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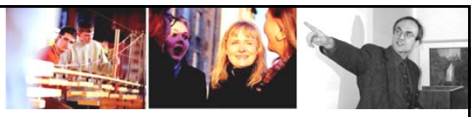

The prevention of MSDs and psychological stress at computer-equipped workplaces

La prevención de trastornos musculoesqueléticos y estrés laboral en trabajo con computadores

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27 November 2014

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Outline

- Introduction
  - Problems with MSDs among computer workers
- Objectives of the study
- Materials and methods
  - Kiva questionnaire
- Results and discussion
  - Safety survey results
  - The results of auditing of safety management systems
  - Results of semi-structured interviews with senior managers
  - Results of focus group interviews with workers
- Conclusions

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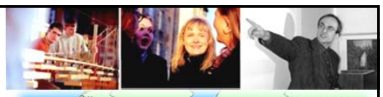
Introduction (1)

Estonia Tallinn



- Population – 1.3 million
- Area – 45 000 km^2
- Official language: Estonian
- Ethnic groups:
  - 68.7% Estonians, 24.8% Russians, 1.7% Ukrainians
  - 1.0% Belarussians, 0.6% Finns, 3.2% others
- Regulation No 362 of the Government of Republic of **'Occupational health and safety requirements for work with display screen equipment'** came into force on 15 November 2001
  - The employer is obliged to evaluate the workplace of the worker during the risk analysis of work environment, considering:
    - the factors endangering the worker's eyesight;
    - potential physical or mental overload at work;
    - risk factors of work environment, including lighting, noise, electromagnetic radiation and indoor climate of the working room;
    - ergonomics and suitability of design of workplace for the worker.

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Introduction (2)

- A safe and healthy working environment is an important element of work life quality (Fugas et al., 2012).

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But the reality?

- 60% of European workers have to hurry at work;
- 22% of European workers suffer from work-related stress;
- About 50% of European workers work in non-ergonomic conditions;
- Almost 28 % of European workers claim that their work has caused or intensified health problems.

European Agency for Safety and Health at Work: 2005-2012

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Introduction (2)

- A safe and healthy working environment is an important element of work life quality (Fugas et al., 2012).
- In USA and Europe, about 25…50% of all adults are exposed to sedentary work health risks (Bakhys Roozeboom et al., 2007; Church et al., 2011).
- Musculoskeletal disorders (MSDs) among office workers with intensive computer use are widespread and the prevalence of symptoms is growing (Robertson et al., 2013).
- MSDs, including carpal tunnel syndrome, represented 52% of all recognised diseases recorded by the European Occupational Diseases Statistics in 2005 (EODS, 2010).

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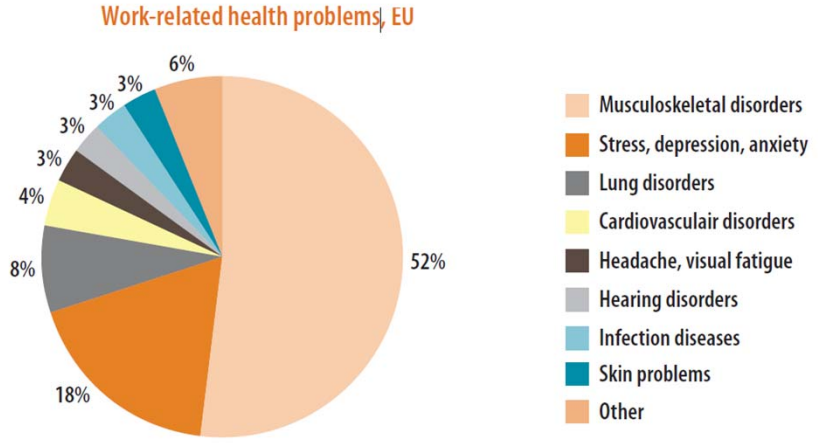
European Picture (1)

Source: EUROPEAN RISK OBSERVATORY REPORT, 2010



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Introduction (2)

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- MSDs, including carpal tunnel syndrome, represented 52% of all recognised diseases recorded by the European Occupational Diseases Statistics in 2005 (EODS, 2010).
- The European Commission reports that MSDs account for the highest number of absences (49.9% of all absences of more than three days) and cases of permanent incapacity for work (60%) (EC, 2012).

