Recommendations for sufficient physical activity at work

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Abstract

Many contemporary work tasks are characterised by little or no physical activity. This pertains to the whole body as well as specific areas such as neck and shoulders. Too little whole body physical activity is generally known to increase the risk of chronic diseases like vascular disorders and diabetes. Low-intensity tasks of static nature are regarded as one of the risk factors of work related musculoskeletal disorders of neck and shoulders.
TNO Quality of Life has developed recommendations for a healthy amount of physical activity at work, both for the whole body and the neck-/shoulder area. These recommendations are presented here, including their scientific basis.

Keywords: physical inactivity, sedentary work, low-intensity static loading, musculoskeletal disorders

1. Introduction

1.1. Contemporary work often lacks physical activity

More and more present-day jobs and work tasks involve little or no physical activity. In the production industry, for example, "lean manufacturing" is prevailing. Walking from one workstation to another or walking to fetch supplies is minimised in order to maximise the output. A refuse collector can pick up and empty a refuse container while sitting behind the wheel of his truck, using a joystick. A modern office has computers, e-mail, teleconferencing etcetera. Most devices are within reach and the neck and shoulders hardly move because the eyes are fixed to the computer screen.

Thus, (too) high physical loading of the human body has been reduced or even eliminated in many jobs and work tasks. Though beneficial for some parts of the body (e.g. lower back and shoulders), it is often not favourable for the whole body's physical activity level. 'Under loading' of the body arose. The introduction of computers and related applications has further reduced the body's physical activity level. In addition, it has led to tasks in which the head, neck and shoulders hardly (have to) move. The musculoskeletal system in those body parts is subject to (low-intensity) static loading.

1.2. Physical inactivity brings about health risks

Whole body physical inactivity is generally known to increase the risk of chronic diseases including coronary disorders and type II diabetes [1]. On the other hand, moderate-intensity physical activity has been shown to have a positive effect on health determinants like body weight, body fat, blood pressure, HDL/LDL cholesterol and bone mineral density, and on health disorders like cardiovascular diseases, type II diabetes, colon cancer, depression and anxiety [2].

Prolonged static loading of the musculoskeletal system is regarded as risk factor for the development of musculoskeletal disorders (MSDs) of the loaded body parts [3]. Even static loading of low intensity, as occurs in VDU work, is related to MSDs in the neck-/shoulder area [4]. In that case, the duration of the sustained loading is considered the main risk [5].

1.3. Preventive strategies can reduce the health risks

The health risks associated with too little physical activity of the whole body and too long-lasting static loading of the neck-/shoulder area may be reduced by suitable interventions at the work place. We performed a literature search to find interventions that could be a valid basis for recommendations to reduce the health risks at work. Regarding whole body physical activity, many studies have been carried out and guidelines have been issued in the general population. For low-intensity sustained static loading of the neck-/shoulder area, not much intervention research has been carried out, nor have guidelines been issued.

We translated suitable interventions into practical recommendations. Experts from TNO and other Dutch scientists provided feedback on draft versions of the recommendations. The final version is presented here.

1.4. Target group

The recommendations are meant for those jobs and work tasks that have the following characteristics: sitting or standing at the same spot; little whole body physical activity; few movements or little variation in movements of the head, neck and shoulders; low force exertion with the hand(s); the hands often fixated to the task at hand and the eyes to the result of the task.

Examples of work tasks and jobs are: all sorts of VDU tasks; working with microscopes; assembly of small, light products; cashiers in a supermarket; musicians (except percussionists); dentists; surgeons; (bus-, truck-, tram-, train-) drivers; engine-drivers.

We assume that the recommendations are useful for employees who perform the work tasks mentioned above during at least 75% of the workday.

1.5. Intended users

The recommendations can be applied by everyone advising on occupational health and safety matters in general and physical workload in particular: company doctors and nurses, ergonomists, occupational health and safety consultants et cetera. Also, scientists, e.g. epidemiologists, can apply or test the recommendations in their research, for instance prospective studies on the effectiveness of interventions or the relation between physical (in-) activity at work and health problems.

2. Recommendation I: "be physically active, at and on your way to work"

2.1. The recommendations

It is recommended that:

I: On an 8-hours workday, an adult employee accumulates 30 minutes or more of moderate-intensity[1] physical activity, either during work, during the lunch break, or on his/her way to or from work.

II: On an 8-hours workday, continuous standing is limited to 1 hour, continuous sitting to 2 hours and the total standing duration does not exceed 4 hours.

