OFFICE WORK: ERGONOMIC AND MEDICAL ASPECTS

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Abstract

A special attention must be given to office work in order to increase efficiency of the corporation and to preserve the health of the workforce. Physical work is easier to plan and to measure because the tasks are predictable and repeatable in a high volume. Office work includes various activities with difficulties in estimating time- and resource need. Physical and mental flexibility of people bridges the challenges of continuous working but there are many long term adverse effects. The paper looks the impacts of office work environment on the muscular-skeletal system of ergonomic perspective. People spend several hours every day sitting in front of the computer during work and non-work activities. Although technologically the development of computer technology is dynamic, people may criticize the results from the ergonomic point of view. Economic aspects and lack of knowledge together may lead to the development of a work environment, which discourages effective work. The most common problems come from the bad sitting posture, the wrong positioning of the mouse or the keyboard on the table and the improper selection of tools and gadgets in the direct work environment. These lead to mutation of human muscular-skeletal system. Next to this the static muscle load results short term problems as well. The experiences of our empiric research shows that factors of individual satisfaction may differ from the professional viewpoint of ergonomics and medical sciences. This is why exploring the possibilities of convergence is important, including knowledge dissemination or promotion of prevention exercises.

Keywords: Workplace design, office ergonomics, job satisfaction

Introduction

Control and quality of production is an elementary aspect of ensuring customer satisfaction (Aft, 1998; Tenner & DeToro, 1992). However,

especially with the services coming to the front, it became apparent that a broader approach is necessary in order to achieve customer satisfaction. Office work is becoming increasingly important (Praeg, 2010; Vink et al., 1998). The greatest challenge is that ensuring the quality and assessment of office work requires different methods from production and the impacts of the developments usually only occur indirectly.

Beyond products, technology and processes there must be given a special attention to the workforce. Establishing the proper work environment allows higher performance and helps to preserve health. People and organizations both feel the impact of the problem on the quality of work. Related to office activities realizing the problems occur too late, the impacts may be irreversible.

The paper looks at the problem – the impact of office work environment on the muscular-skeletal system – of ergonomic perspective.

Challenges of office work

In the case of an employer performing physical job, the efficiency of work is relatively well defined and measurable (Aft, 2000). Although the amount of products moved, produced or assembled in a given time can depend on many factors, the well-structured nature of the task and the working conditions allow the framing of the precise temporal expectations and their following (Bedny & Karwowski, 2007). In addition, there are work types in which the tasks are poorly structured and the lead time can be estimated with only high variance. Furthermore, the change in working conditions is only weakly correlated with performance (Khurana, 2009). These works are complex with various elements, office work is a typical example (Kroemer & Kroemer, 2001). Various activities are to be done in various combinations during office work. This is what makes it difficult to define "efficiency" for the above-mentioned works. Separately each activity can be clearly described, measured and improved but not altogether.

The Human Relations Movement pointed out that the scientific management does not recognize the state of mind of workers. One of Mayo's famous proposals in order to improve the mood of work was the introduction of a rest period, which was not justified by any physiological reasons (Nelson, 1990; Klein, 2004). The practice proved his ideas. The results of the Hawthorne experiments clearly showed that productivity is substantially affected by the "human factor" (Khurana, 2009).

In most researches the focus is on the physical work (Taylor, 1998; Waring, 1991; . With their methods office work can be examined as well theoretically. However, because of its special features it is limited and misleading results can be expected. Due to the diversification of the content of office work it is hard to define 'ideal' expectations, solutions have to be

developed uniquely. Margaritis and Marmaras (2007) present a model of five factors that affect job performance. This model can be considered to be generic for both work types. If an organization wants to produce good quality products and services, quality work processes are needed, which meet the expectations, standards and objectives. This most affected factors are working persons, task requirements, building characteristics, workplace components and physical environment (Margaritis and Marmaras, 2007, .p. 782).

It is difficult to assign numerical standards to office work in general or to create the ideal working environment for each activity. Of course, if a given task (activity section) is repeated in a large number with the same content and under the same conditions, it should be treated similarly to the physical activities.

