspectors and evaluates the applicability of this assessment. OSH inspectors could use Näppärä to assess compliance with the Finnish government decree on computer work [1], which implements Directive 90/270/EEC [2]. Act No. 44/2006 stipulates the measures, i.e., written advice or binding improvement notice [3].

3. MATERIAL AND METHODS

This study is based on observation assessments of OSH at computer workstations made by inspectors who used Näppärä. In 2007, 18 inspectors conducted assessments of 430 computer workstations. Offices in the banking sector represented 57% of the cases, offices of insurance companies made up the next largest sector (22%), whereas single enterprises in different business sectors accounted for the remaining 21%.

The observations and the results of the interviews were documented by virtue of the criteria for observing and interviewing and a more extensive manual. Moreover, the way basic information about computer workstations was gathered was a tool for OSH government supervision (see Appendix A on p. 174). To achieve a reliable application of the method, the inspectors were trained in its use so that regular parallel measurements could be undertaken.

Näppärä is used in OSH inspections. Not only items requiring improvement but also functional items are discussed in the summaries of the measurements after the inspections. According to Standard No. EN 614-1+A1:2006 [7], in ergonomic design principles, the purpose of a three-zone rating system is to establish a system of evaluation that will help to fulfill a risk evaluation in a structured and straightforward way. A three-zone rating system is used in ergonomics risk assessment, because ergonomics hazards often are

ambiguous; they depend on a wide range of characteristics, abilities, and needs; and also because they are seldom related to only one factor [7]. This study used a three-zone rating system as a comprehensible and educational way of presenting complex ergonomics data to simplify the determination of appropriate actions. The conclusions based on the index level of the individual workstations are summarized with a coding system based on traffic lights [8]:

- Green zone: when the index exceeds 80, the inspector can provide instructions for maintaining the good level. The workplace also receives positive feedback about its good working conditions.
- Amber zone: when the index is 80–65, the employer is requested to conduct an ergonomics survey and/or arrange guidance in computer work by, e.g., OHC professionals, and is encouraged to implement the improvement measures listed in the survey.
- Red zone: Should the index fall under 65, the employer is requested to undertake immediate steps to improve the conditions at the workstation. Detailed instructions about the observed shortcomings can be given in an inspection report, e.g., on the lack of adjustable chairs. At the same time, the employer is requested to conduct an ergonomics survey and/or arrange for guidance on computer work by, e.g., OHC professionals, and to implement the improvement measures listed in the inspection survey. In these cases, a follow-up evaluation of the workstation should follow, again with Näppärä.

The index can also be compared to the average numbers for the sector or other parts of the company. This kind of comparison seems to motive employers.

The OSH inspectors' assessments were calibrated, i.e., the inspectors used the assessment for 7 h to ensure that it provided valid results. Statistical analysis of χ^2 test was done with SAS user's guide [9].

4. RESULTS

Table 1 presents the results of Finnish OSH government inspectors' assessment of ergonomics in computer work (see the criteria in Appendix A on p. 174).

The statistical differences between subpoints (the observations of the inspectors compared with the responses of the interviewees) of the numbers of observations tested with χ^2 were as follows:

- statistically significant ($p < .01$) difference between the observations "2.3. Air cleanliness and temperature" and the responses to question "2.4. Are you satisfied with the temperature at your computer workstation?";
- statistically significant ($p < .01$) difference between the observations "3.2. Upper limb posture" and the responses to question "3.4. Is your posture generally comfortable?";
- statistically almost significant ($p < .05$) difference between the observations "4.1. Chair" and the responses to question "3.6. Can you adjust your chair to a suitable height?".

No statistical significances were found in the other items when comparing the responses of the computer operators and the respective observations of the OSH inspectors of the computer workstations or the working environment.

5. DISCUSSION

5.1. Näppärä in OSH Inspectors' Work

If the Näppärä criteria indicate that the results are in the amber or red zones, computer operators should seek guidance on the necessary modifications. Firstly, the following subpoints were identified in the assessment: monitor table/worktop (80% amber); air cleanliness and temperature (77% amber); upper limb posture (73% amber); acoustic environment (72% amber); and upper body and head posture (72% amber). Secondly, the following subpoints were found in the computer operators' responses: "Are you satisfied with the temperature at your computer workstation?"