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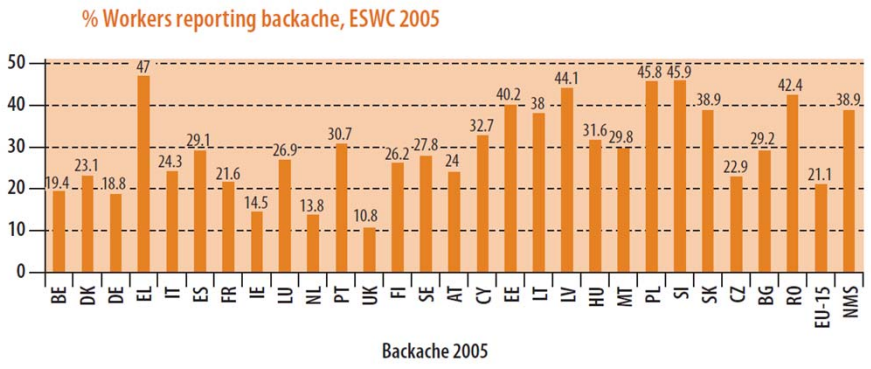
European Picture (2)

Source: EUROPEAN RISK OBSERVATORY REPORT, 2010



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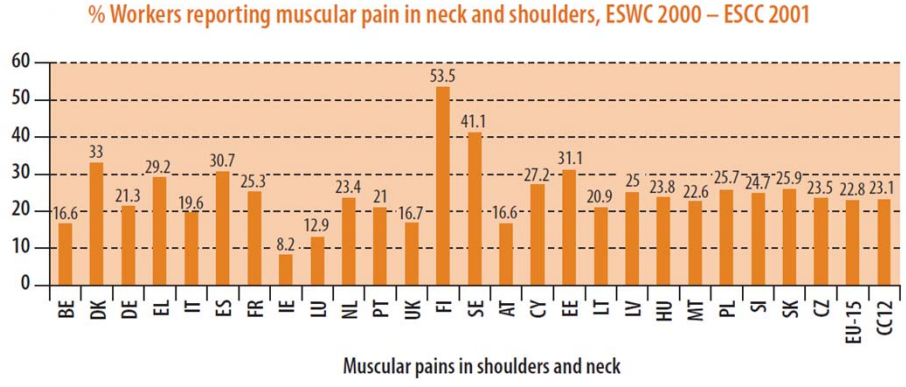
European Picture (3)

Source: EUROPEAN RISK OBSERVATORY REPORT, 2010



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Introduction (3)

- In 2010, Argentina reported 22,013 cases of occupational diseases, with MSDs among the most frequent conditions (ILO, 2013).
- In 2005, about 30% of injury cases in USA were connected with MSDs of upper extremities and neck (Rempel et al., 2006).
- Risk factors contributing to MSDs among computer and office workers are work organizational factors (workload, cognitive demands), suistained awkward positions, psychological stress and psychosocial issues (Sauter and Swanson, 1996; Gerr et al., 2006; Carayon and Smith, 2000).
- A dose-response relationship has been reported: each 2 hours per day increase in sitting time at work is associated with a 5% increase in risk of obesity and a 7% increase in risk of diabetes (Hu et al., 2003).
- There is evidence that suggests that musculoskeletal discomfort may be a predictor for future pain (Hamberg-van Reenen et al., 2008).

