

Musculoskeletal Health of Hairdressers – Protection of Occupational Health and Safety at Workplace

Medical Reference Document



Imprint

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Abstract Scoping Review

Objective Hairdressers are exposed to conditions that can cause or exacerbate musculoskeletal disorders (MSD). The purpose of this scoping review is to gain insight into the current state of research on MSD in hairdressing.

Methods Studies published up to May 2017 (Update Nov, 2018) were identified by a systematic search using electronic databases (MEDLINE, PUBMED, CINAHL, Web of Science, LIVIVO), Google Scholar and reference lists of articles. Studies were screened by two researchers and synthesized in a narrative and quantitative manner. Pooled effect estimates for 12-month and point prevalence of MSD were calculated, using random effects models.

Results Overall 44 studies were included. Nineteen studies reported MSD prevalence: the highest 12-month prevalence was found for the lower back 48% (95% CI 35.5-59.5), neck 43% (95% CI 31.0-55.1), shoulders 42% (95% CI 30.1-53.2) and hand/wrists 32% (95% CI 22.2-40.8). In comparison to other occupational groups, hairdressers reported more frequent MSD in all body

regions or exhibited a greater risk of leaving the profession for health reasons. Common risk factors include working with arms above shoulder level, repetitive movements, forceful exertion of upper extremities, awkward back postures and movements, high mechanical workload and standing. The effect of these risk factors can be enhanced by the lack of adequate breaks, high workload, and general distress. Six rehabilitative and preventive intervention studies were found. Only the rehabilitative studies showed positive effects on the management of physical and mental strain and resulted in significant pain reduction, increased physical capacity and knowledge of potential risk factors for MSD.

Conclusion These data provide some evidence for work-related risk factors for MSD in hairdressers and indicate that there should be an intense focus on preventive technical, organizational and individual measures for health and safety at work. High quality and long-term intervention studies are needed to clarify the effectiveness of complex preventive concepts in hairdressing.

Introduction

The objective of the project “Development and promotion of a healthy and safe working environment through the design of ergonomic workplaces and work processes in the hairdressing sector” (ergoHair) is the uniform implementation of the core

proposals contained in the social partners’ agreement regarding the development of a healthy and safe work environment in the hairdressing sector [1, 2]. To accomplish this, it aims to strengthen synergies and promote the exchange of information bet-

ween European committees for social dialogue within the sector. By doing so, it contributes to the harmonization of occupational health and safety with a particular focus on ergonomic workplace design and equipment. Furthermore, it aims to help promote effective, ergonomic work processes. The overarching goal is to raise awareness of the stresses and strains faced by hairdressers and consequently reduce the number of work-related musculoskeletal disorders (MSD) and conditions (MSC) in this sector throughout Europe by developing and disseminating preventative ergonomic measures and standards in a target group-specific fashion.

The project builds on the European framework agreement on the protection of occupational health and safety in the hairdressing sector, signed in 2016. The objectives identified in this agreement are to contribute to the development of a collective, research-based European standard for protecting health and safety in the workplace. One of the five focal issues is the prevention of MSD. The parties who make up the signatories to the agreement are particularly concerned with communicating at the earliest possible opportunity the need for preventative and health-promoting behaviour in the workplace. This encompasses issues such as product acquisition, workflow organization and the treatment of employees. The aim of this medical reference document is to provide professionals in the hairdressing sector with a guideline listing the criteria which should be taken into account when developing a healthy work environment.

Section 1 contains a description of the hairdressing sector in Europe and the general approaches taken by both the European Union and the social partners from within the industry to strengthen the protection of occupational health and safety.

Section 2 is dedicated to the anatomical structure and functions of the musculoskeletal system and work-related MSD. The prevalence of work-related MSD, multifactorial risk factors and the cost of this health problem are presented in detail. Furthermore, there is a discussion of the economic benefits of preventive measures to counter MSD at work.

Section 3 presents the systematic literature appraisal (scoping review) completed as part of the ergoHair project. In line with the aims of the project, the collated studies provided the scientific basis for the initiative. The epidemiological insights delivered by these studies allow conclusions to be drawn about the occupational and health-related stresses and strains encountered by hairdressers and clearly indicate that there should be a stronger focus on steps to protect occupational health and safety both at work and in educational settings.

Section 4 compiles further research results that were presented in the workshops in Hamburg and Paris.

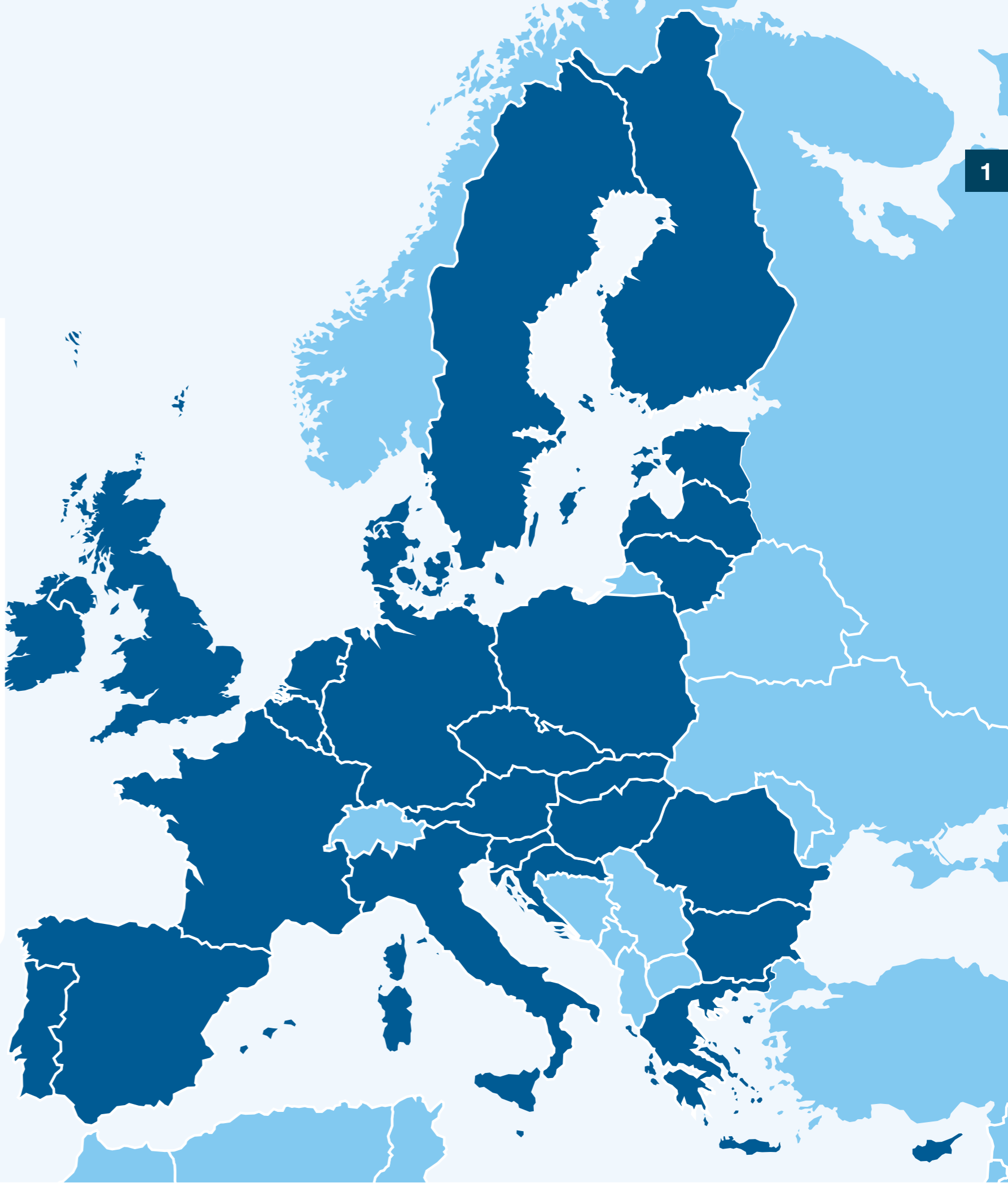
Section 5 then collates suggestions and recommendations for promoting healthy and safe working conditions for hairdressers by designing ergonomic workplaces and work processes.



The hairdressing sector in Europe

The hairdressing sector in Europe consists primarily of small and micro businesses. There are an estimated 400,000 hair salons with approximately one million hairdressers. That is equivalent to around 0.4–0.8% of a country's employees [3, 4]. Self-employment is widespread in the hairdressing sector. According to a study of eight EU Member States¹, around 50–60% of all hair salons are run by self-employed stylists without any employees. The growth rate for hairdressing businesses is between 12% and 149% in EU countries. Italy, Germany and France have the largest number of businesses. Alongside one-person salons, the number of companies that run hairdressing chains or offer franchises is also on the rise [4]. In Germany, these are believed to account for a 15% share of all hairdressing businesses [5]. The majority of employees are women: in most countries, 9 out of 10 hairdressers are female. Compared with other sectors, young people are over-represented in hairdressing; more than half of employees are below the age of 34 [4]. This industry is also hallmarked by a large proportion of part-time workers (approximately 40%) [3]. However, there are considerable differences between countries in this respect. In the Netherlands, for instance, 70% of hairdressers are part-time, compared with just 9% in Hungary. The sector is also characterized by high staff turnover. In the Netherlands and the United Kingdom, around 16% and 14% of employees respectively leave their job within a year [4]. In Denmark, hairdressers spend an average of 8.4 years in the profession (including time spent in training) [6].

¹Denmark, France, Germany, Hungary, Italy, the Netherlands, Slovenia, United Kingdom



1.1. European efforts to strengthen occupational health and safety protection

Preventing or minimizing physical hazards in the workplace is a fixed part of the EU Member States' occupational health and safety policy. Article 153 of the Treaty on the Functioning of the European Union (EU) authorizes the European Council to impose minimum requirements by means of directives to ensure that steps are taken to better protect workers' health and safety. The legal requirements differ between EU Member States. Each state has leeway and can establish stricter regulations for the protection of workers and their interests when it incorporates directives into national legislation [7]. Directive 89/391/EEC explicitly makes employers responsible for individually adapting the working environment with regard to workplace design, the choice of equipment/materials and the choice of production methods [8]. In its priorities for occupational safety and health research for the period 2013–2020, the European Agency for Safety and Health at Work (EU-OSHA) recommends developing and implementing multidimensional ergonomic measures which take individual, technical and organizational aspects into account [9].

1.2. Social dialogue efforts within the hairdressing sector

Social dialogue is a fundamental part of the European social model whose legal basis is set down in Articles 151–156 of the Treaty on the Functioning of the European Union [7]. Various European hairdressing organizations participated in this dialogue. These were Coiffure EU on the employer side and UNI Europa Hair & Beauty on the employee side. The social dialogue centred above all on two issues: harmonizing vocational training and protecting workers' health.

Health protection became a key issue for the hairdressing industry back in the 90s. This was triggered by a rise in work-related skin conditions since the late 80s (e.g. in Germany), which forced many hairdressers to leave the profession. As long ago as 2001, CIC Europa – the predecessor of Coiffure EU – and UNI Europa Hair & Beauty agreed on a set of guidelines for working conditions. The corresponding list of demands included key elements of the European agreement on the protection of health in the hairdressing sector which was subsequently signed in 2012. In 2011, the social partners began discussing a more concrete health protection agreement covering a wider range of issues. This agreement was signed in April 2012 in the presence of the then Commissioner for Employment, Social Affairs and Inclusion, László Andor. It covers the following areas:

- Use of substances, products and tools
- Protection of the skin and respiratory tracts
- Prevention of musculoskeletal disorders
- Working environment and work organization
- Maternity protection
- Mental health

The European Commission was asked to transpose this agreement into a European directive, making it mandatory for all hairdressing businesses. This request has not yet been fulfilled because a number of Member States objected to parts of the agreement. Following renewed negotiations, a revised framework agreement on the protection of occupational health and safety was signed in June 2016 [1, 2]. This focuses primarily on protecting the skin and respiratory tracts and preventing MSD. With regard to work-related skin disorders, the social dialogue originally called for a European research project to be initiated. Based on scientific findings, this research project was to issue statements on how the

various target groups – such as instructors, teachers, workers and salon managers – could implement the social partners' agreements at national level. In response to this call, Osnabrück University completed the projects Safehair 1.0 and 2.0 between 2009 and 2012 on behalf of the social partners and the European Commission. The key outcome of the projects was a voluntary commitment on the part of the social partners – agreed in the Declaration of Dresden – to uphold the jointly develop-

ped protection measures and require a knowledge of them as part of hairdressing training and in professional tests and final examinations [10]. According to the social dialogue participants, the number of skin disorders reported in the hairdressing industry has fallen sharply as a consequence of the joint efforts. Furthermore, in 2014, EU-OSHA and the social partners developed an online risk assessment tool, OiRA, for the hairdressing sector [11].



The musculoskeletal system

2.1. Structure and function

Together, the skeletal elements, joints and skeletal muscles make up the locomotor system. The body's supportive framework consists of bony and cartilaginous skeletal elements which are held together by connective tissue. Skeletal muscles move parts of the skeleton or hold them in a certain position. The locomotor system is divided into active and passive structures. The bones, joints and cartilage of the skeletal system are classed as passive structures [13]. They fulfil the following main functions:

- Supporting and acting as levers for muscles
- Protecting other organs (e.g. ribcage protects the heart and lungs)
- Storing the minerals calcium and phosphate
- Producing blood cells in the bone marrow [12]

Bones: An adult's skeleton is made up of approximately 200 bones. Its shape is determined genetically, while the inner structure is influenced by external factors (e.g. a healthy diet, a supply of calcium and vitamin D, and balanced weight bearing) [12].