2.2. Objectives

The first recommendation is a general health promotion measure, aimed at reducing the risks associated with too little whole body physical activity. The second one aims to reduce the risk of acquiring varicose veins, and the occurrence of local discomfort in feet, lower legs and lower back during the workday.

2.3. Scientific rationale

The first recommendation is based on the ACSM guideline for physical activity and public health [6,7] and its Dutch equivalent: the NNGB [8].

The second recommendation is based on the ISO 11226, a European standard on static postures [9].

2.4. Considerations and choices

The recommendations refer to an 8-hours work day. In case of shorter work periods, the recommended durations are reduced accordingly (e.g. 15 minutes of moderate-intensity activity on a 4-hour workday).

The length of moderate-intensity physical activity in recommendation I should be extended to 60 minutes of moderate-intensity physical activity for overweighed and obese employees (i.e. Body Mass Index over 25, resp 30; or an abdominal girth over 94 resp 102 cm for men and 80 resp 88 cm for women [10]), to affect body weight and body fat [11,12].

The ACSM's standard to develop and maintain cardio respiratory fitness (20 minutes of high-intensity activity on (at least) 3 workdays [2]) cannot replace the 30 minutes of moderate-intensity activity on 5 work days. While the intensity level is all right, the intensity

[1] at least 4 MET (Metabolic Equivalent) or 200 kcal above resting metabolism, or 30% HRR (Heart Rate Reserve).

period is too short.

The 30 minutes of activity may be accumulated during the day. We don't apply a lower limit to the duration of one activity bout (e.g. 5 minutes), as such is not described in the NNGB [8]. Also, activity bouts of short duration will help to lose weight or change ones attitude towards healthy physical activity. Moreover, short duration bouts are more easily put into daily work practice than 5-minutes bouts. We do realise, though, that unbroken physical activity is required to affect the cardio-vascular system.

We did not include a recommendation on the total sitting duration of an 8-hours workday, for example 5 or 6 hours as is often proposed. A field study on the applicability of our recommendations to four of the target groups showed that a 5-hours sitting limit was too strict. Only 5% of 39 VDU-workers studied met this standard. Furthermore, there is no evidence that prolonged sitting causes health disorders [13].

3. Recommendation II: "take a time-out to recover"

3.1. The recommendations

It is recommended that:

I: On an 8-hours workday, an adult employee takes a recovering time-out of at least 7½ minutes in the morning and at least 10 minutes in the afternoon after each work shift of at most 1½ hours. Recovery is either a rest period or another task, to relax, respectively dynamically load the neck-/shoulder area. It is a rest period, though, at least once in the morning and once in the afternoon.

II: Within each 1½-hours work shift, an adult employee takes a recovering time-out of at least 30 seconds after at most 20 minutes. Recovery is rest in this case

3.2. Objectives

Both recommendations aim to tackle the sustained character of low-intensity static loading in the neck-/shoulder area by restricting the duration of the loading period. These interventions are supposed to reduce work-related short-term loading effects in the neck-/shoulder area, like local fatigue and discomfort. We did not find sufficient scientific evidence to claim a decrease of long-term loading effects, i.e. (diagnosed) work-related MSDs in the neck-/shoulder area. It is plausible, though, that our recommendations contribute to decreasing the risk of these disorders.

3.3. Scientific rationale

The scientific motivation comes from a number of studies. Their conclusions are that:

- Extra breaks, in addition to the usual coffee and lunch breaks, limit discomfort and fatigue in neck/shoulder [14-20];
- Micro breaks, e.g. 30 seconds per 20 minutes, limit discomfort and fatigue in neck/shoulder [21];
- The inability to take extra breaks is associated with a higher risk of MSDs in the upper extremities [22-24];
- Productivity is not unfavourably affected by the extra breaks [16,17,19];
- A break duration of 7,5 to 10 minutes is the best of the reviewed alternatives for both employees and employer [14,15,19,20];
- The break duration should be longer in the afternoon than in the morning [15,19];
- Active breaks (i.e. exercise) do not have more value, nor less value compared to passive breaks (i.e. rest) with respect to limitation of fatigue and discomfort during work, and regarding disorder reduction in employees with MSDs [25-29];
- Diversity in load intensity (as occurs in proper job rotation) has a positive effect on fatigue development in shoulder muscles [30,31].

