sciendo

Work ergonomics in a service enterprise – case study

doi:10.2478/mape-2019-0027
Date of submission to the Editor: 04/2018
Date of acceptance by the Editor: 07/2018
MAPE 2019, volume 2, issue 1, pp. 274-282

Artur Kuboszek*
ORCID ID: 0000-0002-8499-8028
Silesian University of Technology, **Poland**

INTRODUCTION

Ergonomics is applied science, aimed at the optimal adaptation of tools, machines, devices, technologies, organization and material working environment, and common-use objects to the requirements and physiological, psychological and social needs of people. It applies to ensuring proper working conditions at all workplaces. The problem of ergonomics of manual work positions, characterized by high loads on the human body, is relatively often raised and the actions of employers in this matter are sometimes visible. Unfortunately, these activities, as well as the activities of scientific communities that raise ergonomic problems at workplaces (Koszembar-Wiklik et all., 2015; Bartnicka et all., 2017; Bartnicka at all., 2018; Mleczko, 2016; Winnicka-Jasłowska, et al. 2017; Kuboszek at all., 2018; Żabińska and Kuboszek, 2018; Kabiesz and Bartnicka, 2018; Bartnicka at all., 2018; Matuszak and Żabińska, 2018) do not bring the expected effects. The main problem is still the low awareness of employees about the principles of ergonomic work. The knowledge of the principles of ergonomics and ergonomic design of workplaces in case of positions not associated with high physical effort is much worse.

The article presents the results of research carried out as part of a project aimed at integrated ergonomic diagnosis of the work environment in terms of improving technical and psychosocial conditions. Selected results of an ergonomic diagnosis covering a number of hairdressers' work stations are also presented in this article.

METHODOLOGY OF RESEARCH

The ergonomic diagnosis was carried out by direct observation of the employee while performing the tasks. The observation was supported by several research tools that allow a relatively fast and accurate assessment of the ergonomic situation in the analyzed work environment. Due to the short time in which observations could be conducted, in relation to a single workstation and the need to choose a universal tool for all groups and positions, it was decided to use the check list method - the Dortmund List. Additionally, 3DSSPP software was used to analyze the physical load of the musculoskeletal system for selected poises adopted during performing work. The man's poise during work was modeled on the basis of photo documentation taken at the work stations.

* artur.kuboszek@polsl.pl

CHARACTERISTIC OF THE HAIRDRESSER WORKPLACE

The ergonomics of the hairdresser's work is one of the kinds of industrial ergonomics, covering all the working conditions related to the hairdresser's work environment. The hairdresser's working conditions depend on a number of factors (Suligowska and Małek, 2007):

- material factors: rooms, workplace equipment, tools and apparatus used in the performance of professional activities,
- physical factors: ionizing radiation, ultraviolet radiation, noise, lighting,
- chemical factors: all substances contained in the chemicals used in hairdressing,
- biological factors: all kinds of infections carried by clients or other employees,
- social working conditions, for example: atmosphere, interpersonal relations, ability to work in a team.

Ergonomics defines how a hairdressing salon and particular workstations should be equipped, what tools and apparatus should be used during professional activities to protect an employee from harmful and undesirable factors.

Hairdressers' workstation should be characterized by a clear division of places into the zone of performing hairdressing and waiting area. The most important thing when arranging a hairdresser's workstation is to analyze the dimensions and possibilities of the room itself. Hairdressing services require proper connection of water, sewage and electrical networks. First of all, the most important sub-zones should be distinguished in the hairdressing zone, i.e. the hairdresser's zone, washing zone and cosmetics storage area. The profession of a hairdresser is connected with the necessity of working in a standing position, often in a forced position. The necessity of long standing, often in one position, means that the hairdresser's work can be defined as a hard job in terms of physical loads (Dz. U. 2003 nr 169 poz. 1650, 2003). It is connected with a long-term burden of i.e. joints, ligaments, tendons, and especially the spine. These strains contribute to the development of spine diseases, back pain, varicose veins and even cardiovascular disease. Reducing the adverse impact of a hairdresser's standing job is associated with a change in the organization of work so that the employee can sit down or walk from time to time (Kowalska, 2016a, Kowalska, 2016b).