Joints and cartilage: Joints connect cartilaginous and/or bony skeletal structures and allow the individual parts of the trunk and the extremities to move. They also serve to transfer energy. Most articulating surfaces are covered with hyaline cartilage and surrounded by a cavity which is filled with synovial fluid and encased in a joint capsule. The cartilage receives an optimum supply of nutrients when it is regularly worked and relaxed by means of movement. High unilateral load carrying or a lack

of exercise can prompt degenerative changes – also known as osteo-arthritis – especially in older people [13].

The active locomotor system consists of muscles, tendons and ligaments. They are primarily responsible for active movement and maintaining an upright posture via voluntary and involuntary contraction and relaxation of the muscles.

Muscle: There are more than 400 muscles in the human body; they make up approximately 45% of the body mass. There are three basic types of muscle: skeletal muscle, smooth muscle (e.g. walls of the gastrointestinal tract) and cardiac muscle. Unlike the other types, skeletal muscle is controlled by a voluntary nerve impulse. At rest, skeletal muscle accounts for 20–25% of energy expenditure [12, 13]. There are gender-specific differences too: men have a higher muscle mass than women (30 kg versus 24 kg on average). This means that women only have 65% as much physical strength as men [12, 14].

Tendons and additional structures: When muscles contract, tendons joining the bone to the muscles transmit the force to the skeleton. They consist of tough, fibrous collagen tissue. Depending on the location, shape and architecture of the muscle, tendons are classed as tensile tendons, compressive tendons or aponeuroses [13]. When muscles work, friction is generated. Additional structures such as muscle fascia, tendon sheaths, bursae and sesamoid bones are very important in minimizing the energy, which is expended as a result [12, 13].

2.2. Musculoskeletal disorders (MSD)

The term “musculoskeletal disorders” covers a variety of degenerative and inflammatory injuries and conditions affecting the locomotor system. They affect both passive and active structures. These disorders range from mild short-term symptoms (e.g. tight muscles resulting from overloading or incorrect loading) to irreversible, chronic conditions (e.g. osteo-arthritis). Damage to the musculoskeletal system occurs when external mechanical loads exceed the maximum load-bearing capacity of the individual structures within the body [15]. Pain is the primary symptom of MSD. There are two types of pain: acute and chronic. Acute pain acts as a biological warning to prevent further damage to the locomotor system. Chronic pain has moved beyond this point and impedes the patient's use of their locomotor system [16]. This results in high, intangible costs for the patient, such as restricted physical function or a lower quality of life [17, 18]. Patients are also less able to work and less productive as a consequence [19]. The conditions and symptoms are heterogeneous; they vary considerably depending on their location² and the tissue structure affected [20]. Musculoskeletal disorders are among the most widespread conditions within the population. Population surveys conducted worldwide (n = 23) show that between 13.5% and 47% of the general population is affected by chronic musculoskeletal pain [21]. A recent Europe-wide survey found that back pain (43%) and muscular pain in the arms (41%) were by far the most common complaints. Women reported MSD significantly more frequently than men [22].

2.2.1. Work-related MSD

Epidemiological studies provide sufficient evidence that MSD is caused by the physi-

cal and psychomental effects of working in a particular profession and the associated overloading or incorrect loading of the locomotor system [23-26]. There are many forms of work-related MSD (figure 1). The World Health Organization (WHO) defines these as the interplay of various factors from the work environment which contribute significantly to causing and/or exacerbating MSD to different extents [15]. Kromer (1989) defines three stages of work-related MSD: Stage 1: symptoms are experienced at work but go away; Stage 2: symptoms last overnight after a day at work; Stage 3: symptoms continue at rest, disturb sleep and last for months or years [27].

The proportion of work-related MSD can only be estimated roughly due to their predominantly multicausal genesis and high prevalence among the general population [28]. In industrialized nations, around a third of all sickness-related absences are attributable to MSD. Conditions or injuries affecting the back account for approximately 60% of these. They are followed by conditions affecting the upper extremities, which are also referred to collectively as repetitive strain injuries or cumulative trauma disorders [15]. In the Labour Force Survey (EU-27), 8.6% of workers (20 million people) reported work-related health problems in the previous 12 months; most of these were complaints affecting the locomotor system [29]. According to the European Occupational Disease Statistics (2005), work-related MSD accounted for the largest share – 38% – of all occupational diseases in 12 EU Member States. The inclusion of carpal tunnel syndrome (CTS) takes this percentage up to 59% [30]. The ten most common occupational diseases for the reporting years 2001–2007 include CTS and conditions affecting the muscular and tendinous insertions, the tendon sheaths (e.g. tenosynovitis, epicondylitis) and the angioneuroses, which are caused by mechanical stresses (e.g. Raynaud's syndrome) [31].

² (1) Upper extremities,
(2) cervical vertebrae (C1–C7),
(3) thoracic vertebrae (Th1–Th12),
(4) lumbar vertebrae (L1–L5)
and
(5) lower extremities[20]

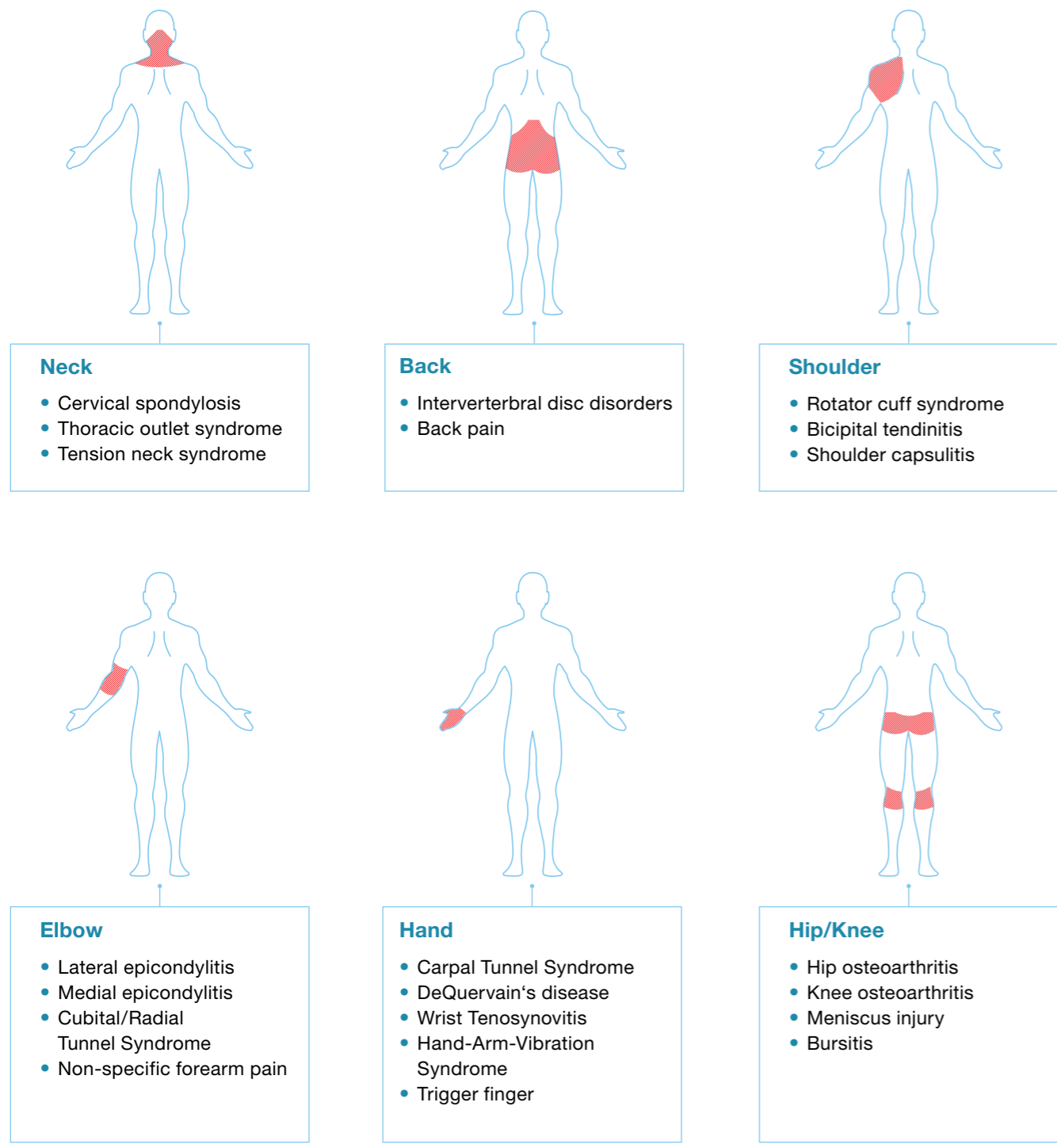


Figure 1: MSD which can be caused by biomechanical factors (modified from the ILO [32]; Mani & Gerr [33]; Sluiter et al. [34])

2.2.2. Risk factors for MSD

Epidemiological studies have sufficiently documented that there is an above-average occurrence of degenerative MSD in occupations where workers are exposed to considerable physical strains [23, 25, 26, 35, 36]. However, the ways in which MSD is explained and viewed have evolved substantially in recent years: instead of focusing solely on biomechanically based causality theories, there has been a shift towards complex biopsychosocial disease

models. Along with occupational demands, these include genetic predispositions, social factors, levels of training and productivity, and stress perception and resistance [16] (figure 2). However, not all of these are risk factors as such, i.e. factors which contribute towards causing MSD. Reference is increasingly made to risk indicators which are frequently observed in association with the symptoms, such as work dissatisfaction or lack of gratification [12].

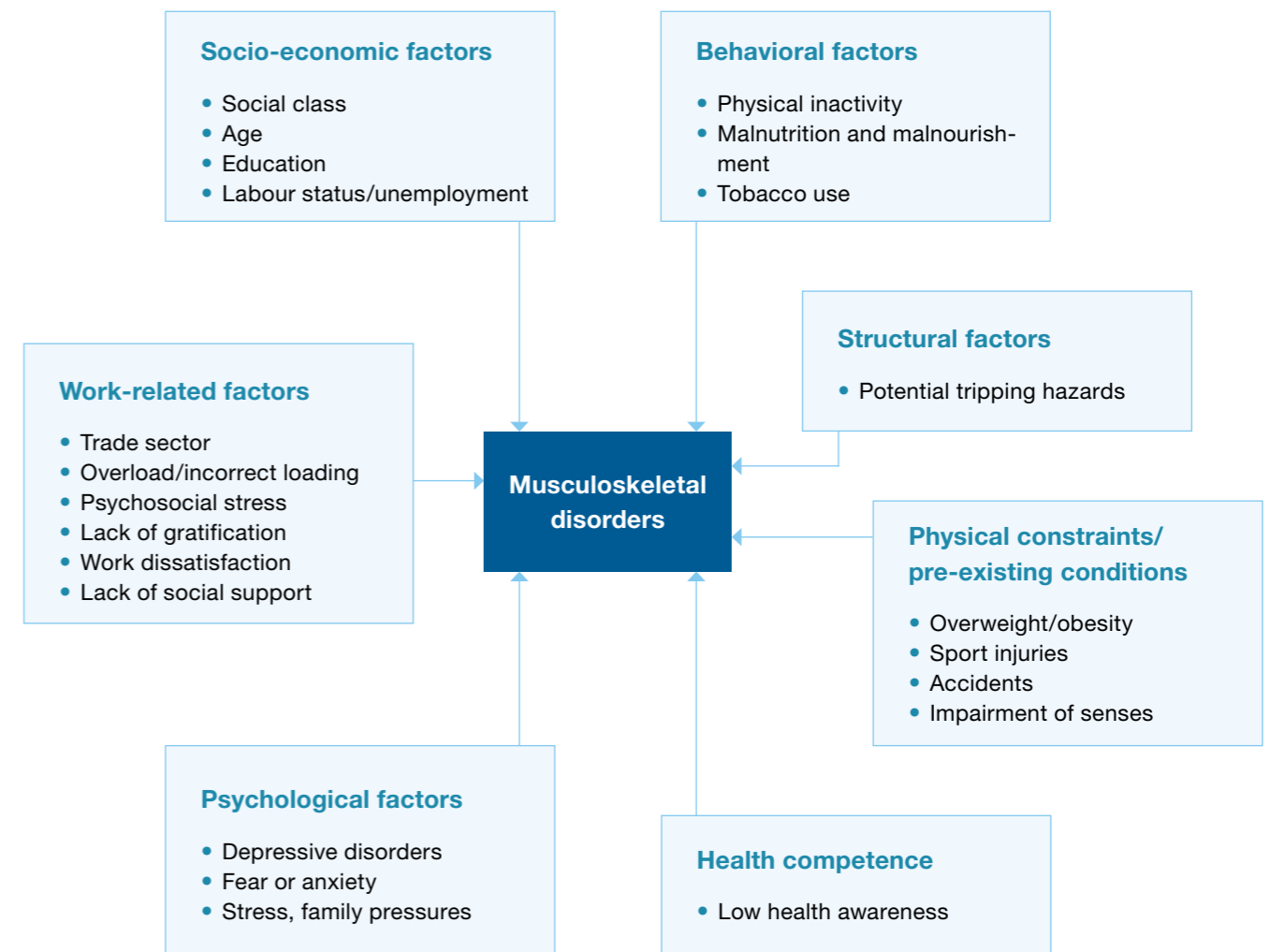


Figure 2: Potential influential factors for musculoskeletal impairment and conditions, modified from Walter & Plaumann [12]



A systematic review of longitudinal studies in various professional groups examined the influence of work-related and individual risk factors for MSD. This determined levels of evidence for the individual risk factors and parts of the body. The evidence expresses the extent to which the statistical associations observed in studies can be trusted and therefore viewed as a causal relationship. Table 1 shows “reasonable evidence” biomechanical, psychosocial and individual risk factors³ for the respective body regions [24]. It is noticeable that there is a very high probability of exposure to biomechanical factors having a damaging effect on all regions of the body. The next section takes a closer look at the individual risk dimensions.