3.4. Considerations and choices

The recommendations are meant for work-related low-intensity static loading of average precision, time pressure and emotional load. In case of higher than average precision (e.g. lots of mouse manipulation), higher than average time pressure (e.g. approaching deadline), and higher than average emotional load (e.g. troublesome client at the counter), the recommended work shift durations ought to be reduced and/or the recommended time-out durations increased. With respect to psychosocial work characteristics, recent epidemiological studies by van den Heuvel [32] have shown an association of MSDs in the neck/shoulder area and high task demands, high efforts combined with low payment, and undue personal commitment. Regarding high precision work, experimental studies have shown increased muscle activation and little alternation of activity between different parts of a muscle or between various muscles (review by Douwes and Huysmans [33]). Sustained muscle activity in high precision work is thought to be required to suppress the

neuro-motornoise, i.e. noise resulting from imprecise motor control [34]. These studies suggest more strict recommendations in case of a high psychosocial workload and/or high demands on precision. At this moment, however, we have no sound scientific motivation to define alternative durations.

The recommendations are meant for work-related low-intensity static loading. In case of high-intensity static loading, for example as a result of high force exertion with the hands, other guidelines on physical workload should be applied (e.g. [35]).

If more strict recommendations have been agreed upon within a company or a group of companies, for instance in collective bargaining agreements, these agreements have priority over our recommendations.

The number of intervention studies on work-related low-intensity static loading was limited, making the scientific basis of the current recommendations fairly small. We strengthened this basis by thorough discussions and a consensus meeting with TNO experts and by adjusting the recommendations after consulting external experts. We regard the current versions as a solid starting point; open to discussion, extension, fine-tuning, and practical application.

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References

[1] US Surgeon General. Surgeon General's report on physical activity and health. JAMA 276 (1996) 522.

[2] Pollock ML, Gaesser GA, Butcher JD, Després J-P et al. American College of Sports Medicine Position Stand; The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adult. Med. Sci. Sports Exerc. 30/6 (1998) 975-991.

[3] Gezondheidsraad (Health Council of The Netherlands). Publicatie RSI 2000/22 en RSI 2000/22E (Publication Repetitive Strain Injuries 2000/22 and 2000/22E). Gezondheidsraad, Den Haag, The Netherlands, 2000.

[4] Visser B. Upper extremity load in low-intensity tasks. Ph.D. Thesis, Vrije Universiteit Amsterdam, The Netherlands, 2004.

[5] Sjøgaard G and Jensen BR. In: Marras WS and Karwowski W (Eds.) Fundamentals and assessment tools for occupational ergonomics. Taylor&Francis, CRC Press, Boca Raton, USA, 2006, pp 14-1–14-3.

[6] Pate RR, Pratt M, Blair SN, Haskell WL et al. Physical Activity and Public Health. A recommendation from the Centers for Disease Control and Prevention and the American College for Sports Medicine. JAMA 273 (1995) 402-407.

[7] Balady GJ, Berra KA, Golding LA, Gordon NF et al. In: Franklin BA, Whaley MH and Howley ET (Eds.) ACSM's guidelines for exercise testing and prescription. Lippincott Williams and Wilkins, Baltimore, USA, 2000.

[8] Kemper HCG, Ooijendijk WTM, Stiggelbout M, Hildebrandt VH et al. In: Hildebrandt VH, Ooijendijk WTM and Stiggelbout M (Eds.) Trendrapport bewegen en gezondheid 1998/1999 (Trend report physical activity and health 1998/1999). Koninklijke Vermande, Lelystad, The Netherlands, 1999, pp 11-21.

[9] ISO/FDIS 11226(E). Ergonomics - Evaluation of static working postures. ISO, Geneva, Switzerland, 1999.

[10] Jans MP, Hildebrandt VH, Hendriksen IJM and Wortelboer S. Gering bewustzijn van overgewicht en ongezonde leeftstijl (Little awareness of overweight and unhealthy lifestyle). Confidential report, TNO Arbeid, Hoofddorp, The Netherlands, 2003.

[11] Saris WHM, Blair SN, Baak MA van et al. How much physical activity is enough to prevent unhealthy weight gain? Outcome of the IASO 1st Stock Conference and Consensus Statement. Obesity Rev. 4 (2003) 101-114.

[12] Gezondheidsraad (Health Council of The Netherlands). Overgewicht en obesitas (Overweight and obesity). Gezondheidsraad, Den Haag, The Netherlands, 2003.

[13] Nordin M. In: Wilke HJ (Ed.) Ergomechanics. Shaker Verlag, Aachen, Germany, 2004, pp 10-35.

[14] Balci R and Aghazadeh F. The effect of work-rest schedules and type of task on the discomfort and performance of VDT users. Ergonomics 46 (2003) 455-465.