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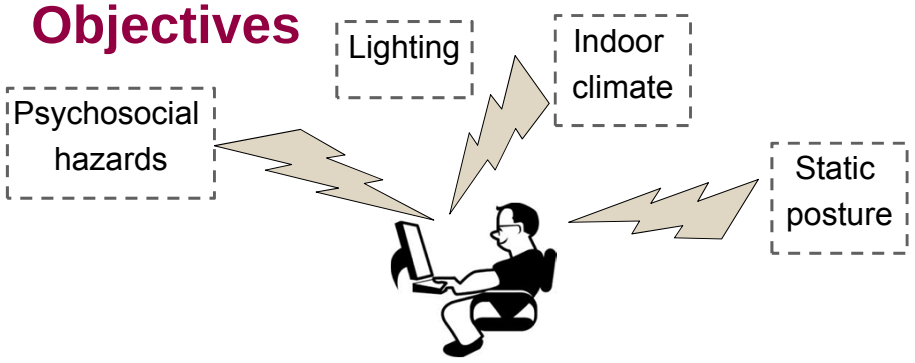
Objectives



- To investigate the computer workers' satisfaction with their working conditions;
- To find out the health disturbances and measure the risk for MSDs with myoton;
- To make the suggestions for interventions.

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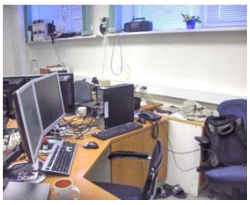
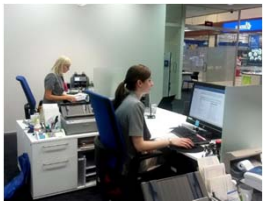
Materials and methods (1)

- Group A
- Age: <40 years
- N=251
- Employment history (VDU workplace): average 4.81 years

- Group B
- Age: >40 years
- N=172
- Employment history (VDU workplace): average 17.38 years





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Materials and methods (2)

- Measurements of working conditions
  - The indoor air: EVS-EN-ISO 7726:2003 “Thermal environments- Instruments and methods for measuring physical quantities“; equipment: TESTO 435.
  - Workplace lighting: EVS 891:2008 “Measurement and evaluation of electrical lighting in working places”; equipment: Delta Ohm HD 2302.0
  - Dust: WCB method 1150:1998 „Particulate (total) in air”; equipment: HazDust EPAM-5000.

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Materials and methods (3)

- Workers' opinion on working conditions – questionnaire:
  - QPS Nordic (Dallner et al. 2000);
  - Work ability index (WAI) (Tuomi et al. 1998);
  - Kiva questionnaire (Näsman et al, 2011).
  - By e-mail or paper
- QPS Nordic questionnaire → the assessment of psychological, social, and organizational working conditions through multiple choice questions.

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Materials and methods (4)

- Work Ability Index (WAI) → series of questions about work, workability and health; followed by the interview with an occupational health professional who rates the responses according to the instructions.
- Kiva questionnaire → characterizes the wellbeing of workers at work. The ratings are given in an 10-point scale (1 - not at all, 10 - very certain).

The Kiva questionnaire was composed of seven questions:
1.Have you enjoyed coming to work in the last weeks?
2.I regard my job meaningful
3.I feel in control of my work
4.I get on with my fellow-workers
5.My immediate superior performs as superior
6.How certain are you that you will keep the job with this employer?
7.How much can you influence factors concerning your job?

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Materials and methods (5)

- Measurement of cortisol levels
- The high-performance liquid chromatography method (HPLC Water Alliance with UV detection) was used to determine cortisol in saliva.
- Saliva samples were collected three times during the day: in the mornning (8-9), at noon (12-13) and in the afternoon (16-17).

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Material and methods (6)

Determination of fatigue in muscles: **Myoton-3**

- Myoton-3 was used for early detection of occupation-related muscle conditions.
- Myoton-3 exerts a local impact on the biological tissue by means of a brief mechanical impulse.
  - Muscle tone
  - Muscle stiffness
  - Muscle elasticity
- 34 participants How does it work?

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Results (1)

- Computer workers assess their health status considerably high – in group A→ 50.1% were satisfied with their health; in group B→ 43.1% of people assessed their health good.