Biomechanical risk factors

Exposure to biomechanical risk factors at work – such as awkward forced postures, heavy lifting and carrying, frequent bending and twisting of the upper body, manually handling loads, repetitive work, physical exertion or whole-body vibrations – contributes towards causing and/or exacerbating symptoms. The combination, duration, frequency and intensity of these factors can cause considerable damage to anatomical structures such as muscles, tendons, joints and nerves. If adaptability is reduced and there is a lack of compensation mechanisms, this can give rise to excessive strain, which in turn results in pain and decreased productivity. Accordingly, the consequences vary from person to person [37].

³ Reasonable evidence risk factors—satisfied at least one of the criteria for causality, but bias or confounding factors could not be completely ruled out (most of the studies presented 1–3 potentially misleading factors). Strong evidence risk factors—satisfied at least four of the five criteria for causality and bias and confounding factors were controlled for or were not present (most of the studies presented no misleading factors). Strong evidence was not assigned to any of the risk factors [24].

Table 1: Reasonable evidence risk factors for MSD

Body region	Work-related risk factors with reasonable evidence of a causal relationship		
	biomechanical	psychosocial	individual
Neck	<ul style="list-style-type: none"> • awkward posture 	<ul style="list-style-type: none"> • low level of work satisfaction and support • high level of distress 	<ul style="list-style-type: none"> • female gender • co-morbidity • smoking
Lower back	<ul style="list-style-type: none"> • awkward posture • heavy physical work • lifting 	<ul style="list-style-type: none"> • negative affectivity • low level of job control • high psychological demands • high work dissatisfaction 	<ul style="list-style-type: none"> • younger age • high BMI
Shoulder	<ul style="list-style-type: none"> • heavy physical work 	<ul style="list-style-type: none"> • high levels of distress • performing monotonous work • low level of job control 	
Elbow	<ul style="list-style-type: none"> • prolonged computer work • heavy physical work • awkward posture • repetitive work 		<ul style="list-style-type: none"> • co-morbidities • older age
Wrist/hand	<ul style="list-style-type: none"> • prolonged computer work • heavy physical work • awkward posture • repetitive work 		<ul style="list-style-type: none"> • high BMI • older age • female gender
Hip	<ul style="list-style-type: none"> • lifting • heavy physical work 		
Knee	<ul style="list-style-type: none"> • awkward posture • lifting • repetitive work 		<ul style="list-style-type: none"> • co- morbidities

Source: da Costa & Vieira [24]

The European Foundation for Improvement of Living and Working Conditions (Eurofound) conducts regular surveys on working conditions in Europe every five years. The sixth survey reaches the conclusion that the physical work environment has barely improved over recent years. Exposure to posture-related risk factors remains very frequent. Exposure via repetitive movements, static and forced postures, lif-

ting or carrying heavy loads, and vibration are the most common physical risk factors in Europe (figure 3) [22, 38]. The individual dimensions of the so-called physical environment index⁴ reveal substantial differences between professions. For example, workers in the skilled trades have the highest and therefore worst score for postural risks at 37 points; the average for the EU-28 is 24 points [22].

⁴ The physical environment index (one dimension of job quality) comprises 13 indicators related to specific physical hazards (e.g. vibration from hand tools, tiring positions, temperature or lifting/moving people, etc.) [22].

Exposed to physical risks over time (% exposed quarter of time or more)

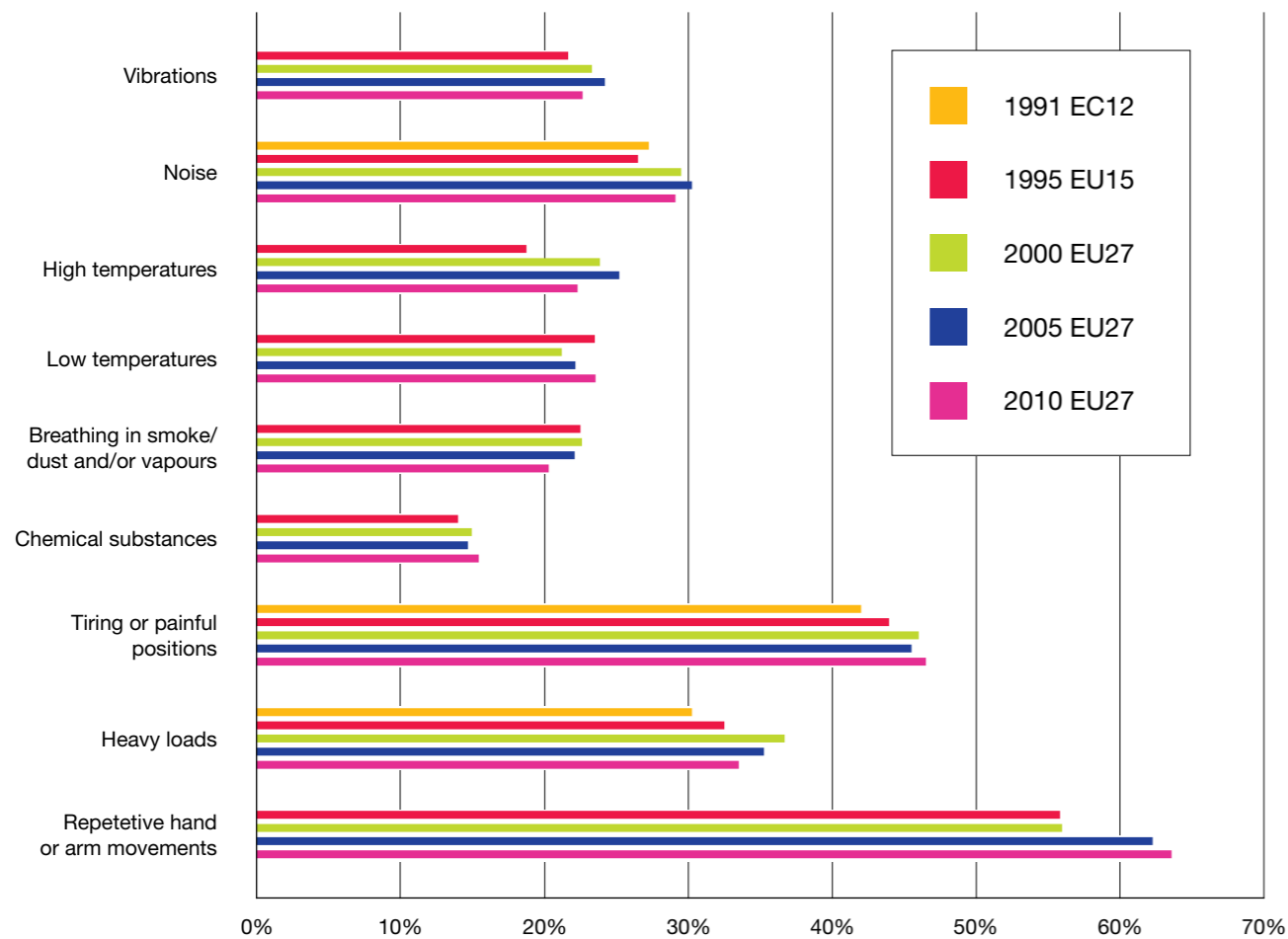


Figure 3: Percentage of physical risk factors for workers in Europe – results of earlier Eurofound surveys [38]

Eurofound (2012), Fifth European Working Conditions Survey, Publications Office of the European Union, Luxembourg

Individual, lifestyle-related influential factors

Like most chronic conditions, MSD are triggered by multiple risk factors. In addition to stress at work, aspects such as sport, lack of exercise, diet and substance use play a significant role in their development. Furthermore, systemic diseases such as diabetes and rheumatoid arthritis can have a negative impact on the pathogenesis. The risks vary with age, gender and ethnicity or socio-economic status (SES) [37]. A number of factors are listed here by way of example:

■ **Age:** Aerobic and muscular performance decrease with age, which impairs the physical ability to work [39]. Older employees are more prone to work-related MSD than younger ones due to their reduced functional capacity [40]. However, the increase is less marked among 55 to 64-year-olds. This phenomenon is also known as the “healthy worker effect”, i.e. employees who are unwell retire early [31].

■ **Gender:** According to several studies, there is a higher overall prevalence of MSD

among women than men [31, 41, 42]. Gender-specific difference could also be explained by different exposures to occupational risk factors. A review indicates that men are at greater risk of back pain due to heavy lifting and carrying and for neck/shoulder complaints caused by hand or arm vibrations. Meanwhile, women have a higher risk of neck/shoulder complaints resulting from awkward static arm postures [43].

■ **Socio-economic status:** A low SES (low level of education⁵, low income or qualifications) correlates strongly with the prevalence and incidence of MSD (figure 4) [31, 44, 45]. Absences from work due to back pain are more frequent among workers in low-qualified, manual jobs. This observation is virtually constant regardless of gender and age [46].

■ Lifestyle:

Weight/diet: Overweight and obese workers have a higher risk of suffering from MSD and take longer to recover than those whose weight is normal [47]. Furthermore, the Western lifestyle⁶ contributes towards a negative calcium balance and bone demineralization [48].

Smoking: Bone atrophy and fractures have been observed more frequently among heavy smokers (including passive smokers). Smoking also delays healing and increases complications in connection with fractures and trauma [49]. In addition, smoking has been linked to local inflammatory reactions by the musculoskeletal system (e.g. epicondylitis) and greater sensitivity to pain [48].

Exercise: Inactivity is an independent risk factor for back problems [50]. Decreased production of joint fluid (synovia), which serves to protect the surface of joints, can also exacerbate wear and tear to joints [51].

⁵ The assumption is that education – along with access to good employment opportunities – also enables healthier lifestyles and choices, which can protect individuals from disadvantages later in life.

⁶ Sedentary living, caffeine and alcohol consumption, smoking and possibly high animal protein consumption [48]



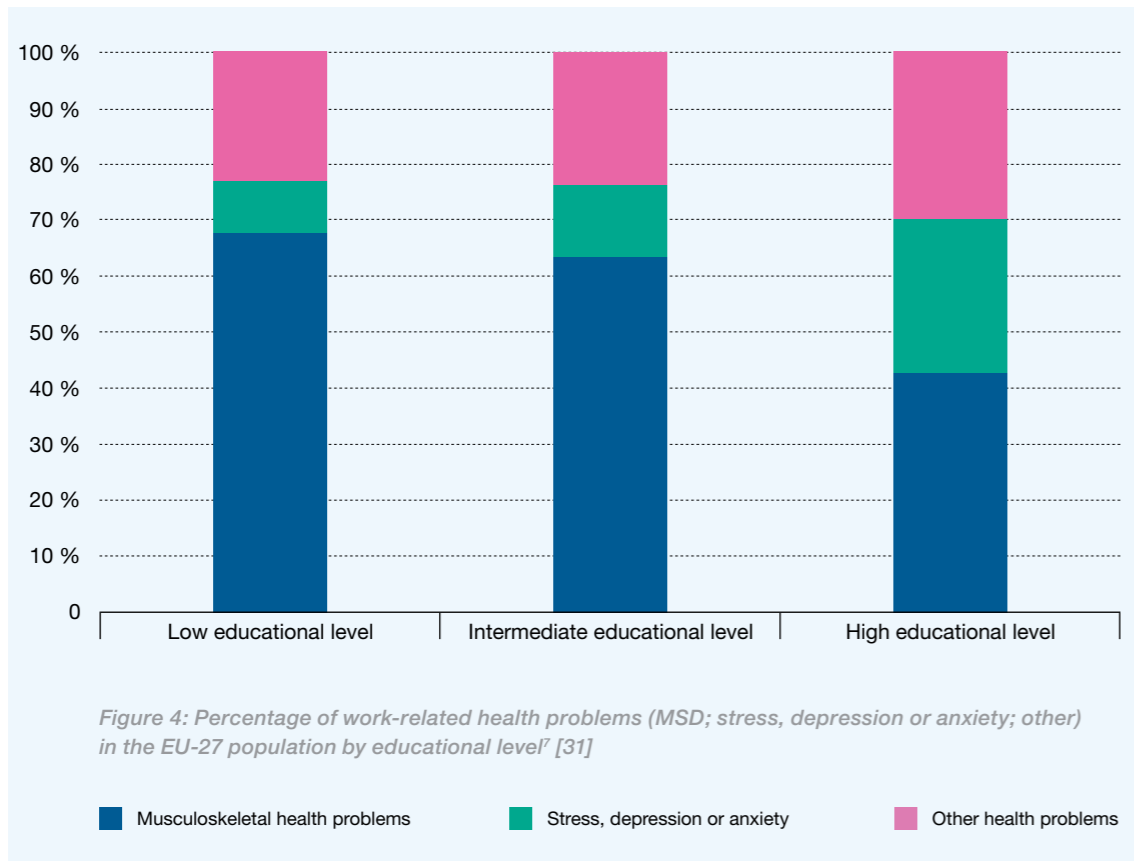


Figure 4: Percentage of work-related health problems (MSD; stress, depression or anxiety; other) in the EU-27 population by educational level [31]

Legend: Musculoskeletal health problems (dark blue), Stress, depression or anxiety (teal), Other health problems (pink)

Psychosocial and work-organizational influential factors

Systematic reviews show links between psychosocial factors and MSD [24, 52-54]. These can have a negative effect on the condition's progression with regard to behaviour and dealing with pain. Psychological tension resulting from conflicts at work or within the family can manifest itself physically and impair the autonomic nervous system. The body reacts with increased muscle tone, which in turn can trigger muscle tightness. Mobility is severely limited by the pain, resulting in inactivity and compensatory postural adjustments. Possible long-term physical effects are muscle loss and joint misalignment [12].