[15] Boucsein W and Thum M. Design of work/rest schedules for computer work based on psycho-physiological recovery measures. Int. J. Ind. Erg. 20 (1997) 51-57.

[16] Dababneh AJ, Swanson N and Shell RL. Impact of added rest breaks on the productivity and well being of workers. Ergonomics 44 (2001) 164-174.

[17] Galinsky TL, Swanson NG, Sauter SL, Hurrell JJ and Schleifer LM. A field study of supplementary rest breaks for data-entry operators. Ergonomics 43 (2000) 622-638.

[18] Henning RA, Jacques P, Kissel GV, Sullivan AB and Alteras-Webb SM. Frequent short rest breaks from computer work: effects on productivity and well-being at two field sites. Ergonomics 40 (1997) 78-91.

[19]Looze MP de, Bosch T, Rhijn JW van, Grinten MP van der and Schoenmaker N. Increasing the volume flexibility in line assembly. Int. J. Prod. Research (submitted).
[20]Thé KH, Douwes M and Bongers PM. Kort en vaak pauzeren ter preventie van RSI (Prevention of RSI; take often a brief break). TBVG 7 (1999) 116-121.
[21]McLean L, Tingley M, Scott RN and Richards J. Computer terminal work and the benefits of microbreaks. Appl. Ergon. 32 (2001) 225-237.
[22]Bergqvist U. Musculoskeletal disorders and the workplace: low back and upper extremities. National Academy Press, Washington, USA, 1995.
[23]Ferraz MB, Frumkin H, Helfenstein M, Gianeschini C and Atra E. Upper-extremity musculoskeletal disorders in keyboard operators in Brazil: a cross-sectional study. Int. J. Occup. Environ. Health 1 (1995) 239-244.
[24]Ferreira Jr M, Conceicão GM and Saldiva PH. Work organisation is significantly associated with upper extremities musculoskeletal disorders among employees engaged in interactive computer-telephone tasks of an international bank subsidiary in Sao Paulo, Brazil. Am. J. Ind. Med. 31 (1997) 468-473.
[25]Boersma AL, Vrusch THL, Visser B and van Dieën JH. Preventie van RSI: oefenen of rusten? De invloed van actieve en passieve pauzes op de vermoeidheid van de schouderspieren (Prevention of RSI: exercise or rest?). T. v. Ergonomie 26 (2001) 14-21.
[26]Heuvel SG van den, Looze MP de, Hildebrandt VH and Thé KH. Effects of software programs stimulating regular breaks and exercises on work-related neck and upper-limb disorders. Scand. J. Work Environm. and Health 29 (2003) 106-116.
[27]Mathiassen SE and Winkel J. Physiological comparison of three interventions in light assembly work: reduced work pace, increased break allowance and shortened working days. Int. Archiv. Occup. Environm. Health 68 (1996) 94-108.
[28]Sundelin G and Hagberg M. The effect of different pause types on neck and shoulder EMG activity during VDU work. Ergonomics 32 (1989) 527-537.
[29]Swanson NG and Sauter SL. In: Luczak H, Cakir A and Cakir G (Eds.) Work with display units 92. Elsevier Publishers, Amsterdam, The Netherlands, 1993.
[30]Mathiassen SE and Turpin-Legendre E. Reduction of isometric shoulder elevation fatigue by periods of increased load. PREMUS-ISEOH, Helsinki, Finland, 1998.
[31]Sundelin G. Patterns of electromyographic shoulder muscle fatigue during MTM-paced repetitive arm work with and without pauses. Int. Archiv. Occup. Environm. Health 64 (1993) 485-493.
[32]Heuvel SG van den. Work-related neck and upper limb symptoms. Ph.D. Thesis, Body@work, Vrije Universiteit Amsterdam, The Netherlands, 2005.
[33]Douwes M and Huysmans MA. Precisietaken: implicaties voor ergonomen en ontwerpers (Precision work; implications for ergonomists and designers). T. v. Ergonomie (submitted).
[34]Galen GPV van and Müller M. Stress, neuromotorische ruis en spierspanning en het ontstaan van RSI (Stress, neuro-motornoise and muscle activity and the origin of RSI). T. v. Ergonomie 26 (2001) 3-17.
[35]Grinten MP van der, Douwes M, Korte EM de, Commissaris DACM and Bosch T. TNO-richtlijnen. (TNO Guidelines on physical workload) Confidential report, TNO Arbeid, Hoofddorp, The Netherlands, 2004.