Human beings are quite flexible physically as well as mentally and are capable of solving specific problems with new techniques. People are able to adapt to a wide range of stimuli and to work in case of overload (Woodson & Conover, 1966). Overloading can be physical or mental and may stem from own volition or external pressure (e.g., fear of losing job). As a result of overloading the employee performs the work assigned to him but his body is exposed to increased stress and it is unnoticed. Some of the effects are temporary and may be seen (they are reversible by having rest). However, by the impact of repeated load they may become irreversible and permanent health damage may occur. In the present computers and information technology world the use of the Internet, both at home and at the workplaces is very important. Office and administrative work, business and personal contacts and learning is typically carried out with the support of personal computers that generates new challenges (see e.g. Davis, 2012; Tari, 2010; Zemke et al., 2013). Electronic mailing and contacting people in virtual communities has gone even beyond PCs. Services are accessible on mobile phone even on the move. The widening of the possibilities requires human adaptions to computers from the social, psychological and physiological aspects. The physical environment of the computer work does not only affect the work efficiency but also the psyche. The "alienation" of young people, learning violence from computer games, head ache, back pain and the damage of the eyes may be the typical negative consequences of the use of computer. All the above effects are the consequences of the deficiencies of the adjustment process. The focus should be on finding solutions instead of finding out who is responsible for it.

A popular topic of research is examining the generation gap, especially the relationship between each generation and information technology (Strauss-Howe, 1991; Coupland, 2013; Tari, 2010). Although from most of the aspects of ergonomics the factors and effects are beyond

the habits of the generations the solution is to build on these terms. From the physiological point of view it does not matter whether people load the hands, necks and eyes by work, play or just browsing social networking sites.

As nowadays computer activities are a significant part of the working period office jobs can be modelled with computer jobs. Experience shows that today's health problems originate in computer work not carried out under suitable conditions. The main reason for this is that workplaces are multifunctional. Particularly the musculoskeletal adverse effects, which on the short term are well tolerated by the body but this comes at a price.

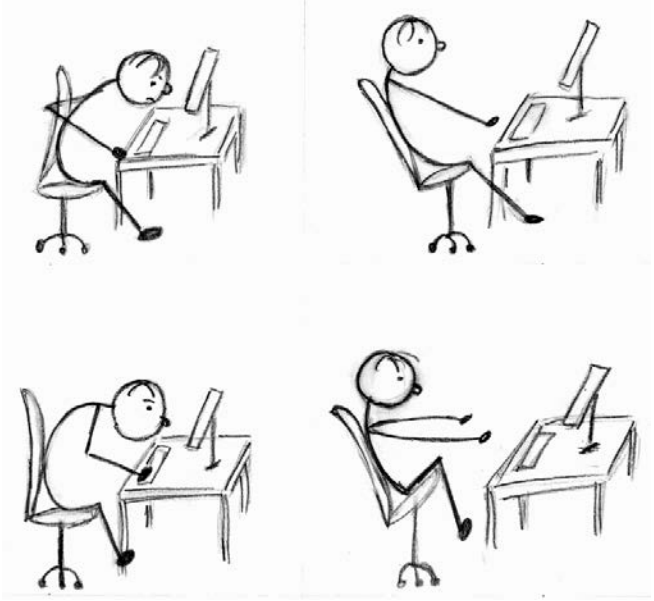
Appropriate work posture should minimize the static load of arm and leg muscle and ensures a comfortable head retention (including eyes and cervical vertebrae minimum load). The posture, however, cannot be sustained for a long time, since only the keyboard and screen is unthinkable to be enough during office work. Office work requires a variety of tools. The incorrect arrangement of them can lead to health problems on the short and the long term too. Various computer input devices, documents, stationery and office machines should be used in a coordinated way. This requires a shorter or longer time change in the job posture. Injurious effects can be mitigated with appropriate equipment and by keeping the resting time.

People usually not or only minimally deal with the proper design of work environment. Since there is no complaint on the short term, complaints during work are neglected despite the fact that the current problems can cause serious problems in the future.

To avoid the risks of monotony during work, it is appropriate to insert breaks with some physical exercises. The arms of the chair, the keyboard holder, the monitor, and even the notebook belongs to those assets which satisfy personal comfort, yet incorrect settings may cause serious damage of the body skeleton-muscular system.

Beside the choice of an ergonomically correct chair (Haibo et al, 2013) it is also important to learn the correct body posture. Sitting casually, in a semi-recumbent posture must be avoided. The improper sitting posture (Figure 1) loads the spine primarily. Abnormalities occurring in the spine also affect the shoulders, neck and back muscle tones. In the short term back pain, cold limbs, numbness and increased tiredness can be perceived.

Figure 1: Typical bad sitting postures



Source: Berényi & Szolnoki (2013, p. 98.)