Lengthy sickness-related absences caused by MSD have been observed more frequently in employees who face intense time pressure at work and have little job control [55]. The following additional factors stemming from the work environment and organization can also have a negative impact on workers' health [56-58]:

- fast-paced work,
- monotonous workflows,
- insufficient breaks,
- precarious employment,
- unfavourable remuneration systems and working time models.

⁷“Low educated workers reported work-related problems more often and were more likely to report MSDs as the most serious work-related problem. In 68% of those with low educational level with a work-related health problem MSD was the main problem. For those in the high level of education classification this was true for 44%” (Eurostat, 2010).

2.2.3. Economic relevance

MSD are responsible for 40% of all global payments in kind and compensation for occupational diseases and work accidents (figure 5) [59]. Work-related back complaints in connection with all occupational health problems are estimated to cost the Member States' economies between 2.6% and 3.8% of the gross social product [60]. Estimates put the cost of work-related MSD in the upper extremities at between 0.5% and 2% of the gross social product [61]. A comparison of the cost of work-related MSD is made more difficult by differences in the individual countries' insurance systems, a lack of standardized recording criteria and the way in which costs are logged. As a result, the following list only sets out to present a number of examples from specific countries:

France, 2007: Work-related MSD caused the loss of 7.5 million working days, which went hand in hand with financial damage of € 736 million [62].

Germany, 2016: All MSD (ICD⁸ M00–M99) were responsible for the loss of 154 million working days, associated with production downtime costs of € 17.2 billion and € 30.4 billion in lost gross value added [63].

Finland, 2004: Work-related MSD caused direct costs of € 222 million.

Austria, 2004: MSD were responsible for the loss of 7.7 million working days.

Slovenia, 2006: MSD were responsible for the loss of 2.47 million working days [62].

⁸ICD – International Classification of Disease.

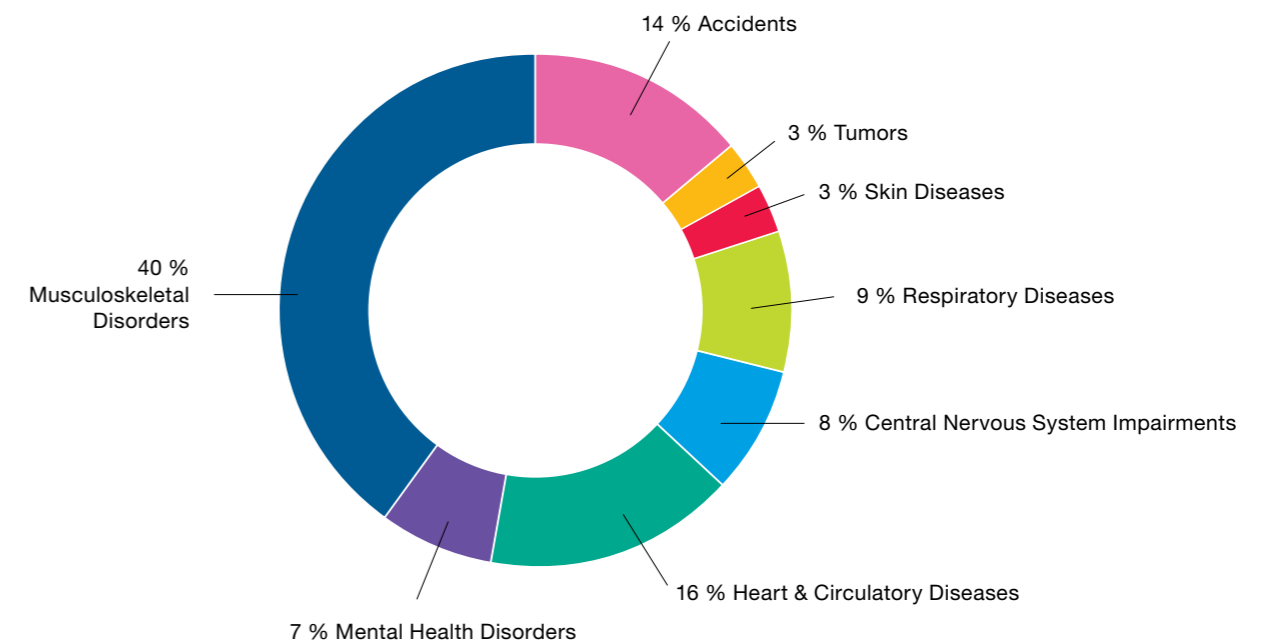
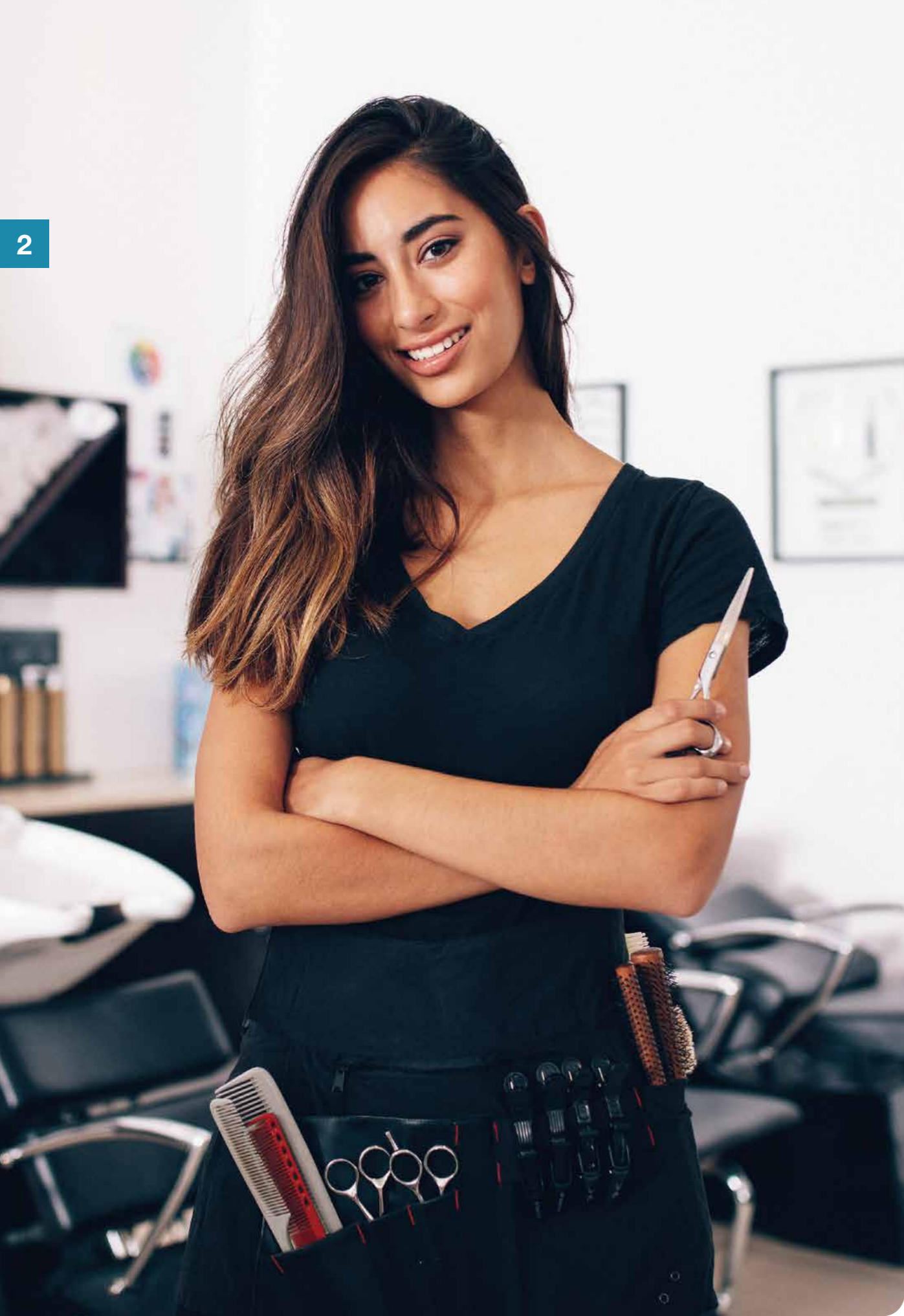


Figure 5: Worldwide compensation costs for work-related diseases and accidents (ILO[59])

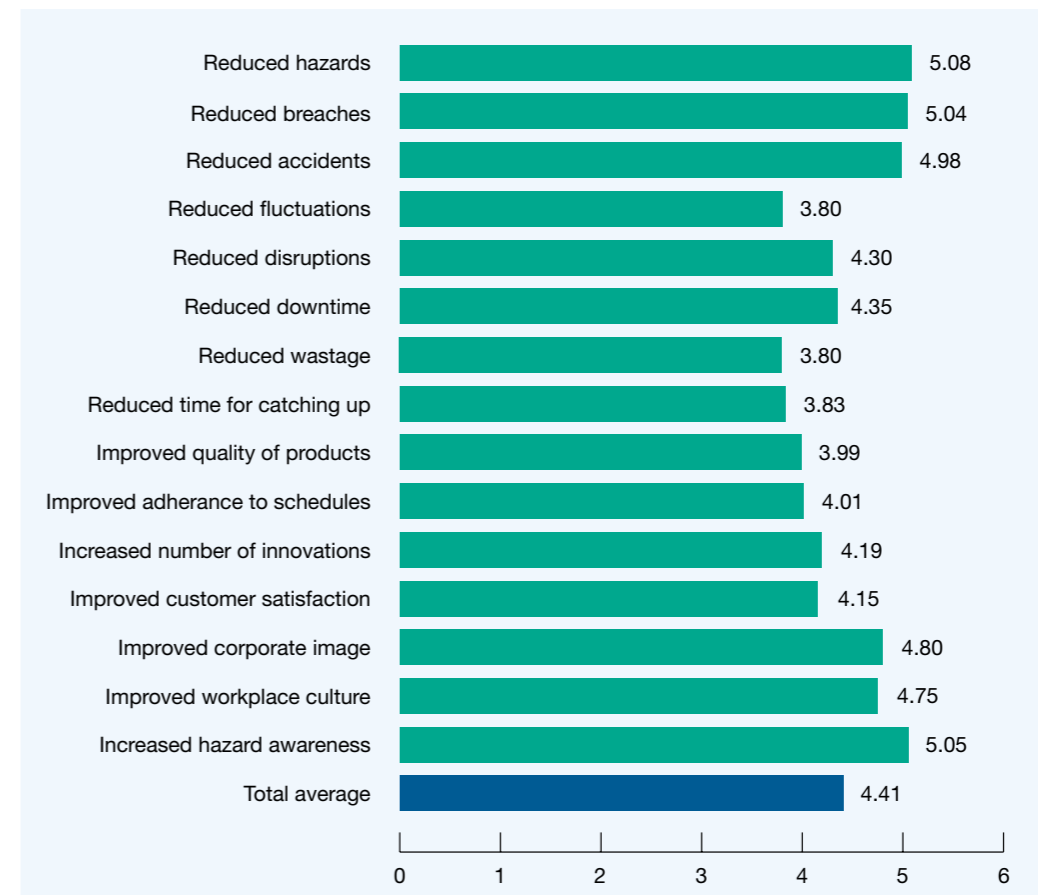


2.2.4. The economic benefit of MSD prevention within companies

Sultan-Taïeb et al. (2017) produced a cost-benefit assessment of ergonomic workplace-related interventions for the prevention of occupational MSD. They also examined factors which had a favourable or obstructive effect on the implementation process. The cumulative savings after the intervention were higher overall than the total investment (with a payback period of 3 to 5 years for employers and 0.82 to 9 years for accident insurance companies). All of the studies showed that ergonomic equipment and an overall strategy significantly reduced accidents and claims for compensation. In studies with positive economic outcomes, there was substantial support from upper and middle management and staff participation was also high.

In studies with negative or inconsistent outcomes, there was a lack of support from managers, the intervention did not meet employees' needs and the "intervention dose" was too low [64].

As part of a further study, 300 companies from 15 countries were asked for their subjective assessment of the overall economic effects of prevention and health protection in the workplace (return on prevention). According to this, the direct effects of prevention measures were a reduction in hazards, greater awareness of occupational risks, and a decrease in dangerous behaviour and work accidents. The most significant indirect effects were improved image and improved workplace culture (figure 6) [65]. However, it must be added as a caveat that these results are based on self-assessments by companies.



1 = no impact
6 = very strong impact

Figure 6: Effects of occupational health and safety within the company (ISSA [65])

Scoping review on musculoskeletal health of hairdressers

3.1. Background

Musculoskeletal disorders (MSD) are common in the working age population and are conditions that affect passive (bones, joints) and/or active structures of the body (muscles, tendons, ligaments, peripheral nerves) [37]. Since MSD account for a high proportion of compensable occupational diseases worldwide many efforts have been undertaken to ascertain the potential risk factors in the development of MSD and its prevention in the workplace setting [23]. MSDs are highly prevalent in manual-intensive occupations such as manufacturing, construction or services [26, 35, 36]. Hairdressers are a group of workers whose working ability and health condition may be affected by specific occupational activities. A daily task analysis showed that experienced hairdressers spend on average 29% of their time cutting, 17% dying, 10% blow-drying and 8% washing hair. These activities required frequent sagittal or lateral bending and twisting of the back (e.g. washing hair at the sink), static postures and long-standing periods. Repetitive tasks have been observed during all client-related activities [66]. Results from kinematic posture analysis revealed that hairdressers spend 9-13% of their total working time with arms elevated over 60° [67, 68]. Working with elevated arms above shoulder level is considered a major risk factor for clinically verified shoulder disorders or persistent severe pain [69, 70]. The relatively high force exertion and wrist velocity – combined with prolonged exposure – may account for the higher rate of hand/wrist pain, especially in female hairdressers [71]. In a study on the working conditions of Finnish hairdressers, the most hazardous factors for health were repetitive movements, awkward working postures, standing, draft, uncomfortable temperatures and chemicals [72]. To understand the impact of MSDs on hairdressers requires quantification of the MSD prevalence, disability or injury, the identification of potential risk factors for these health consequences as well as effective preventive or rehabilitative measures. This is the first attempt to systematically map the current state of research on these aspects by synthesizing empirical, measurement-based or interventional studies in hairdressing.