Ensuring proper working conditions related to the organization of the employee's work should rely on the restructuring of the work system by combining standing, sitting and moving at work, improving the workplace - providing technical assistance, such as adjustable stools (bar stools), which can be used, for example, when cutting or combing hair, ergonomic positioning of workplaces - so that they allow, for example, to lean against the wall (Suligowska and Małek, 2007).

Due to the nature of the work (long-term standing and walking) a very important element ensuring comfort during work is to guarantee the right footwear to the hairdresser. Above all it should be comfortable, and therefore not higher than 2.5 cm heel, with built-in fronts, which can additionally protect the foot, for example against injuries. Another factor that ensures proper working conditions is lighting, which should not burden the eyes or give a glare effect. The best working conditions are provided by daylight. In the case of artificial lighting, it is advisable to use common or halogen bulbs, and not fluorescent lamps that tire the eyes. Points of light should be at each workstation, should not give too strong light and be set properly. When arranging the work station, it is very important to have everything within easy reach

and easily accessible. Objects used by the hairdresser should be undamaged and of good quality, also not causing an allergic reaction.
Another very important aspect of an ergonomic workplace is the use of appropriate furniture. They should meet all sanitary standards and be adapted to the employees' height. Properly selected furniture should provide a comfortable posture when performing a hairdressing service, should also allow the employee to properly arrange the tools, the necessary accessories and materials at the workplace which will be used in the performed procedure. They should be within the reach of the hairdresser's hands, in a suitable and purposeful arrangement. The selection of the console is conditioned by the type and interior design. Island consoles are recommended for spacious rooms. On the other hand, consoles mounted to the walls are so diverse that they can easily be integrated into any interior.
When arranging a hairdressing position, an important point is the choice of a professional chair. It is worth choosing a model equipped with a hydraulic pump, thanks to which it will be possible to adjust its height together with the customer sitting on it. Five-arm bases are easy to move, but the disk or square looks more elegant and above all stable. Taking care of the customer's comfort, it is worth choosing an armchair with a comfortable seat. In turn, taking into account the convenience of the hairdresser's work, a low-backed armchair should be considered. When choosing a chair with a bright color, you should also get special foils/covers to protect against possible dirt. Washing area is also as important element of the work of hairdresser as chair. The nature of treatments carried out in this position (washing, head massage, etc.) requires to be located in a place that provides a little intimacy to the client.
The hairdresser should maintain proper, free and functional posture while working. It is influenced by the confidence, effectiveness and aesthetics of each movement. During the activities, the hairdresser usually "balances" around the client, it means to freely transfers the weight of the body from one leg to the other or evenly distributes its weight to the two lower limbs. At the same time, the load on the spine is reduced.
Ensuring proper posture at work and the correct placement of tools and materials at the workplace enables the introduction of smooth and automatic grips and gestures, which during the treatment reduces the energy expenses of the hairdresser and introduces a certain aesthetics of movements. The aim of this hairdresser's posture is to maximize economical use of energy while working, at the same time reducing service time, minimizing the harmfulness and at the same time obtaining the optimal effect of work. An additional factor affecting the comfort of work at the hairdresser's position is ensuring proper climatic conditions. The devices used during performing work generate a large amount of heat, which in the case of malfunctioning or lack of ventilation, raises the temperature in the workplace, which translates into a reduction in work comfort, but also can adversely affect the feelings of customers. However, the use of fans and air conditioners should not introduce dangerous drafts, local temperature drops to too low values as well as adverse air humidity reduction. Ventilation should also ensure a reduction in the concentration of harmful agents that are derived from the use of all types of cosmetics, hair dyes and other chemicals.
The threat of chemical agents and dust in hairdressing studio can occur at almost every stage of customer service, from hair washing, clipping, dyeing, bleaching, perm doing and straightening hair, or modeling, to disinfection of used work tools (Szewczyńska, 2011). The products used in these activities are often classified as

dangerous substances and may cause various changes in the body, i.e. can be harmful to the nervous system, cause asthma or allergy. Chemicals used at the hairdresser's work station can be divided into two main groups:

- Chemical substances used in treatments at the hairdresser's workstation
- Chemical substances used during disinfection of hairdressing tools