The experiences show that the most common mistake is in the wrong positioning of the mouse and the keyboard on the table. This may not only cause incorrect loading of the upper limbs but often also cause inflammation of the tendon sheath. Due to space saving, people sometimes use the pre-formed keyboard holders, which are usually lower than it would be ergonomically correct.

Among the short-term effects there are to mention also dry eyes, headaches, and in some rare cases neurological lesions. Short-time effects of office work are known better than the ones can be experienced on the long run. Typically, it is to hear little about how to prevent these problems, symptoms at the workplaces.

The actuality of the empirical research

In the 1990s fundamental social and economic changes took place in Eastern Europe (Jovanivic, 2005). The disappearance of the centralized state-organized companies and the result of the privatization process brought the forced marginalization of the issues of work organization and ergonomics. In the economics that was becoming familiar with the concept of bankruptcy the problems of daily survival had to be solved. No time, money and expertise was left to improve work environment or to the scientific study of the work processes. The key of solution was in the hands of producing companies and the new procedures brought from abroad by multinational companies. However this did not mean that the subject received national

treatment. It can be stated that the consumer ergonomics provided some results using the system of concepts (Becker & Kaucsek, 1998) while occupational ergonomics could not move forward. Klein (2004) points out in his historical summary that after the decades of boom following the Second World War a fracture of decades occurred in the research of work psychology and ergonomics. It is to feel a similar break in the ergonomics of computer use and the study of the organization of work relations.

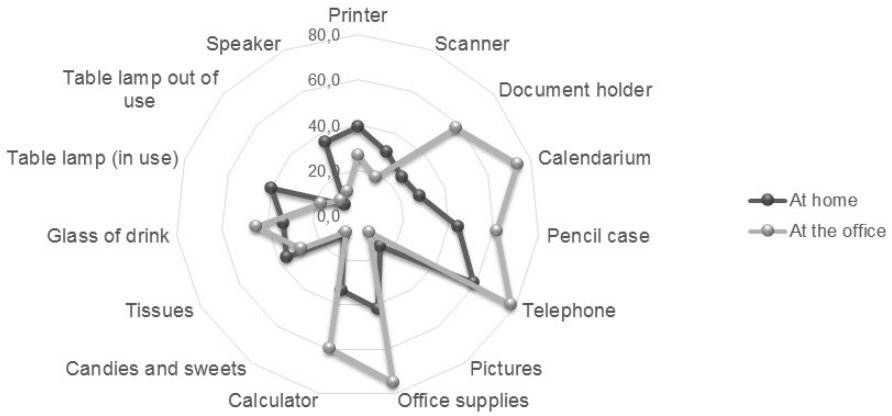
The economic and operating environment, the process conditions, data collection and processing procedures all have changed a lot in the meantime. This means that the method and tools are necessary to refresh. Moreover, both society and business must prepare themselves to the fact that the dynamic development of computer technology has not stopped yet. A few years ago smart phones and tablets were rare but today these are affordable and realistic alternatives also to desktop computers.

Results of the empirical research

Tools and gadgets for working

Our research at the University of Miskolc, Institute of Management Sciences is examining among other things, what people keep on their desks. 117 of 155 respondents completed the questionnaire related to their home and work place. Figure 2 shows the percentage of respondents, who keep on their desks the listed devices and objects.

Figure 2: Things kept on desks at home and the workplace



Source: own edition

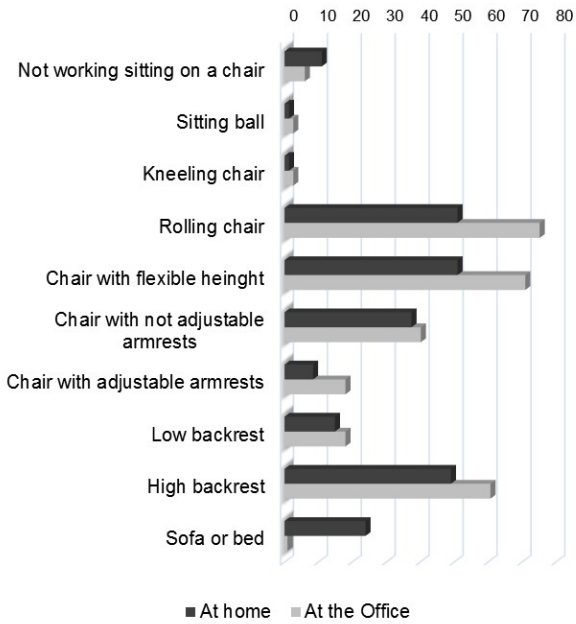
The fact that a growing number of people use portable computers contribute to the musculoskeletal problems. Space saving on the desktop is possible with them, but it is impossible to work with a proper sitting posture. 85% of the respondents use Notebooks, four-fifths often. 22% of the respondents use compact netbooks and most of them rarely. Smart phones