3.2. Methods

Due to a variety of study designs and a lack of summary of evidence, we decided to conduct a scoping review. The general purpose of a scoping review is to examine the extent and nature of research activity, summarize the relevant findings and to identify research gaps [73]. For methodological purposes, we implemented the six-stage framework for a scoping review as adopted by Arksey and O'Malley [73]. The six stages have been implemented as follows:

Stage 1: Identification of the research question

The following question should be answered: What is known from the existing literature about the frequency of MSD, work-related risk factors and measures to prevent or reduce MSD in hairdressers? We were seeking to present an overview of all thematically relevant material in a clear and comprehensible manner. Therefore, the study results were summarized and analyzed by applying a thematic approach based on the three subsections of the study question:

- (1) What is the prevalence and/or incidence of MSD in the different body sites?
- (2) Which work-related risk factors are associated with MSD?
- (3) Which work-related measures are applied to prevent or reduce MSD in hairdressers?

Stage 2: Identifying Relevant Studies

A systematic literature search was conducted in the electronic databases MEDLINE, PUBMED, CINAHL, Web of Science and LIVIVO. The key words for population⁹ were combined with key words for outcome¹⁰. We also searched the reference lists of identified articles and Google Scholar. The search included peer-reviewed and non-peer reviewed literature published from the inception of the database up to Aug. 17, 2017 (Update Nov. 5, 2018).

Stage 3: Study selection

Studies on musculoskeletal health were considered for the analysis if they reported separate results for hairdressers, assessed MSD frequency, work-related risk factors and preventive or rehabilitative measures against MSD. The following inclusion criteria were applied:

- (i) **Population:** includes hairdressers who continue to work in their job and those who have changed or left their profession for health reasons. Also other related professions such as cosmetologists were considered.
- (ii) **Exposure:** includes ergonomic, biomechanical, organizational and psychosocial factors which occur in the occupational context of hairdressers.
- (iii) **Intervention:** includes all interventions that aim to prevent or reduce MSDs.
- (iv) **Outcome:** includes health disorders related to musculoskeletal system such as (recurrent) pain, discomfort, tingling, numbness, stiff joints, swelling or dull aches.
- (v) **Study design:** includes peer review and non-peer-review publications of all study designs except editorials, commentaries, conference papers and policy statements.

Reports published in English, German, Dutch, French, Italian, Portuguese and Spanish were included. Two reviewers independently assessed the title, abstract and full text of the articles. In the event of disagreement consensus was achieved by discussion.

Stage 4: Charting the data

General information on author(s), year of publication, study location, publication type, aim, design, participant characteristics, methodology and outcome measures were recorded. The data was extracted by one person (AK) and verified by another reviewer (TW).

Stage 5: Collating, summarizing and reporting the results

To collate and aggregate the data on disease frequency in a comprehensible way, we chose a pooled testing strategy [74]. However, as we did not appraise the study quality, the estimates may be biased and should serve as approximate values which require further exploration. Where indicated, 12-month and/or point-prevalence data were extracted and pooled¹¹ using the Excel spreadsheet developed by Neyeloff et al. [74]. All potential work-related risk factors examined in the studies were extracted and grouped into superordinate risk categories.

Stage 6: Consultation exercise

The methodology and findings of the scoping review were presented at a European workshop within the project 'ergoHair'. Workshop participants provided further ideas and suggestions for interpretation of study findings and recommendations for preventive measures.

3.3. Results

Our search strategy identified 186 articles, of which 44 met the eligibility criteria for the qualitative data synthesis (see Fig 7). The characteristics of the included studies are provided in the Annex 1. Of the eligible studies 29 were conducted in European countries. The majority of the included studies (84%) were published after the year 2000, which indicates that research in this occupational setting has recently increased. Of these, one study applied a qualitative design with interviews [75] and three were national surveys of occupation-specific data which included hairdressers [76-78]. One study examined trends in compensation claims for WRMSDs [79]. Furthermore, seven studies were related to evaluation research [80-86], three studies solely measured working postures while performing regular hairdressing tasks [68, 71, 87] and three studies were from the same cohort of students entering working life [88-90]. All but one study predominantly included females [91]. In one study, only cosmetologist were queried [92].

¹¹ As substantial heterogeneity — variability in the population of effects between studies — was suspected, we used random effects models to calculate the pooled effect estimate for pain/disorder prevalence in different body sites. Heterogeneity was quantified using the Chi-square (χ^2) and I statistics. The latter is expressed as percentage of the total variability between studies: the higher the percentage, the higher is the degree of heterogeneity.

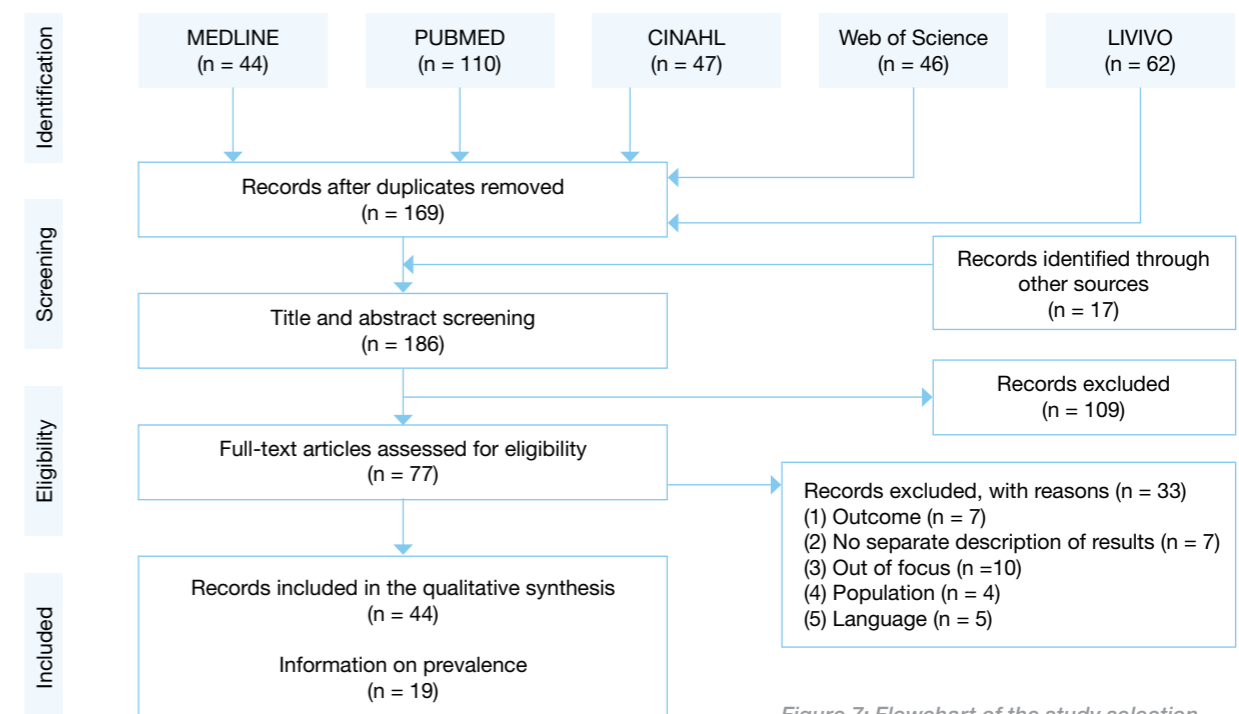


Figure 7: Flowchart of the study selection

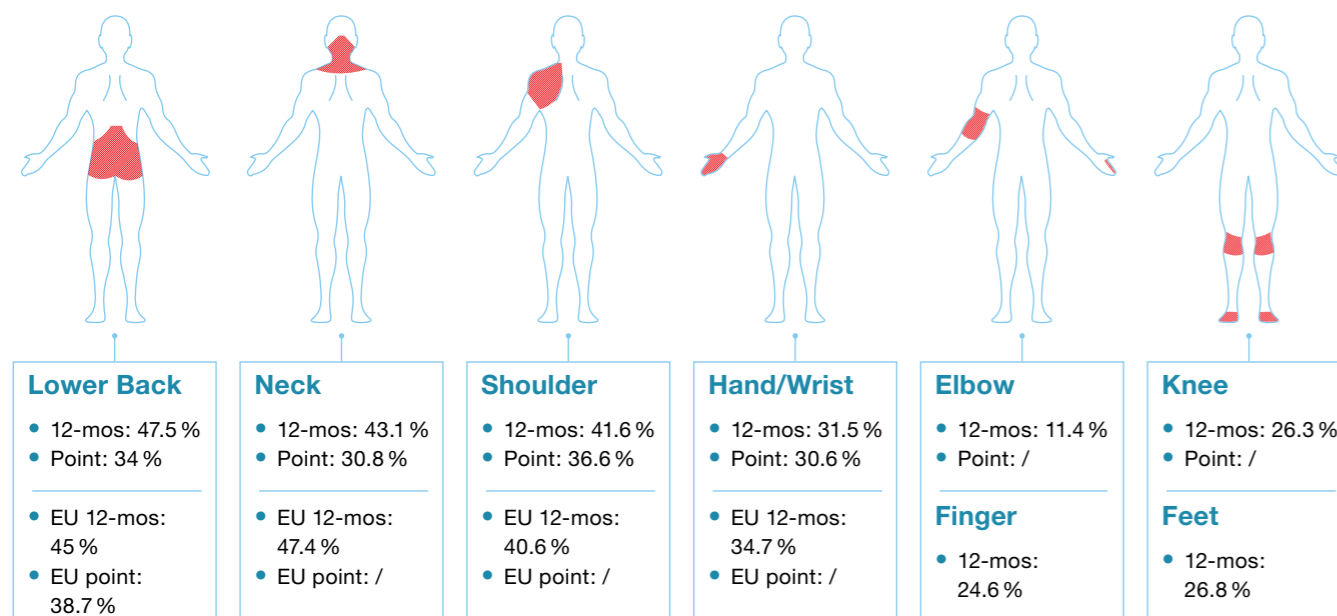
⁹ Population: hairdress* OR barbering OR cosmetologist* OR beautician* OR coiffeur* OR beauty culture*.

¹⁰ Outcome: musculoskeletal symptoms OR musculoskeletal pain OR musculoskeletal disorders OR musculoskeletal diseases OR upper limb* OR upper extremity* OR neck pain OR back pain OR shoulder pain.

3.3.1. Prevalence of musculoskeletal disorders

In total, 19 studies provided data on MSD prevalence in at least one body site and were pooled depending on the given time frame, e.g. 12-month or point MSD prevalence [78, 86, 92-108]. In a subgroup analysis, studies from European countries were pooled [78, 86, 92, 94, 96-100, 105]. The greatest 12-month MSD prevalence was reported for the lower back 48%, neck 43%, shoulder 42% and hand/wrist 32%. The point MSD prevalence was on average lower: 34%, 31%, 37% and 31%, respectively. The overall MSD with no specification of body site and time frame was 55%. If only studies from European countries were considered, the 12-month MSD prevalence remained similar for the respective body sites: 45%, 47%, 41% and 35% (figure 8). A study from France examined trends in hairdressers' compensation claims for the years 2010-2016. The overall claim rate for work-related MSD increased by 12.8% (n.s.). Permanent disability (incidence rate 2/1000) and number of lost work days significantly increased by 16% respectively. In total 666,461 days were lost due to work-related MSD [79].

Figure 8: Pooled 12-month and point MSD prevalence of the spine, upper and lower extremities. Subgroup results: Prevalence from European studies are indicated by the abbreviation EU (for detailed results, see annex 2 and 3).



3.3.2. Reasons for leaving the trade

A Finnish study assessed the risk of leaving the profession for health and other reasons among female hairdressers as compared to workers engaged in commercial work. The relative risk of leaving the profession among hairdressers was increased by 2.7 (95% CI 1.1-6.3) for a repetitive strain injury of the wrist and elbow and by 1.7 (95% CI 1.2-2.5) for diseases of the neck or shoulders [109]. Two studies from Denmark examined the health reasons for leaving the hairdressing trade: one with retrospective and one with prospective study design. Among all former hairdressers the primary health complaint causing them to leave their job was musculoskeletal pain (42%) followed by hand eczema (23%), other diseases (21%) and allergy (18%) [6]. The prospective study showed that during the 3-year follow-up, 21.8% of the hairdressing apprentices had left the trade; of them 70.4% due to health complaints. The most frequently reported reasons were musculoskeletal pain (47.4%), followed by skin diseases (42.1%) and respiratory symptoms (23.7%) [110].

3.3.3. Comparative findings

A National German Health Survey provided a representative analysis of back pain prevalence by occupation category. Hairstylists/beauticians belong to the top 4 high-risk occupations for back pain (e.g. the 12-month was 70% and 7-day prevalence was 47%) [78]. According to the U.S. National Health Interview Survey on back pain, female hairdressers belong to the top 6 high-risk occupations for back pain [76]. Epidemiologic surveillance data on carpal tunnel syndrome (CTS) from Maine and Loire regions in France showed that a substantial proportion of new CTS cases (between 2002-2004) among female hairdressers were attributable to work (attributable risk fractions 86.6%). Thus, they belong to the top 10 high-risk occupations for CTS [77].