The first group of means include those used, for example, in the process of hair washing or in the hair dyeing process. These substances can affect the human body leading to permanent damage, which is especially important for a hairdresser who is exposed to long-term effects of these factors. Also clients are exposed to irritants, which will translate into their comfort during the hairdressing service, even though in less extend. In hairdressing salons, substances and chemical preparations which are health hazard also occur in biocidal products and cosmetics. Employees are in contact with biocidal products directly when using disinfectants and indirectly when using cosmetics that contain preservatives. The threat that is associated with the use of a given measure depends, for example, on the type of active substances included in its composition. Active substances in this type of agents include aldehydes, chlorine compounds, peroxygen compounds, alcohols, phenolic compounds. In addition to the active substances in disinfectants, there are other dangerous substances, e.g. increasing the cleaning properties of the preparation or regulating the pH. In order to reduce the occupational exposure associated with chemical agents at the hairdresser's workplace and to improve ergonomic working conditions, it is recommended to apply, among others, the following principles (Szewczyńska, 2011):

- reduction of working time in conditions of exposure to chemical agents.
- using of automated systems for dispensing dangerous substances and chemical preparations.
- installation of general and local ventilation systems.
- airing rooms
- equipping employees with properly selected personal protective equipment, in particular protective gloves and aprons.

DETERMINATION OF THE PHYSICAL LOAD LEVEL ON THE HAIRDRESSER'S WORK STATION

This chapter presents the results of the physical load analysis at the "hairdresser" workplace for two different cases, differing essentially in the place of performing haircut and hairstyle modeling.

Employee no. 1.

Working on the position is not associated with a significant physical load. Small muscle groups are involved in the work. It is not possible to simultaneously perform additional tasks. Most activities are carried out in a standing position. There are no limit/peak loads of the musculoskeletal system.

The employee must lift and carry work items, that is, move to the client's home with her work tools. Because the treatments are performed at the client's house, it can not be assumed that the passageways will be free of obstacles.

During work, the Employee often takes an unnatural position. She is forced to slightly tilt the figure to have the face of the client at the height of her eyes. The hands are raised slightly up to the height of the face. Such a pose is taken several times (7-15)

while performing activities related to the service and lasts for about 3 minutes. The described item is shown in Fig. 1., and then subjected to further computer analysis.

Fig. 1 Phantom view. The position most often taken during make-up. Employee 1

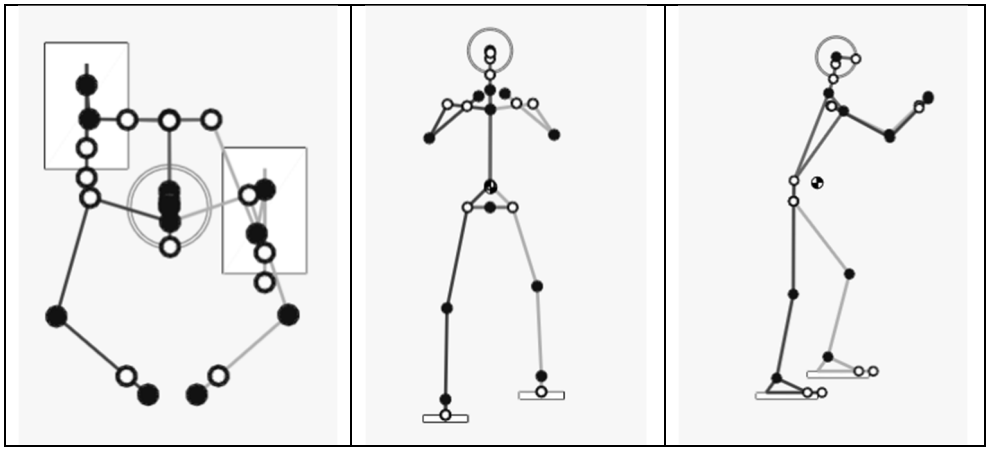

Fig. 2 Reported work position. Edge view for Employee 1

On the basis of a collective report on computer analysis, it can be stated that the momentary load of the musculoskeletal system is within the permissible ranges (Fig. 3). It should be noted that there is a greater load in the arms and only 15% of the population with these anthropometric parameters it is imperceptible.