and tablet machines should be taken into account today, which require the users to make compromises. Although the former is not typical of the respondents (20%), 66% of the respondents regularly use the "smart" functions of the smart phones, which is three quarters of the questioned people. Although these are useful tools, the right arm and head holding is not ensured at the same time by the touch screens (their use can soon lead to neck pain).

Design of seat position

It is not the only element but the choice of the chair is determining. Professional literature advises the use of low chairs with wheels and a bucket for office work but such thing are rare in practice. Although the so called chief's chairs are popular because of their convenience and the proving of prestige, a lot of problems occur with them. Beyond the later discussed health effects many times they do not fit into the working environment (e.g. do not fit under the table). The characteristics of the popular chairs for the research sample are summarized in Figure 3.

Figure 3: Chair, sitting position features



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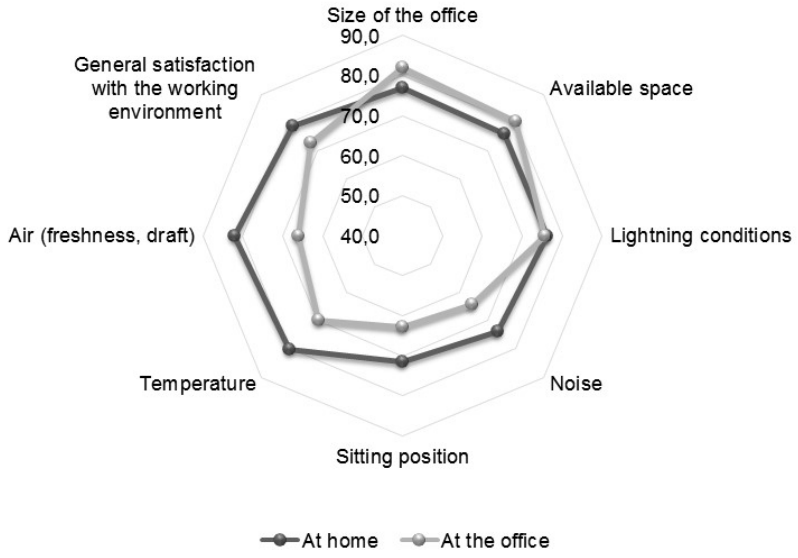
Satisfaction with the work environment

Besides the physiological and ergonomic features the personal opinion and subjective satisfaction of the employers should be taken into consideration. The experience is that these are often contradictory, non-rational aspects decide about the design of the working environment. Németh

(2011) focuses on employee satisfaction, which affects the company performance. This is important from the motivational aspects and the ergonomic adaptation to the physical working environment. A survey comparing work at home to office work shows that providing more freedom (at home) leads to greater satisfaction even if the equipment and the working environment is less favorable from technical and health aspect. This temporarily makes the work more efficient and fine but it can soon lead to health problems. The empirical results for the satisfaction are summarized in Figure 4.

Figure 4: Satisfaction with the work environment



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The results of the research found that although satisfaction with the work environment has a positive impact on the quality and performance of work it cannot provide protection against health problems.

Effects

The diseases and symptoms connected to office work have many names (see Kahn, 2004): RSI (Repetitive Strain Injuries), CRI (Computer Related Injuries), CTD (Cumulative Trauma Disorder), WRULD (Work Related Upper Limb Disorder) or OOS (Occupational Overuse Syndrome). The substantive difference between the definitions is a minimum from a non-medical viewpoint.

Mutation during office work is primarily due to the static muscle load (McKeown, 2008). This does not include only the long-term mobilization of the muscle but the potentially repetitive line items as well. Spasmodic user

mode, stress and environment in stimulations add to the physical stress (Donkin, 2002; Helander & Helander, 2006, Kroemer et al., 2001)

RSI-type diseases are mainly a result of the overload. In case of overload mutation appears in the muscular-skeletal system, which have developed as a result of intolerable load. In case of such diseases an underlying cause (e.g. work tool) is to find which causes dysfunction (e.g. Stressful situation during work). Organ lesions appear as a result of this dysfunction (e.g. Tendinitis). Although the first step is local treatment at such lesions, emphasis should be put on finding the causes of dysfunction and encouraging prevention.