In a case-control study, which was conducted with 147 hairdressers and 67 non-hairdressing controls, hairdressers reported significantly higher levels of MSD, including shoulder (OR 11.6, 95% CI 2.4-55.4) wrist/hand (OR 2.8, 95% CI 1.1-7.6), upper back (OR 3.8, 95% CI 1.0-14.9) or lower back pain (OR 4.9, 95% CI 1.5-15.9) [96]. In a further comparative study with office workers female hairdressers reported pain in all body regions significantly more often (neck 36% vs. 8%, shoulders 39% vs. 10% or hand/wrists 41% vs. 4%) [101]. In a case-control study from Turkey the frequency of CTS in female hairdressers was slightly higher compared to unemployed female control group (RR 1.35, 95%CI 0.98-1.84). In addition, they showed significantly higher pain intensity and functional loss levels. Hairdresser who were diagnosed with CTS worked significantly longer in their profession than those hairdressers without CTS [111]. A study from France analyzed data from occupational health examination of self-employed and wage-earning hairdressers. The risk of

musculoskeletal injuries was significantly higher among the self-employed (66.8% vs. 29.7%) [99].

3.3.4. Work-related risk factors

Fifteen studies examined potential risk factors for work-related MSD (WRMSD) in hairdressers – either by means of self-rating or statistical estimation (Annex 4). They varied greatly in types of risk factors, the applied methods and the reporting of the findings [72, 88-92, 95, 97, 98, 100-102, 104, 108, 112]. The reported risk factors were synthesized into the following six main categories:

1. Strenuous hand or arm postures and movements (e.g. arms above shoulder, repetition)
2. Awkward postures and movements of the spine (e.g. bending and twisting the back)
3. Workload and biomechanical strain (e.g. mechanical workload, overtime, no breaks)
4. Prolonged standing and sitting
5. Other factors (e.g. work experience, mental stress and burnout, gender or low support)
6. Specific hairdressing tasks (e.g. cutting, dying or styling hair)

Mastrominico et al. [112] showed that all principle hairdressing activities performed for at least 50% of the working day, exhibited intermediate to high risk for upper limb disorders (ULD). Similarly, Mahdavi et al. [102] found that 61% of studied postures could be classified as high risk postures for MSD.

The following studies examined hairdressing activities and/or the corresponding body postures and movements of the musculoskeletal system.

In a study by Chen et al. [71], the mechanical exposure of hairdresser's and barber's wrists were assessed by using electromyography (EMG). Female hairdressers exhibited significantly greater EMG activity ($p < 0.001$) and faster overall extensions-flexion speed (velocity) in their non-dominant hand ($p < 0.001$) than their male counterparts. The authors concluded that high force exertion and wrist velocity combined with prolonged exposure may account for the greater rate of hand/wrist pain in female hairdressers.

Wahlström et al. [68] analyzed upper arm postures and movements in female hairdressers by using inclinometers. They found that the exposure for the left and right hand was similar. On average hairdressers spent more than 30 minutes of the working day with arms elevated at $>60^\circ$ (right arm 6.8% and left arm 5.5%). Exposure to elevated arm postures was more strenuous during customer tasks (which accounted for 58% of the total working day). Similar results were found by Veiersted et al. [86].

In a pilot study from Portugal, 77% of the hairdressers reported that they performed their activities in a standing position, 17% in a sitting position with rotation of the spine and 7% in a sitting position with elevated arms above shoulder level. In regards to upper limb activities during work, 30% performed repetitive and dynamic movements and 60% elevated objects above shoulder level ($>60^\circ$) [97].

Figueiredo da Rocha and Simonelli [113] found that hair straightening with a round brush requires high mechanical overload of the cervical and spinal columns (e.g. straightening curly hair takes up to one hour). Moreover, the upper limbs are strained from repetitive movements in protracted extended positions. They concluded

that the daily workload of hairdressers is high and aggravated by the lack of regular breaks. Similar results were found in a Dutch study. More than six hours of repeatedly using the wrist and elbow as well as working in static positions caused the greatest strain on the musculoskeletal system. These movements are predominantly triggered by tasks such as blow drying and cutting, which comprised up to 82% of the working day [100]. The lack of sufficient uninterrupted breaks contributed to the strain experienced by hairdressers [100, 114].

The previous results are also supported by an objective job tasks analysis. During the working day, hairdressers often abducted their upper arms on both sides, which was combined with static holding phase (>4 seconds). Moreover, they often had to stretch their arms over the shoulder level and perform tasks with horizontal adduction of the arms. While washing at the sink, hairdressers often had to bend forward or twist their spines and work in prolonged static postures. During washing and cutting hair, forward flexion of the neck was frequently observed. This poor posture was often combined with hunched back. Those who used the rolling stool often exhibited a steeply inclined lumbar spine and had to raise their hands more often above shoulder level [66]. The same authors report that during cutting, dying and blow-drying, more than 25% of time was spent in flexion (angles $>20^\circ$ and $>60^\circ$) and abduction ($>-20^\circ$ and $>-60^\circ$) for both shoulders. Pronation (>20 and $>40^\circ$) of both elbows was observed during all tasks. Extension ($>-25^\circ$ and $>-50^\circ$) of the left hand was observed for cutting and washing hair. A high proportion of time with forward curvature of the spine was recorded during cutting (66%), washing (62%) and dying (36%). The greatest proportion of time in static awkward postures was observed on

the spine during cutting hair. All four hairdressing tasks led to highly repetitive actions of the upper extremities. The Kilbom [115] reference values for high repetition (high risk) in the shoulder (>2.5 rep/min), and for the elbow and hand (>10 rep/min) were both significantly exceeded, particularly when using the round brush to straighten hair (e.g. right hand 50 rep/min) [87].

A prospective study from Norway followed a young cohort of students from technical schools entering working life. After 2.5-years of follow-up, hairdresser students exhibited the greatest median pain in the neck-shoulder region, as compared to the other students. Also, hairdressers had the highest median sustained muscle activity of 52% of the total working day in contrast to other students ($< 33\%$). The relative time of sustained muscle activity showed a significant correlation with pain ($r=0.21$, $p < 0.001$) [88]. When compared to other female students, hairdressers spent longer working times with arms elevated at $>30^\circ$ (45% vs. 35%), $>60^\circ$ (11% vs. 1%) and $>90^\circ$ (2% vs. 0.4%). For every additional unit increase in arm elevation of more than 60° , an estimated 28% increase in shoulder pain was found among female students [90]. Moreover, the authors observed a significant increase in the prevalence of moderate/severe pain for female students over the course of 6.5 years (RR 1.5, 95% CI 1.24-1.81). Mechanical workload and perceived muscle tension were identified as risk factors for neck and shoulder pain in women [89]. According to a study by Mussi and Gouveia [104], uncomfortable neck and shoulder postures were likewise associated with MSD in hairdressers (OR 2.8, 95% CI 1.4-5.5).

Nordander et al. [105] explored the exposure-response relationship between work-related risk factors and MSD in elbows and

hands. The mean value for palmar wrist flexion, expressed as the 90th percentile, was greater for hairdressers than the overall mean for other occupations (21° vs. 10°). Moreover, hairdressers exhibited a slightly higher mean angular velocity ($20^\circ/s$ vs. $17^\circ/s$). With respect to static and peak load of muscular activity, expressed as the 10th or 90th percentile of maximal voluntary contraction (% MVC), hairdressers showed higher static (4.5% vs. 1.8%) and peak loads (35% vs. 26%) of the right hand muscles.

3.3.5. Preventive and rehabilitative approaches to prevent or reduce MSD

Seven studies addressed evaluation research. Three studies described preventive and three rehabilitative measures. One study evaluated a new Ergonomic Tool Design (ETD) scissors.

Preventive approach

Bertozzi et al. [82] assessed the effect of an exercise program targeted to the cervical and lumbar spine in combination with an ergonomic brochure. The control group received only the brochure. After six weeks of intervention, no significant differences were found in pain intensity or level of disability between the exercise and control groups.

Similarly, Veiersted et al. [86] examined the effect of a short-term intervention, including five recommendations on working techniques to reduce neck and shoulder workload, such as working with less elevated arms and relaxing the upper body and follow-up instructions. The control group received a brochure with corresponding illustrations. Time spent with highly elevated upper arm postures above 90° was reduced from 4% to 2.5%. No intervention effect was detected on muscular load, velocity of arm movements or neck and shoulder complaints.



In a further study by Crippa et al. [84], young trainees were provided with an education program on the prevention of risks related to skin, respiratory or upper limb disorders. At the beginning of the school training and two years later, their knowledge of risks, work-related symptoms and adopted preventive measures was assessed. Positive effects on their knowledge, preventive measures and work-related dermatitis were observed. However, the rates for lower back pain (9% to 36%) and shoulder or elbow pain (3% to 15%) increased significantly over the training years.

Rehabilitative approach

Three studies from Finland evaluated the effectiveness of occupationally oriented medical rehabilitation courses on changes in working techniques, subjective well-being, physical and muscular capacity, MSD, perceived work ability or redesign of workplaces/tools [80, 81, 85]. The courses were addressed to hairdressers and/or other occupations with a history of chronic neck-shoulder or back pain. In the studies from Arokoski et al. [80, 81], hairdressers reported significant reductions in subjective physical and mental strain, subjective neck-shoulder and back pain and visits to the doctor due to MSD after the rehabilitation. When asked for subjective reasons for the decrease in strain the following aspects were mentioned: use of new working techniques, frequent use of a chair, use of exercise breaks, increased physical fitness, and new ability to relax during work [80].

In a similar study by Nevala-Puranen et al. [85], hairdressers with a history of MSD underwent a rehabilitation course that addressed workplace redesign, theoretical knowledge, physical exercises, and discussion of interpersonal relations or stress. In addition, subject's habitual work techniques were videotaped in simulated work situations. The video data was utilized in

teaching ergonomics. For example, ergonomic techniques during hair cutting focused on using a chair, keeping arms near the body and cutting with the wrists in a neutral position, relaxing the shoulders and asking customers to turn or bend the head. The new work techniques led to decreased activity of the right trapezius muscles, from 6-12% to 3-8% MVC. Static, dynamic and peak muscle load decreased from 2% to 1%; 6% to 3% and 13% to 9% MVC, respectively. Correspondingly, the overall pain intensity decreased from 5.0 to 2.6 points on a visual analogue scale.

Ergonomic tool design approach (ETD)

Boyles et al. [83] investigated the use of ETD scissors with a bend in the handles of 90°. In contrast to standard scissors, the ETD scissors allow the hand/arm to remain in a neutral position and below the shoulder level when cutting hair from any angle. In comparison to standard scissors, perceived pain scores (1-7) were significantly less for hand/wrist (2.1 vs. 1.3) and back/shoulder (2.0 vs. 1.4). The time spent in neutral position of the wrist increased (27.7% vs. 72.6%) and working with hand above shoulder level decreased (53.2% vs. 17.2%). Although initial use of ETD scissors was very unaccustomed, participants felt comfortable after some time.

3.3.6. Strategies and barriers to reduce or prevent MSD

In a qualitative study with 14 Swedish female hairdressers, musculoskeletal stress was mentioned as one of several work-related symptoms. To provide some relief, minor individual changes in work-techniques and use of products or physical training were employed. However, the hairdressers often failed to take further steps due to lack of knowledge or due to the financial restriction and organizational situ-

ation of the salon. At the beginning of their career, hairdressers put more effort into training and application of acquired skills; preventive work techniques were of secondary importance. The practice of good work routines depended on factors such as colleagues, personal knowledge or existing symptoms. Hairdressers' awareness of the preventive work gained in importance when they started a business of their own [75]. In a study by Aweto et al. [95] more than half of the subjects reported the gradual onset of symptoms in the first five years of being a hairdresser. When asked which coping strategies they adopted to reduce MSD symptoms the hairdressers most often mentioned taking sufficient breaks (35.3%), not attending customers if this causes/worsens discomfort (18.5%), and modifying the working position (14.3%). The hairdressers also reported that the symptoms affected their daily activities, and thus their job efficiency. Some reported that the working activities aggravated an already existing injury (14.4%). According to Bradshaw et al. [96], more than half the hairdressers reported that they continued to work while suffering health problems, as they are not able to take time off from work (36%), had a manageable disease (30%) or because they are self-employed (21%).

3.4. Discussion

Specific ergonomic measures are needed to reduce the harm to the affected individual, as well as preventing absences from work or even premature retirement/leaving the sector due to MSD. The available publications only provide relatively sparse evidence for effective preventive or rehabilitative actions. Studies on measures to prevent MSD have demonstrated virtually no reduction in pain or stress [82, 84, 86]. Hairdressers who have suffered MSD of the back, neck or shoulder and who have already received rehabilitation

treatment apparently benefit from newly learned ergonomic working techniques and newly purchased equipment [80, 81, 85]. The components of the rehabilitation programs may provide helpful approaches for the prevention of MSD. However, they are more extensive, prolonged and expensive than the preventive measures described here. Several studies point out that MSD can even occur in the first years at work [84, 89, 95]. This underlines the necessity and importance of early preventive measures in hairdressing (e.g. in training facilities).