Health complaint	Group A (persons <40- included; years of age), % of all investigated	Group B (persons >40 years of age), % of all investigated
Musculoskeletal disorders	53.6	50.1
Cardiovascular disturbances	20.4	45.7
Visual disturbances	16.7	23.2
The problem of overweight	20.2	25.0
The health status good	55.6	43.1

Health complaints (Nordic and WAI questionnaires)

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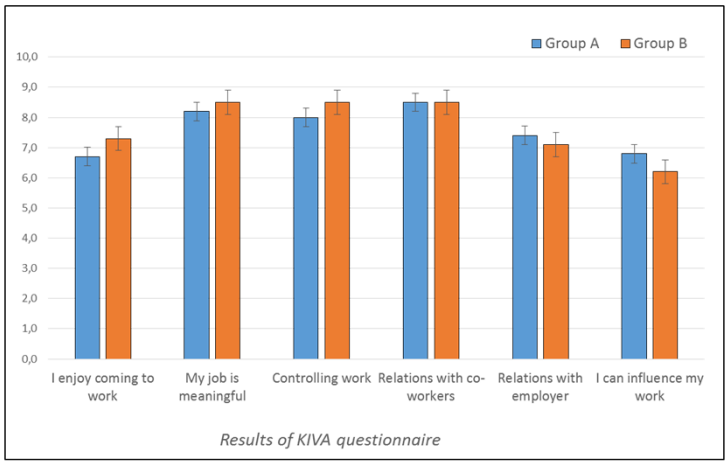
Results (2)

- Kiva questionnaire (scale 1-10)



Results of KIVA questionnaire

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Results (3)

- 34 participants were selected whose MSDs were examined profoundly.

Pain region	Number of workers (% from all 34 respondents)	Severity of pain (0-10)
Neck	22 (64.7%)	4.18
Shoulder, right	15 (44.0 %)	3.80
Shoulder, left	14 (41.0%)	2.80
Elbow, right	2 (5.9%)	4.71
Elbow, left	2 (5.9%)	2.12
Wrist, right	7 (20.6%)	4.57
Wrist, left	2 (5.9%)	4.01
Back	16 (47.0%)	4.28

The results of measurements of fatigue in muscles with myoton

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Interventions (1)

How to avoid sedentary behaviour and risk for MSDs and workplace stress among computer workers?

- Health promotion activites:
  - A fitness programm
  - Environmental support for physical activity
  - Walking during lunch-time
  - Promoting stair use
  - Promoting the use of public transportation
  - Organize walking meetings

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Interventions (2)

How to avoid sedentary behaviour and risk for MSDs and work-related stress among computer workers?

- Conventional sitting with software reminder to change position
- Sitting on an excercise ball or active sitting

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Active sitting

- Swopper chair
- Back App chair

http://www.thegreenhead.com/2007/08/swopper-active-sitting-chair.php

http://www.ds-ergonomics.com

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Interventions (2)

How to avoid sedentary behaviour and risk for MSDs and work-related stress among computer workers?

- Conventional sitting with software reminder to change position
- Sitting on an excercise ball or active sitting
- Sit-stand office desk
- Dynamic workstations:
  - Treadmill-desk
  - Semi-recumbent elliptical trainer
  - Workstation with bicycle ergometer

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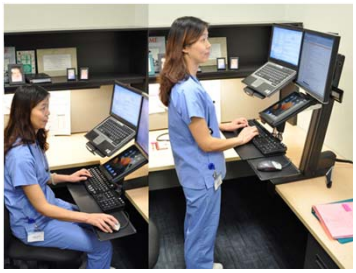
Sit-stand workstation

- Varying work postures throughout the workday with sit-stand adjustable workstations, has demonstrated health benefits for computer workers such as reduced MSD symptoms, decreased foot swelling and tiredness, increased perceived energy (Paul and Helander, 1995; Roelofs and Straker, 2002).



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Sit-stand workstation (2)

- A significant decrease in MSDs has been observed when workers were given an adjustable/flexible work environment, coupled with a systematically designed ergonomics training workshop (Robertson et al., 2008).
- Provision of control over the work environment through adjustability and knowledge may enhance worker effectiveness as well as health (O'Neill, 1998; Robertson and Huang, 2006).