An active part of human locomotory system are the muscles, which are in close conjunction with the bones (Stewart, 2005). All muscles have origin and insertion points. The muscles are connected to the bone by tendons at both points. An additional component of the muscles is the tendon sheath, which is the tubular membrane surrounding the muscles. In case of overload, physical constrain, these tendons become inflamed and paralyze the movement of the fingers, arms and shoulders.

The following lists the body parts loaded during office work and their active-passive musculoskeletal elements. Those complaints are listed, which are the most often experienced by both managers and employees.

Table 1: Features of body parts loaded during office work

Body part	**Symptom**	**Reason**
Vertebral	Bend, blunt back pain, torpidness, radiant pain in limbs	Not appropriate height of the desk or chair. Bad positioning of keyboard and mouse. Bad body posture.
Neck	Neck pain, which may radiate back to neck and shoulder. The hard muscle tone can lead to narrowing of the movement. . Head ache and tiredness can be experienced.	The monitor is set in a wrong angle. Not appropriate height of the chair and table. Bad body posture and sitting posture.
Body	Back pain, pain radiated back to the limbs. Sudden stabbing pain when moving. Narrowing of movement space; organic problems may occur in the long run.	Bad body posture, bad chair. Not enough activity, continuous sitting. Bad positioning of the monitor.
Upper limbs	Pain radiated back to the limbs, torpidity, feeling cold. narrowing of the movement space, pain when moving joint swelling, painful moving	Not suitable placement of the keyboard and the mouse can cause these symptoms first of all. Secondly, the excessive load.

Source: based on Haibo et al (2013); Kroemer et al. (2001); Wilson (1986)

Body parts listed in the table are often overloaded during office work. Static workload of the muscles damages mainly the joints of the priority areas. The relevant parts of the body muscles also stiffen and the tendon sheaths are often inflamed. Those can be presented as musculoskeletal lesions, which can be experienced in the long term in the mentioned position.

Continuous load and a working environment that support the static use of muscles can cause RSI-type diseases. Prevention is very important against these diseases (Chim, 2013). It is not only necessary because changes occur in the long run but because the dynamics of today's work requires it. In case of working at home the above effects should be expected and there is even less professional ergonomic control. It is advisable not only to develop the offices only according to the requirements of anthropometry. Those practices and movements should be supported, which serve both the physical and spiritual refreshment in addition to prevention. Numerous exercises exist, which can be applied during office work.

The exercises (Cooper, 1983; Gál, 2008; Groza-Nolte & Reichel, 2001) must include trunk rotation, head rotation, relaxation of arms and hands and also breathing elements. The colleagues at the Faculty of Economics were trained and asked to do some exercises regularly. Most of them did the exercises on an occasional basis when they felt very tired at work but the research observed that some people did the exercises regularly and were interested in other options. Their feedback was positive about the importance of the topic. However every interviewed person said that during work the focus on that work should be carried out as soon as possible.

Conclusion

Intellectual and clerical works are envied by many people because of the common belief that it is less located than the physical work. The improper design of the working environment, stretching the physiological and psychological boundaries have a negative effect on the individual and the performance of the human system. Discovering the problem, developing and implementing solutions is the responsibility of the management. People spend several hours every day sitting in front of the computer during work and non-work activities. Although technologically the development of computer technology is dynamic, people may criticize the results from the ergonomic point of view. The economic aspects (the cheaper option) and the lack of knowledge together may lead to the development of a working environment, which discourages effective work. Efficiency improvement motives are evident in industrial environments and particularly in mass production. Detailed methods are available to improve the man-machine relationships, as in the case of office ergonomics. With regard to the computer, office and managers work it is hard to describe requirements

similar to the heavy industrial activity time and performance standards, thus measuring the efficiency can be problematic. In addition high tolerance and subjective perception of the workplace by people should be taken into account. People are able to complete the work sufficiently if the conditions are not ideal and health (especially long-term) effects are not counted. Knowledge, will and practice have compensatory effects and they are able to cover up the real causes of the decline in effectiveness for a long time.

The goal is to highlight some of the critical issues and their solutions in this paper. With its help each organization can make the first steps in the development of an ideal work environment. The recommended exercises may seem plausible after first reading but it is a complex task to adopt them to the daily rush and working hours.

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