Potentially harmful task: styling and blow-drying hair

At this point we should consider two typical and common activities performed by hairdressers that are classified in the publications as being stressful. The first is styling and drying hair with a circular brush – for which very high values for repetition have been measured that exceed thresholds [87, 100]. Continuous grasping the brush and hairdryer, in combination with physical postures and movements that may be extreme and non-ergonomic (e.g. shoulder abduction >60°), require high peak loads and static stress on the muscles [68, 87, 112]. Mechanical stress, subjective muscular tension and working at shoulder height have been identified as risk factors for pain in the shoulders and neck in female apprentices in technical occupations [89, 90]. This observation has been confirmed by a recently published meta-analysis. The authors found moderate evidence for an association between physical stress and shoulder diseases for hand-arm elevation (OR 1.9, 95% CI 1.5-2.5), shoulder load (OR 2.0, 95% CI 1.9-2.1), as well as slight evidence for hand force exertion (OR 1.5, 95% CI 1.3-1.9) [116]. Older reviews also confirm these associations [117, 118]. The combination of repetition and low force exertion typically leads to a moderate increase in the risk of MSD. With high force exertion, the risk is greatly increased

[119]. These risk factors are also associated with the carpal tunnel syndrome [120] and other specific diseases of the elbow [121].

Potentially harmful task: cutting hair

Much of the working day is taken up with cutting hair and this activity is also associated with risk. During this procedure, the wrist is permanently held in a non-neutral position (flexion and extension) while the scissors and comb are grasped precisely [71]. It has been shown that a large proportion of the time is spent with the left hand extended [71, 87]. Studies including direct observations or technical measurements classify this activity as being associated with a high risk of MSD of the upper extremities [71, 100, 112]. Not only are the upper extremities stressed but also the upper and lower segments of the spinal column. One important malposition is the anterior curvature of the spinal column. Posterior extension of the cervical spine is also fairly common. In comparison to other activities, cutting hair involves relatively long periods (>4 sec.) with static curvature of the trunk and anterior or posterior inclination [87]. Incorrect usage of cutting stools enhances abnormal straightening of the lumbar spine and can lead to additional structural stress. In addition, hairdressers who work when seated lift their arms higher than when working in the standing position [66].

Potentially harmful aspect of work organization: lack of breaks

Another important factor is the possibility of taking a break between the stressful activities, as this can prevent or alleviate micro injuries [119]. However, the available studies show that the physical loads during normal hairdressing work exceed tolerance thresholds and that regular breaks are rarely respected [84, 95, 98, 100, 114]. The probability of tissue damage increases with the frequency and duration of biomechanical exposure [122].

3.5. Conclusions

This is the first scoping review, which provides an overview of the frequency of MSD, potential risk factors, preventive and rehabilitative measures and ergonomic findings in hairdressers. The most affected body sites are the back, neck, shoulder and wrist/hand. Physical strains are mainly caused by prolonged non-neutral postures, along with forward flexion and backward extension of the trunk and repetitive movements of the upper extremities. Activities such as styling or cutting hair may contribute to the risk of developing or deteriorating musculoskeletal health of hairdressers. Additional factors are lack of adequate breaks during work, working at high pace, general distress or prolonged standing periods. These results emphasize how urgent it is to investigate measures to reduce occupational stress for hairdressers. This occupational group could benefit from preventive structural, operational and educational measures. However, only a limited number of intervention studies with inconclusive results are available that could provide some options for reliable actions. Thus, further studies evaluating multilevel strategies for the prevention of MSD in hairdressers combining behavioral and organizational measures are needed.

Outcomes of the workshops in Hamburg and Paris – ergoHair project

To supplement the systematic literature review, the key outcomes of the workshops in Hamburg (12 to 13/10/2017) and Paris (11 to 12/04/2018) are summarized below. First, a number of national insights regarding MSD complaints and risk factors are presented. Then, the findings of ergonomic studies are provided.



MSD prevalence and risk factors

1. Franck Léhuédé, study and research manager at CREDOC,

Jacques Minjollet, AG2R La Mondiale, Deputy Director to the Director General, Director of Les Institutions de la Coiffure, France

Survey: In a survey in France (2016), students, employees and employers (n = 1,100) were asked about health complaints and general working conditions. Here are the key results:

Occupational resources

- The majority of respondents were positive about working with customers (>90%).
- They enjoy the creative and artistic aspects of hairdressing.
- The variety of tasks is seen as enriching.

Occupational disadvantages

- 66% criticized the low pay.
- 51% complained of MSD.
- 50% reported a lack of respect from customers.

Health complaints

- 23% were off sick long-term.
- 17% would like to leave the profession due to health complaints; MSD is a key reason.
- There is a great need among both employees and employers to tackle the MSD problem.

2. Prof. Eva Skillgate, associate professor in epidemiology at the Musculoskeletal and Sports Injury Epidemiology Center, Institute of Environmental Medicine, Karolinska Institute, Sweden

Survey: In Sweden (response rate 23.3%), hairdressers from two professional associations were asked about working conditions, lifestyle, stress at work, health complaints (in the previous three months) and resulting limitations¹². Here are the key results:

- The provision of ergonomic furniture was described as very good.
- The social working climate and satisfaction were good or high overall.
- The stress level was somewhat more pronounced than in other sectors.

Health complaints

- 39% were overweight/obese, 22% suffered from insomnia, 15% had a moderate or raised risk of depression.
- 55% had health problems, of which 42% resulted in limitations at work.
- 43% had back complaints, of which 25% resulted in limitations at work.
- 40% had neck complaints, of which 30% resulted in limitations at work.
- 46% had arm/shoulder problems, of which 31% resulted in limitations at work.
- 18% suffered from MSD in all three regions.
- The probability of symptoms rose with considerable stress at work, co-morbidity, excess weight/obesity, and a poor social climate.

¹² It is possible that the "healthy worker effect" influenced the results of this study as complaints were primarily reported by young hairdressers. Older workers with health problems have probably already left the hairdressing industry.

3. Dr. Sonja Freitag, German Social Accident Insurance for the Health and Welfare Services (BGW), Department for Occupational Medicine, Hazardous Substances and Public Health

Survey: In Germany (response rate 41.2%), 550 hair salons were asked about MSD (in the previous 12 months). Here are the key results:

- 70% had neck complaints with 14% of these weight bearing every day.
- 65% had back complaints with 13% of these weight bearing every day.
- 61% had shoulder complaints with 13% of these weight bearing every day.
- 58% had upper back complaints with 12% of these weight bearing every day.
- 32% had wrist complaints with 4% of these weight bearing every day.
- Less prevalent body regions were the feet (29%), knees (27%), hips (20%), thumbs (20%), fingers (18%) and elbows (13%).
- 13% had reduced their working hours due to MSD.
- The probability of symptoms increased with age, greater professional experience, the number of working hours per week, female gender and a reduction in work due to MSD.

4. Mathieu Verbrugghe, researcher at Mensura, Belgium

Routine data analysis: Mensura, an external occupational health service provider in Belgium, supports small businesses and sole traders (>50,000 customers), including 3,029 hairdressers. The data shown relates to the period from 2010 to 2016 and was collected in connection with regular occupational health examinations:

- The regions most frequently affected¹³ were the shoulders (14%), neck (16%) and lower back (16%). During the period under review, shoulder complaints rose overall, while reports of upper and lower back pain decreased.
- Only 0.25% of the hairdressers with symptoms were deemed unfit for work, most of them only temporarily.

¹³ It is highly probable that the actual prevalence is higher; many hairdressers avoid reporting their symptoms at medical check-ups.

Ergonomic studies

1. **Jane Frølund Thomsen**, Ph. D., head of Department of Occupational and Environmental Medicine, Bispebjerg University Hospital in Copenhagen, Denmark

Ergonomic measurement study: In Denmark, an ergonomic measurement study was conducted which looked into 31 different occupations. A total of 10 people per occupation were assessed objectively for repetition and hand positions while they worked.

Repetitive work by hand: hairdressers exhibit high exposure to repetition (hairdressers ranked 7th out of 30 occupations studied).

Hand position: hairdressers have the highest exposure to non-neutral hand positions (hairdressers ranked 1st out of 28 occupations studied).

Carpal tunnel syndrome (CTS): the group with the highest biomechanical exposure (including hairdressers) was at twice as much risk of CTS as the group with the lowest exposure.

2. **Jacques Minjollet**, AG2R La Mondiale, director of Les Institutions de la Coiffure, France,

Phillipe Bielec, consulting engineer at French Social Insurance Funds, France,

Dr. Pascale Gillet, chairman of Medialane (telehealth platform), France

Evaluation – prevention programme: As part of a prevention programme – RSI Prévention Pro Programme – social insurance agencies invested € 10 million in ergonomic equipment (e.g. electrically adjustable sinks, styling chairs, hairdryers, scissors) for sole traders. The equipment was selected in advance on the basis of set criteria and standards. It was then available to purchase at subsidized prices.

- **Electrically adjustable sinks (TMS Preciseo device)¹⁴:** Salons which purchased ergonomic basins were asked about symptoms prior to installation and six months afterwards. Symptoms in the neck, shoulders, arms and upper body were significantly (-23%) reduced. Symptoms in the lower back and the hand/wrist, elbow and fingers dropped by 17% and 9% respectively.
- **Hydraulic styling chairs¹⁵:** Adjusting hydraulic chairs to the right height has clearly demonstrable effects. If the chair's height is not adjusted to the customer and the hairdresser, the hairdresser has to assume a larger number of postures requiring them to work above shoulder level (abduction >60°).
- **Ergonomic scissors¹⁶:** No significant reduction in non-neutral angle ranges at the shoulder, wrist and elbow could be detected. Possible limitations arose from the type of steel, the length of the blade or insufficient training in correct use.
- **Hairdryers:** It is difficult to measure the noise level because there is a great deal of ambient noise in the salon. This normally stands at between 75 and 78 dB per work shift.

3. **Dr. med. Morten Wærsted**, Department of Work Psychology and Physiology, National Institute of Occupational Health, Oslo, Norway

Ergonomic measurement study – Dual Air hairdryer [www.dualair.no]: In a pilot study, a new ergonomic Dual Air hairdryer was compared with a traditional model (Parlux 1300) with respect to joint positions and shoulder muscle activity. What makes this model special is that the air flows between two outlets and both handles can be held loosely.

- The number of postures requiring hairdressers to work above shoulder level (abduction >60°) was reduced.
- There was a decline in trapezius muscle activity in the laboratory but not at the salon.
- Pain in the neck and shoulder area was not affected.
- 68% of the study participants preferred the traditional hairdryer (possible reason: the hairdryers probably received too little information about making optimum use of the new model).



¹⁴ Dr. Pascal Gillet (2016). Medialane – a telehealth platform, France

¹⁵ Prof. Francesco Marcolin. Static and dynamic evaluation of the biomechanical overload joined to different height adjustments of the armchair seat "Lioness 3365". Università di Udine, Italy

¹⁶ Mourad Benoussaad & Jean-Yves Fourquet (2015). Rapport d'Analyse Posturale Lors d'Utilisation de Ciseaux de Coiffure. University of Tarbes, France

Ergonomic and organizational approaches to prevention

Ergonomics is the practice of designing workplaces with users in mind. It aims to reduce physical strain, prevent risks and eliminate disorders arising from the overloading or incorrect loading of the musculoskeletal system. The objective of long-term preventive measures encompassing the working world, ergonomic/physiological considerations and organizational factors should be to protect people whose occupations put them at particular risk and to keep healthy people healthy. Ultimately, healthy working conditions do not just lead to a reduction in absences, work accidents and occupational diseases. They also enhance a company's attractiveness, the sense of belonging within its workforce, its economic performance and therefore its competitiveness.

As there are so many work-related risk factors for MSD, prevention and health promotion strategies should take a multi-layered approach. In the interests of individual behavioural prevention, efforts should be made to improve health awareness and encourage behavioural changes. These measures should be complemented by organizational and technological approaches to behavioural prevention [12].

The following section attempts to derive ergonomic and organizational prevention solutions from the ergoHair workshops in Hamburg and Paris. Various suggestions and proposals were put forward by employees and employers, accident insurance companies, salon outfitters and specialists in occupational medicine. They are listed below. This list is currently incomplete. Closer examination and research is needed regarding the ergonomic design of hairdressing fixtures and tools in particular to create a basis which can be utilized throughout Europe.



5.1. Outcomes of the ergoHair project workshops

The following approaches to making working as a hairdresser healthy, relaxed and safe are presented in summary form below.

- Prevention in training and continuing professional development
- Ergonomic equipment
- Ergonomic working
- General health-promoting conditions in the workplace
- Risk assessment methods

5.1.1. Prevention in training and continuing professional development

In the course of the workshops, the participants repeatedly emphasized the need to embed the prevention of health problems in training courses to sensitize trainee hairdressers to an ergonomic way of working as early as possible¹⁷. It is increasingly being observed that young people are motivated to try out the latest techniques and technologies which enhance their professional skills and incorporate tips on preventing MSD (Raphaël Perrier; Martin Cremer).

Furthermore, it is imperative that all persons within the hairdressing sector implement an ergonomic work environment and practise an ergonomic way of working. It is important that work is designed in a way that preserves health so that salons remain competitive and deliver consistently good quality. With this in mind, hairdressers should be able to complete advanced training and continuing professional development in this field on a regular basis (principle of lifelong learning). Theoretical content should be presented specifically and practically in an authentic, real-world environment to ensure that stylists put what they have learned into practice frequently and happily. This could be done, for example, via visual instructions, e.g. on

platforms for video clips, apps, social media, smartphones, etc.

A healthy lifestyle – a balanced diet, physical activity, sufficient sleep, relaxation, and conscious attitude towards alcohol and tobacco – also helps to preserve hairdressers' health and contributes towards well-being.

Training covering the science of ergonomics/prevention and associated behaviours should ideally take a participatory, resource-focused approach which incorporates hairdressers' day-to-day work. "Resource-focused" means concentrating on individual resources, preserving health, remaining fit for work and on the individual design of healthy working conditions and a healthy work environment instead of emphasizing strain, health problems or a list of don'ts. A vivid demonstration by an employer, instructor, insurer or health-oriented organization can motivate people to put what they have learned into practice in their day-to-day work. This succeeds by conveying new work-relevant content which can be tested and practised at training events (e.g. teaching trendy new styles and techniques). The approach taken by BGW studio78 (Germany) can be summed up as follows: *"The best movement is the next movement"; "Doing it allows you to experience it. If it feels good, you'll want to do it again. Doing the same thing over and over leads to healthy new routines"* (Sabine Schöning; Björn Teigelake). To change behaviour long-term, people have to believe that the new methods and behaviours really do feel better and will improve their lifestyle.