TABLE 1. Distribution of government inspectors' ergonomics assessment at computer workstations (*N* = 430)

Object of Observation	*In Order* (%)	*Not in Order* (%)	Assessment
1. Workspace			
1.1. Location of computer workstation	81	19	green
1.2. Tidiness and cleanliness	71	29	amber
2. Working environment			
2.1. Lighting	89	11	green
2.2. Are you satisfied with the lighting at your computer workstation?[a]	88	12	green
2.3. Air cleanliness and temperature	77	23	amber
2.4. Are you satisfied with the temperature at your computer workstation?[a]	63	37	red
2.5. Accoustic environment	72	28	amber
2.6. Are there noises near your computer workstation disturbing your ability to concentrate?[a]	72	28	amber
3. Posture			
3.1. Upper body and head posture	74	26	amber
3.2. Upper limb posture	73	27	amber
3.3. Leg and foot posture	82	18	green
3.4. Is your posture generally comfortable?[a]	84	16	green
3.5. Can you interrupt continuous work at the computer to have a break?[a]	93	7	green
3.6. Can you adjust your chair to a suitable height?[a]	96	4	green
4. Furniture and equipment			
4.1. Chair	91	9	green
4.2. Laptop: is it possible to connect your laptop to a monitor, a separate keyboard, and mouse?[a]	91	9	green
4.3. Monitor	87	13	green
4.4. Can you see the symbols on the screen easily?[a]	91	9	green
4.5. Keyboard and mouse	92	8	green
4.6. Monitor table/worktop	80	20	amber
4.7. Do you have enough free table space?[a]	84	16	green
4.8. Do you need a document holder?[a,b]	85	15	green
4.9. Do you need a foot rest?[a,b]	83	17	green
5. Work orientation and guidance			
5.1. Have you been given guidance in workplace ergonomics in this organization?[a]	72	28	amber
5.2. Have you received sufficiently guidance in how to use computer programs in your work?[a]	86	14	green
total	82	18	green

Notes. a = question asked of computer operator, b = question asked only if equipment is not used.

(63% red); "Are there noises near your computer workstation disturbing your ability to concentrate?" (72% amber); and "Have you been given guidance in workplace ergonomics in this organization?" (72% amber).

The OSH government inspectors acted as evaluators and without their input, this survey could not have been conducted. This kind of assessment is not part of the traditional inspection procedure, which focusses on minimum OSH requirements. The findings of Näppärä can point to further investigations to be done by OHC professionals and to improvements when necessary. In addition, computer operators can also use Näppärä to identify and assess their own computer workstations. Näppärä can be used in self-assessment,

e.g., management can set goals for the indexes of ergonomics at computer workstations, compare their progress against the goals and undertake modifications if there is a discrepancy between a goal and the current state. In this self-assessment [10], goals are established (deliberative mindset), there is planning (implemental mindset), goal striving takes place (actional mindset), and goal evaluation/revision concludes this process (evaluative mindset). Once goals are established, they provide a standard against which feedback is continually compared as a means of regulating behavior and effort. Näppärä can be applied in participatory ergonomics [11] to understand how changes in computer work need to be implemented in practice. Ergonomics is always a collaborative activity [12]. Näppärä can also be used to implement workplace ergonomics, i.e., OSH inspectors can use the results during their consultations with employers and workers' OSH representatives.

The assessment of risk factors is an integral part of the participative ergonomics process [13]. In participative ergonomics [12], it is important for the organization to be convinced about the benefits of good ergonomics; this is a central element of ergonomics practice. It means that ergonomics has to be context sensitive and to embrace qualitative approaches and methods as well as the more traditional quantitative methods [14]. In participative ergonomics, the active participation of the management and technical personnel as well as better collaboration and communication between workers, management, and technical personnel can result in significant improvements [13].

The traditional approach of OSH inspectors making notes of OSH risks must be complemented with new refined methods built on assessment, interviews, and dialog [15, 16]. This study indicated that OSH inspectors would have to promote co-operation between employers and workers' OSH representatives and to encourage them to seek support from OHC professionals about how best to implement Näppärä and undertake improvements on the basis of its results. Systematic OSH management and work organization issues require a much more sophisticated, educational approach from government OSH inspectors. Changes in the regulatory strategy have taken place in several areas of official surveillance conducted by OSH inspectors [16]. In summary, according to the results of our study, this represents change in the system away from coercion towards one which encourages voluntary action, i.e., Näppärä. There is a great demand for (a) new methods using techniques which assess physical exposure to work-related musculoskeletal risks and (b) practical exposure assessment tools that meet the needs of ergonomics experts and practitioners [17, 18, 19, 20, 21]. Moreover, Näppärä can be used by both OHC professionals and computer operators.

Relevant examples describe these kinds of investigations and the multidimensional measures with which it is possible to assess practical aspects associated with the ergonomics of computer work [22, 23, 24, 25, 26, 27, 28].

5.2. Implications for Further Research

Future research should investigate whether supplementary or complementary observation methods of computer workstations and workers' interviews would help to identify best practices of ergonomics in computer work. Another option would be to consider what might be the boundary conditions that reveal the effectiveness of one type of best ergonomics practice rather than some other approach. By investigating physiological reactions to computer work, areas which are typically confined to research on work stress, these results could potentially be used in examining many other aspects of organizational behavior. For example, investigations into the social psychology factors in the workplace could also help to improve computer operators' health and have economic advantages not only to commercial concerns but also to society as a whole.