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Importance of office ergonomics training

- Training should be more than just including minimal verbal instructions or a pamphlet providing information about the adjustment features of the workstation and chair.
- The focus should be on „why's" instead of how's".
- There are significantly lower report of discomforts in the back, neck and shoulder regions with participants in flexible workspace who received training instructions as compared to those in the old, fixed workstations with minimally adjustable chair (Vink et al., 2009).

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Designing an office ergonomics training

- Lecture, slide and video presentation
- A module of reviewing the basic ergonomics principles
- Case studies, group debriefing
- Hands-on practice periods
  - Team work
  - „Ergo buddies“

Scope:
1. Recognizing work-related MSDs and hazards
2. Understanding the importance of varying work postures
3. Knowing how to rearrange the workstation to maximize the ‘comfort zone’
4. Understanding computing habits (rest breaks)
5. Knowing how to change work-rest patterns

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A study by Robertson et al. (2013)

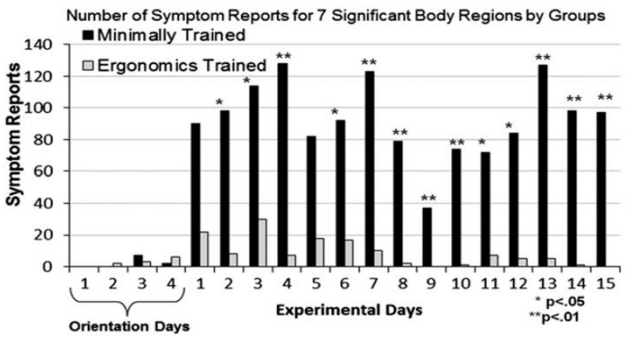

Figure. The total number of reported symptomatic occurrences greater than No pain/ discomfort (rating >1.05) for the seven significant BACK body regions (Left Upper Neck, Right Upper Neck, Left Lower Neck, Right Lower neck, Left Shoulder, Right Shoulder, and Lower Back) across all Days independent of the Sessions, including the 4 pre-experimental orientation days, comparing the ET and MT groups.

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Designing an office ergonomics training (2)

- Trained participants can use their work environment for:
  - Performing their job more effectively
  - Performing their job more ergonimically
  - Performing their job in a safe and healthy manner
- According to surveys, the total amount of time individuals spent in a standing position 40…60 minutes per day.
- Some studies have used ratio 1:1 sit versus standing.

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A study by Robertson et al. (2013)

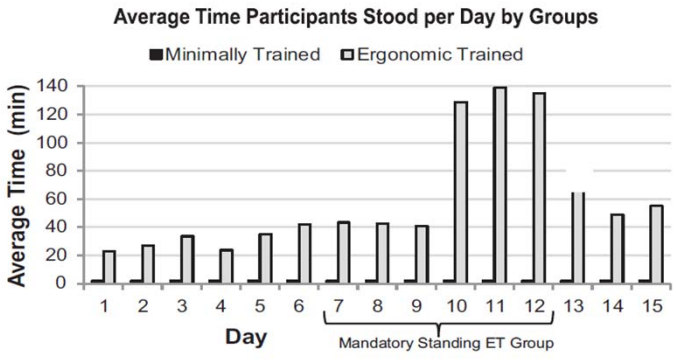

Figure. The average time ET participants spent standing per day comparing the pre-Mandatory days (1–6) vs. the post-Mandatory days (13–15), ($p < .05$), (dependent *t*-tests for *only* the ET group). None of the MT participants stood during the entire experimental days.

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Sit-stand workstation (3)

- A number of different ratios have been used in sit-stand workplace with little or no justification.
- As studies have shown that there's a strong association between low back pain and standing occupations (Andersen et al., 2007; Roelen et al., 2008), then this suggests that if the standing portionof the sit-stand cycle is too long, there may be no reduction in discomfort resulting from sit-stand.
- Sit-stand workplaces can effectively reduce whole body and lowback discomfort, but some evidence suggest that sit-stand workstations can increase discomfort in the upper extremities (specifically hand and wrist).