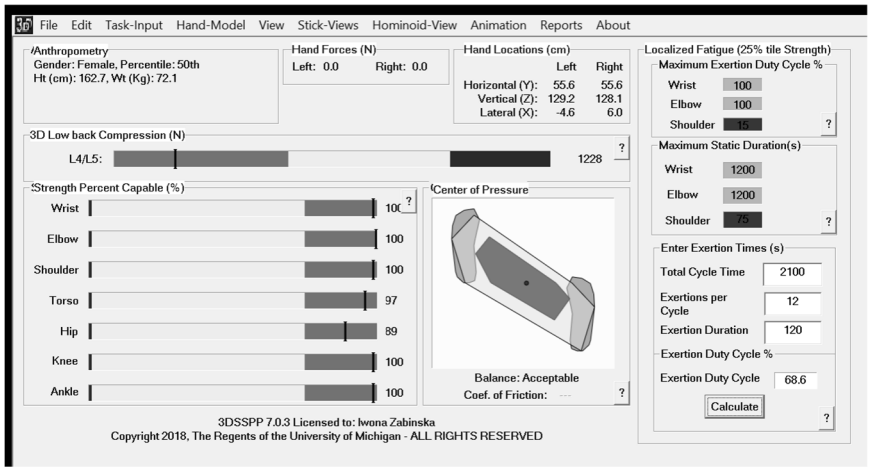

Fig. 3 Analysis and summary report field for Employee 1

Employee no. 2.

Working in this position is not associated with a significant physical load. Small muscle groups are involved in the work. It can be stated that it is not possible to perform additional tasks simultaneously. The employee does not have to lift and carry work items while performing his duties. Due to the job characteristics, static loads prevail. Muscle load affects the majority of the neck, arms, hands and legs. Static load mainly affects small muscle groups. During performing work, it is possible to eliminate static loads by changing the position at work.

During work (hair styling, hair cutting) the worker is often forced to perform unnatural movements with hands. The position of the forearms and arms is unnatural, but the employee does not control it and does not pay attention to it. Such postures are taken several times (8-18) while performing activities related to the service and last about 15-20 seconds. The computer simulation (Fig. 4), based on the photos at the workplace, showed that the employee should be additionally trained so that it would be possible to perform the tasks without taking unnatural positions.

The adoption of such positions is largely related to the use of equipment with non-ergonomic profile and handle construction. The inclination is compensated for by spreading the feet (Fig. 5). It is necessary to bend slightly in the knees. The right hand (holding the scissors) is turned in the wrist and elbow (together at 110°), which results in the need to unnaturally lift the elbow. The wrists are not supported. The head is additionally inclined because in this position the employee can observe the working field well.

Fig. 4 Modeled work position. A phantom view. Employee No. 2

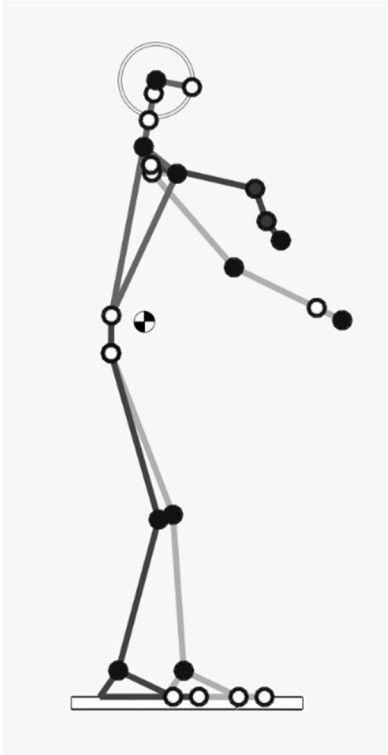

Fig. 5 Modeled work position. Edge view. Employee No. 2

On the basis of a collective report on computer analysis, it can be stated that the momentary load of the musculoskeletal system is within the permissible ranges (Fig. 6), only in the arms there may be a higher load, and only for 17% of the population with these anthropometric parameters it is imperceptible. The analyzed item is critically unstable.