However, to reach this goal, longitudinal research is necessary to fully capture participatory ergonomics in order that it can be included in the practical applications of the OSH legislation. A full investigation of the many dimensions of the implementation of Directive 90/270/EEC [2] would require developing a multidimensional measure which would be capable of evaluating the key dimensions of the practical ergonomics

applications according to the directive. In addition, the effectiveness of participatory ergonomics interventions should be investigated as a way of preventing work-related musculoskeletal and mental problems in computer work.

At the same time, increased efforts are necessary to derive a deeper understanding of how the quantitative assessment methods implemented by OSH inspectors and OHC professionals can best be used to assess the actual physical exposure to work-related musculoskeletal and mental risks of computer operators. Future research should investigate the extent to which the primary dimensions of the ergonomics assessment of computer work can be identified through observations and interviews with the operators. At the same time, it is important to investigate in depth how Näppärä could be better applied in participatory ergonomics.

The basic guidance provided to the managers responsible for acquiring furniture and products for computer workstations relates most frequently to their delivery. It would be interesting to examine how participatory ergonomics can be promoted when new furniture is purchased for computer workstations. For example, the individuals installing furniture installations could be trained so that they would be able to explain the critical issues of ergonomics to ensure that good ergonomics furniture is not set incorrectly at computer workstations.

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APPENDIX A. Criteria for government inspectors' ergonomics assessment at computer workstations

Objects of Observation	Criteria[a]
1. Workspace	
1.1. Location of workplace	Access to the workplace is easy, the area is secluded, set apart, e.g., away from pathways.
1.2. Tidiness and cleanliness	There is no work-hindering disarray or visible dust (on floors, shelves, and tables); no bundles of electrical wires on the floor; the means to keep the area clean and tidy are available.
2. Working environment	
2.1. Lighting	General lighting is good, there is no direct dazzle, e.g., from windows.[b]
2.2. Lighting (question)	Changes of lighting during working day or according to seasons, etc.
2.3. Air cleanliness and temperature	Ambient air is of good quality, temperature and air movement suitable for work
2.4. Temperature (question)	Changes in temperature during working day or according to seasons, etc.
2.5. Accoustic environment	Accoustic environment pleasant, no disturbing noises.
2.6. Accoustic environment (question)	Noise caused by others, disturbing noises caused by phones, air conditioning or traffic, etc.[c]
3. Posture: evaluate posture when the operator is using keyboard and mouse	
3.1. Upper body and head posture	Posture of upper body and head looks comfortable; monitor is at a suitable distance and below eye-level, and backrest supports lumbar region of the back.
3.2. Upper limb posture	Posture of upper limbs looks comfortable; lower arms are supported by the table or armrests.
3.3. Leg and foot posture	Posture of legs seems comfortable; there is enough space for legs, feet are firmly on the floor or on a foot rest, base structure of the table or other items do not essentially hinder turning in the chair.
3.4. Posture (question)	Can operator sit without tensing shoulders, back, or arms, etc.?
3.5. Breaks (question)	Can operator change posture freely and get up now and then from the chair to walk, etc.?
3.6. Adjustment of chair (question)	Are adjustment possibilities in order, does the operator know how to use them, etc.?
4. Furniture and equipment	
4.1. Chair	Suitable for operator, supportive and adjustable.
4.2. Laptop (question)[d]	
4.3. Monitor	Can the monitor be rotated and angled? The height is adjustable when necessary. The screen does not flicker and is located in front of the operator. There are no reflections or dazzles.
4.4. Eye sight (question)	How does the operator feel about eyesight, e.g., when using glasses?
4.5. Keyboard and mouse	There is enough space in front of keyboard and mouse to rest both hands or resting is arranged by other means. There is also space to move the mouse and change the position of the keyboard.
4.6. Monitor table/worktop	There is space (width and depth) for equipment and free space on both sides of the worktop.
4.7. Table space (question)	Is there enough space to work and for equipment and papers?
4.8. Document holder (question)[e]	If necessary, is there a firm and adjustable document holder? [f]
4.9. Footrest (question)[g]	
5. Work orientation and guidance	
5.1. Guidance in workplace ergonomics (question)	Adjusting the chair, arranging equipment, etc.
5.2. Guidance on how to use computer programs (question)	Necessary courses, guidance by computer advisor, colleagues, and supervisors, etc.

Notes. a = *yes* = *in order*, unless indicated otherwise; b = lighting is *in order* if dazzle can be shut out with blinds; c = *no* = *in order*, *yes* = *not in order*; d = to be asked if employee uses a laptop at the workplace; e = to be asked only if there is no document holder; f = *not necessary* = *in order*, *should have* = *not in order*; g = to be asked if there is no footrest, *not necessary* = *in order*, *should have* = *not in order.*