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Interventions (2)

How to avoid sedentary behaviour and risk for MSDs and work-related stress among computer workers?

- Conventional sitting with software reminder to change position
- Sitting on an excercise ball or active sitting
- Sit-stand office desk
- Dynamic workstations:
  - Treadmill-desk
  - Semi-recumbent elliptical trainer
  - Workstation with bicycle ergometer

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Dynamic workstations

Treadmill-desk
Semi-recumbent elliptical trainer
Workstation with bicycle ergometer

- The use of dynamic workstations can help office workers to alternate postures → a significant health factor in individual ergonomics.

Treadmill-desk (1)

Research results:

- Higher energy expenditure (+100…405 kcal/h, McAlpine et al, 2007; Botter et al, 2013; Cox et al, 2011)
- Better physical shape: lower body mass, lower body fat, weight loss, lower cholesterol level (John et al, 2011; Thompson et al, 2013; Koepp et al, 2013)
- No effect for fatigue (Thompson, 2008)
- Better psychosocial climate (Ben-Ner et al, 2014)

Allikas: TNO Work and Employment, Hoofddorp, Holland

Video 1 Video 2 Video 3

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Treadmill-desk(2)

Research results:

- Conflicting results for job performance:
  - Lower computer work performance (Funk et al, 2012; John et al, 2009; Straker et al, 2009)
  - Using a mouse more disturbed than writing a text (Thompson and Levine, 2011)
  - No effect for computer work performance when velocity is less than 2,2 km/h (Funk et al, 2012)
  - Most congitive tests: no significant difference (Alderman et al, 2013;Ohlinger et al, 2011, A.C.M. Comissaris et al, 2014)
  - Self-questionnaires: employees did not report difference on job performance (Thompson, 2008, Koepp et al, 2013)
  - No difference for reading performance (John et al, 2009; A.C.M. Comissaris et al, 2014)
  - No effect for attentiveness (Ohlinger et al, 2011)

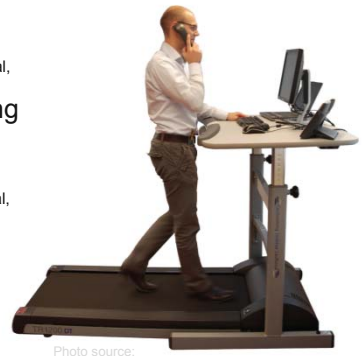

Photo source:
TNO Work and Employment, Hoofddorp, Holland

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Video 1 Video 2 Video 3

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Semi-recumbent elliptical trainer

Life Balance station

Research studies:

- Higher energy expenditure (+289 kcal/h, Carr et al, 2012)
- Slight negative effect for using a mouse (Starker et al, 2009)
- No effect for typing tasks (A.C.M. Comissaris et al, 2014)

Photo source: Untersuchung von dynamischen Büroarbeitsplätzen, DGUV, 2014

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Video 4 Video 5

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Dynamic workstation – intervention effectiveness

- Acceptability
- Integration
- Sustainability
- Studies report positive opinions of users

'I would use the treadmill-desk if this were an option'

- Actual use (compliance) is shown to progressively decline:
  - The course of 4 weeks: day 1→100%, day 13→~50%, day 20→below 20%. (Carr et al., 2011)
  - With motivational elements (website and/or e-mail reminders) the actual use of pedal machine (days pedalled/days with access) was only 38% (Carr et al., 2013).

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Conclusions

- New innovative interventions to prevent MSDs are needed as they proove to be effective in reducing local discomfort reported in the pain of back body regions.
  - Effective training is a key issue.
- Further research exploring an optimal suggested sit-stand or sit-dynamic station ratio would be beneficial in guiding usage guidelines and training.
- Further research on safety and risk for occupational injury of dynamic workplaces is needed.

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THANK YOU!