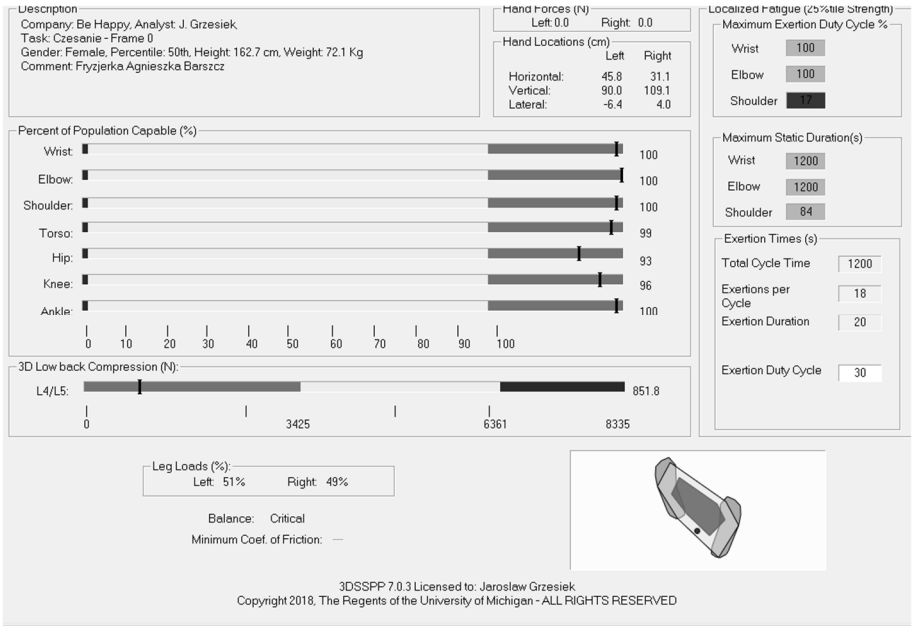

Fig. 6 Analysis and summary report field. Employee No. 2

Analysis of local loads based on snapshot observation, indicated that the unbearable load on joints: ulnar and bunches is associated with improper training in clipping

(unwillingness to change the position of scissors) and with non-ergonomic scissors holders. Although the arms are forwarded for the entered information about the cycle of repetitive activities, they are not overloaded, only the time remaining in this position is limited. For a person with these dimensions of upper limbs it is 186 sec. After about 3 minutes, the body position must be changed. The work station allows for such changes which was also noted during 1200 seconds of observation.

CONCLUSION

The presented research results concerned two cases from many carried out as part of the research project implementation. The results of these and other analyzes induce to draw the following conclusions:

- The conducted static load analysis shows that the overall level of muscle load on the hairdresser's workstation is not too high.
- Employees show interest in the ergonomics problem at their workplace.
- Since some employees do not have a stationary workplace and are condemned to the conditions prevailing in the client's premises, the most important aspect is taking the right position during performing work.

Recommended preventive actions:

- When working in a standing position, employees should maintain a natural posture, devoid of any extortion of the body. Natural posture means an upright posture, maintaining the anatomical curvature of the spine, directed forward and untwisted.
- While working in a standing position, employees should:
  - evenly distribute the weight on both feet,
  - regularly stretch and relax the muscles of legs, back and abdomen,
  - allow you to rest the feet and legs,
  - take the right posture.

REFEENCES

3D Static Strength Prediction Program™ Version 7.0.4. Available at: https://c4e.engin.umich.edu/tools-services/3dsspp-software/ [Accessed 15 May 2018].

Bartnicka, J. et all. (2017). Ergonomics education in orthopedic surgery. LIFE: International Journal of Health and Life-Sciences, 3(2), pp. 194-215.

Bartnicka, J. et all. (2018). Train4OrthoMIS online course as a manner of improving ergonomics in orthopaedic surgery. Advances in Intelligent Systems and Computing, Volume 590, pp. 2194-5357.

Bartnicka, J., Ziętkiewicz, A. and Kowalski, G. J. (2018). An ergonomics study on wrist posture when using laparoscopic tools in four techniques in minimally invasive surgery. International Journal of Occupational Safety and Ergonomics, 24(3), pp. 438-449.

Dz.U. 2003 nr 169 poz. 1650. (2003). Rozporządzenie Ministra Pracy I Polityki Socjalnej z dnia 26 września 1997 r. w sprawie ogólnych przepisów bezpieczeństwa i higieny pracy (tekst jednolity)

Ergonomia pracy fryzjera – przydatne wskazówki. Available at: http://awansem.pl/a/ ergonomia-pracy-fryzjera-przydatne-wskazowki/

Kabiesz, P. and Bartnicka. J. (2018). Ergonomic and workflow study of sausage production process in the context of manual transport tasks. At: MAPE 2018. XV International Conference Multidisciplinary Aspects of Production Engineering, 05-08 September 2018, Zawiercie, Poland. Conference proceedings, 1(1), pp. 695-701.

Koszembar-Wiklik, M. et al. (2015). Ergonomics of integrated didactic workplaces. Applied natural sciences 2015. 5th International Scientific Conference, Jasna, Low Tatras, September 30 - October 2, 2015. Ed. P. Nemecek. Trnava: Faculty of Natural Sciences University of SS. Cyril and Methodius, pp. 174-180.

Kowalska, E. (2016a). Praca stojąca – uciążliwość narzucona względami technologicznymi, czy też niewłaściwą organizacją? Część I. Przyjaciel przy Pracy nr 02/2016.
Kowalska, E. (2016b). Praca stojąca – uciążliwość narzucona względami technologicznymi, czy też niewłaściwą organizacją? Część II. Przyjaciel przy Pracy nr 04/2016.
Kuboszek, A., Żabińska, I., Sujova, E. and Zitnansk, J. (2018). Ergonomic diagnosis of a computer workstation. In: MAPE 2018. XV International Conference Multidisciplinary Aspects of Production Engineering, 05-08 September 2018, Zawiercie, Poland. Conference proceedings, 1(1), pp. 739-744.
Matuszak, Z. and Żabińska, I. (2019). Ergonomic diagnosis of locksmith workplace. Tech. Diagn, 28(1), pp. 18.
Mleczko, K. (2016). Wymiana wiedzy, jako czynnik wspomagający proces projektowania ergonomicznych narzędzi medycznych. Systemy Wspomagania w Inżynierii Produkcji, 2, pp. 240-248.
Suligowska, I. Małek, E. (2007). Organizowanie stanowiska pracy fryzjera, 514[01].Z2.01, Poradnik dla ucznia. Instytut Technologii Eksploatacji – Państwowy Instytut Badawczy, Radom.
Świeboda, A. (2013). Zabiegi kosmetyczne muszą być wykonywane z zachowaniem zasad bhp. Available at: https://www.experto24.pl/bhp-i-instalacje/szkolenie-bhp/zabiegi-kosmetyczne-musza-byc-wykonywane-z-zachowaniem-zasad-bhp.html?cid=K000KN
Szewczyńska, M. Dobrzyńska, E. Pożniak, M. Jeżewska, A. (2011). Czynniki chemiczne w zakładach fryzjerskich – zagrożenia i profilaktyka. Bezpieczeństwo Pracy.
Winnicka-Jasłowska, D. et all. (2017). Ergonomics of laboratory rooms - case studies based on the geotechnical laboratories at the Silesian University of Technology. -ACEE Archit. Civ. Eng. Environ, 10(2), pp. 35-41.
Żabińska, I. and Kuboszek, A. (2018). Ergonomic diagnosis of concrete mixer workplace. Case study. In: MAPE 2018. XV International Conference Multidisciplinary Aspects of Production Engineering, 05-08 September 2018, Zawiercie, Poland. Conference proceedings, 1(1), pp. 751-758.

Abstract. The article presents the results of research carried out as part of a project aimed at integrated ergonomic diagnosis of the work environment in terms of improvement of technical and psychosocial conditions. The studies carried out so far included small and medium-sized enterprises located in the Śląskie (Silesian) Voivodeship. The research included manual work as well as administrative (mental) work. Ergonomic diagnosis was carried out by direct observation of employees at the workplace using tools such as the Ergonomic Control Test CET II and the Dortmund List. This article presents the results of ergonomic analysis at the hairdresser workplace.

Keywords: ergonomics, ergonomic diagnosis, work station, hairdresser