5.1.2. Ergonomic design and equipment

What aspects should be considered when designing a salon to enable an ergonomic/physiological way of working?

■ Interior design

The salon's equipment must fulfil ergonomic requirements and be adjustable to suit hairdressers and customers of different sizes. Furthermore, all the relevant persons (e.g. occupational health professionals, customers, instructors) should be informed about ergonomics and safety in the workplace. This promotes the consistent implementation of ergonomic measures and makes for satisfaction and confidence among all those involved. When designing a salon, ergonomics should be just as important as the aesthetics of the furniture and tools.

Efficient interior design – The space should be designed to provide sufficient freedom of movement while also enabling short, efficient routes between workstations, e.g. by choosing furniture and equipment to suit the size of the room and providing enough work and storage space at a back-friendly height.

Barrier-free access – Attention should also be paid to ensuring that disabled people, older customers or parents with pushchairs have barrier-free access to the salon.

Room temperature – The room temperature should also be well regulated to keep both stylists and customers comfortable, e.g. by avoiding overheating, insufficient cooling and draughts.

■ Lighting

Optimum lighting should avoid casting shadows, flickering and dazzling. The bright-

ness at the workstations must meet national standards. Lighting should be adjusted to the job being performed and must have an intensity of at least 400 lux (framework agreement, clause 7 [3]). If there are steps in a salon, they should be well lit.

■ Flooring

The flooring in a hair salon should be flexible, non-slip, noise-reducing, hard-wearing, shock-absorbent and easy to clean. Slip hazards are caused by hair clippings, splashes of dye and haircare products, moisture or dirt trodden in from outside. Trip hazards are caused by objects, power or connection cables, uneven floors or height differences. All of these potential risks should be avoided by means of thorough cleaning, prompt removal and optimum interior design.

■ Break room

A break room which staff can withdraw to in order to relax, switch off and eat is another important element of the interior design. If possible, it should be shielded from customer view and easily accessible. Smoking should not be permitted there. A break room should also have the following features if possible:

- Sufficient (comfortable) seating as hairdressers spend most of their working time standing
- A table and cupboards where personal possessions or food can be stored
- Equipment for preparing hot food
- A first-aid kit
- Skin protection and care products
- Posters/signs with stretching and strengthening exercises that can be done during the day

■ Colouring station/laboratory

If possible, products that are used every day should be stored in an orderly fashion and be easily accessible (e.g. on shelves instead of behind cupboard doors). Chemi-

¹⁷ An example from the Netherlands shows that ergonomics is not an attractive subject for hairdressers. The topic is even less relevant for colleges than for employers. 75% of colleges did not follow the guidelines because the teachers did not always set a good example and because the colleges were not well equipped (Martijn de Kort).

cal substances are used in hair salons to make hair colourants and cleaning products, so there should be a good ventilation system.

■ Styling chair

Ideally, an ergonomic salon should have styling chairs and rolling stools which are easily height-adjustable and work well together. Functionality and well-being are the most important criteria. It is important to take the different needs of customers and stylists into account, such as size, the customer's weight, seat comfort and ease of use. At present, there are no standards for an optimum ergonomic styling chair.

The standards for office chairs (EN 1335) can be used as a guide to ensure stability, strength, safety and durability. The following features are advantageous:

- **Adjustable height:** The styling chair can easily be adjusted to the size of the employee/customer or to suit the task in hand. The height¹⁸ can be adjusted hydraulically or electrically. Chairs with electric height adjustment are easier to use.
- **Stability:** The styling chair should be stable and non-tilting. It should be possible to fit it with five feet stoppers, braked castors or a large round base, for instance, as needed.
- **Seat comfort and ease of use:** The ergonomic seat shape must not impair the circulation. Furthermore, head, foot, back and armrests should ensure comfortable, relaxed sitting. Operating the adjustment mechanism should not require much strength. A styling chair should not have a protruding design so that it is easily accessible from each side.
- **Cleaning:** The castors should be stable and easy to clean so that trapped hair can be removed. It must also be possible to replace them as needed.

■ Rolling stools

Height-adjustable rolling or swivelling stools with and without backrests make work easier by relieving pressure on the spine, hips and legs. The criteria for stools are similar to those for styling chairs. The following features are advantageous:

- Adjustable height¹⁹ as they are adjusted before each use
- Stable and non-tilting
- Smooth-running, removable castors
- Comfortable seat (e.g. saddle seat or normal seat)
- Easy to clean, incl. the castors

■ Sinks

A distinction is made between tilting backwash basins and portable shampoo bowls. They are made from a range of materials, such as porcelain, ceramic or plastic. Ergonomically ideal sinks should be adjustable both horizontally and vertically and offer the best possible working radius. The following features are advantageous:

- **Size:** The sink should be deep and wide enough to accommodate hair of all lengths²⁰.
- **Standing comfort:** The design of the basin should allow plenty of space for legs and feet²¹. This supports an upright, relaxed posture.
- **Adjustability:** The sink should be height-adjustable so that hairdressers can adopt a relaxed posture when washing hair. It should be possible to raise an optimum shampoo sink to the height of the costal arch²².
- **Seat comfort:** The basin should tilt to conform to the customer's neck as well as possible²³.
- **Stability:** Basins or backwash units should be stable and non-tilting and made from high-quality material if possible²⁴.

■ Salon trolleys

A salon trolley should have enough storage space to keep tools that are in daily use readily accessible. The following features are advantageous:

- Pull-out drawers and lots of storage options, e.g. for hand-care products
- Smooth-running, stable and quiet castors
- Solid frame for stability
- Easy to clean and maintain

■ Hairdryers

Hairdressers make frequent, intensive use of hairdryers every day, so they should feature an optimum ergonomic design to prevent symptoms of fatigue in the arms. As well as having an ergonomic shape, a hairdryer should be effortless to use, powerful and quiet. The following features are advantageous:

- **Shape:** An ergonomic handle which does not have a smooth surface makes the hairdryer easier to use. A soft-touch coating ensures good grip.
- **Weight:** A hairdryer should weigh no more than 600 g.
- **Cord length:** The cord should be 3 m long for optimum freedom of movement.
- **Power:** A powerful hairdryer should have a power rating of at least 2,000 watts.
- **Volume:** A quiet hairdryer is always preferable; the ideal is 69 dB with a power rating of 2,000 watts.
- **Air speed:** The air speed should be at least 100 km/h on the head.
- **Motor:** An AC motor is preferable as it is powerful and can operate on the highest setting for a longer period of time. This substantially shortens styling time²⁵.

5.1.3. Ergonomic working

What should be taken into account to ensure that employees can move in an ergonomically optimum, relaxed way when completing their various tasks?

Working in a relaxed, physically balanced fashion is not just beneficial for individuals: it also has a positive effect on the whole team. Customers notice that and happily return to the salon more frequently.

Regularity and feedback

Regular dialogue about the need for ergonomic working and its advantages improves perception of the problem. Hairdressers who talk to one another about their symptoms and problems at regular meetings can coach each other in their day-to-day work. Positive working methods and techniques are anticipated and supported; physically demanding postures are identified and improved faster (Martin Cremer). One of the advantages of hairdressing is that stylists can use the mirror to analyse their own posture and correct it if necessary.

Training when new equipment is introduced

Ergonomic measurement studies examining new equipment have shown that comprehensive, individually tailored training is necessary for optimum use in order to boost acceptance and avoid further unnecessary strain.

Adjusting work materials

Studies have shown that the number of awkward postures can be reduced significantly by adjusting the styling chair and/or stool to the customer's height. It is important that the back is straight and the shoulders remain low. If the styling chair is too high or the stool is too low, the hairdresser very often has to raise their upper arms/shoulders laterally. In addition to this, the

²⁵ All of the details provided are based on the criteria presented by Olymp GmbH & Co KG.

¹⁸ Seat height: the lowest seat height (without footrest) should be a maximum of 490 mm. The seat height of hydraulic chairs should be adjustable to at least 170 mm. National differences in the height of men and women should be taken into account. For example, the seat height for Norwegian men is 190 mm while that for Italian women is 164 mm (Christian Frank, Olymp GmbH & Co KG).

¹⁹ Seat height: the lowest seat height should be a maximum of 500 mm. The seat height of hydraulic stools should be adjustable to at least 200 mm (Christian Frank, Olymp GmbH & Co KG).

²⁰ The distance between the back edge of the basin and the neck rest should be no more than 500 mm.

²¹ To allow sufficient room for feet, the distance to the rear edge of the basin should be at least 200 mm.

²² The upper sink edge should be at a height of at least 900 mm.

²³ When washing seated, the base should be no wider than 300 mm.

²⁴ All of the details provided are based on the criteria presented by Olymp GmbH & Co KG.

spine is misaligned, e.g. from bending forwards with the upper body (hunched back) or overly arching the back.

5.1.4. General organizational conditions in the workplace

How can employees' satisfaction and health be promoted and maintained long-term via salon organization?

Hairdressers work in a service industry with frequent and sometimes intense customer contact. This means they are often exposed to time and performance pressures or demanding clients. A strong focus on clients and customer satisfaction plays a key role, which means that great demands are placed on hairdressers. As well as being skilled, they are expected to be empathic and caring. Several studies show that hairdressers often report symptoms of exhaustion and/or stress. The situation is exacerbated by insufficient workplace and job descriptions, little or next to no ability to influence work organization, and a lack of resources and specialist knowledge, which can have a negative effect on psychological well-being.

A persistently high level of stress at work can adversely affect employees both psychologically and physically. However, there are various means of reducing or preventing work-related stress. A number of approaches are presented in summary form below.

Communication

The importance of the employer's role in preventing work-related health risks should be emphasized because they largely determine how the work environment is designed and the salon is organized (e.g. via rules on breaks and working hours). They can have a lasting impact on prevention

policy in the workplace by means of support and communication.

Trusting communication between the employee and employer can promote a health-preserving way of working among staff (e.g. ergonomic postures and movement sequences). Ergonomics could be included on the agenda of regular staff meetings. This would mean that any measures could always be discussed quickly (e.g. the use of special insoles or floor mats to relieve the legs and spine). It could also motivate staff to try out new resources and to report on whether they make work easier (Martin Cremer).

Participation and commitment

A cooperative team paves the way for good work. Both the employer and the employees are responsible for creating a good team atmosphere (Martin Cremer). This is achieved with the help of mutual respect, support, constructive feedback, participation in important decision-making processes or joint activities.

Breaks

Only being able to take short breaks – or none at all – was discussed intensely at the workshop. Numerous studies show that the physical strain of normal hairdressing tasks exceeds tolerance limits and that regular breaks are rarely taken. These are crucial, however, e.g. to prevent skin damage by applying cream and resting the hands, reducing stress by relaxing, or improving physical well-being with short exercises. Taking proper breaks is an underestimated health factor because those who take several short breaks each day are less exhausted in the evenings.

- Break rooms promote a good break culture (quiet and easily accessible).
- Breaks should really be used as breaks, not as time to do other tasks.
- Managers can set a good example: they

should take breaks themselves and give them to staff as well.

- Breaks should serve as an opportunity to relax, not to shorten the working day (avoid breaks at the beginning or end of the day).

Work organization

When planning a hair salon concept, work organization aspects should be considered as well as interior design and equipment. These include:

- Number of customer chairs and sinks
- Hairdressers' specialisms
- Opening hours
- Scheduling appointments
- Customer care
- Storage of materials and equipment

Example: *“When people open a new salon, they often tend to install a lot of chairs. However, in practice, it is rarely possible to serve such a large number of people at one time”* (Raphaël Villechenaud).

5.1.5. Risk assessment

Which risk assessment methods can be used at a hair salon to identify and prevent hazardous working conditions in a targeted fashion?

An in-depth risk assessment can be conducted to gain a good overview of the risks at certain workplaces and to take targeted action against them. Possible psychological, psychosocial and environmental risks for MSD in hairdressers are listed by way of example in table 2. Recent studies show that risk assessments are barely or never completed by small businesses and self-employed in particular for a variety of reasons. A major reason for this is insufficient knowledge of the demands of work. EU-OSHA endeavours to enhance awareness and understanding of issues relating to

occupational health and safety and the associated tools for small businesses and self-employed.

OiRA tool for the hairdressing industry

Developed in conjunction with Coiffure EU and UNI Europa, the **Online interactive Risk Assessment Tool (OiRA)**²⁶ offers practical instructions and aids for risk assessments in the hairdressing sector. The OiRA tool comprises a risk analysis of all relevant aspects of hairdressing where health risks can arise.

Support from EU-OSHA

EU-OSHA also strives to reach out to small businesses and self-employed via additional advertising material and encourage them to use the OiRA tool, e.g. by using infographics, instruction videos, fact sheets, pamphlets, brochures, online banners, posters and social media support²⁷. Further resources which are relevant to the hairdressing sector can be accessed on the EU-OSHA website:

- Report on health risk in hairdressing “Occupational health and safety in the hairdressing sector”²⁸
- E-fact 34 – Risk assessment for hairdressers²⁹
- OiRA – case study: “At the cutting edge of risk assessment”³⁰

²⁶ <https://oiraproject.eu/en/sector/hairdressing>

²⁷ <https://oiraproject.eu/de/promotional-resources>

²⁸ https://osha.europa.eu/sites/default/files/publications/documents/en/publications/literature_reviews/occupational-health-and-safety-in-the-hairdressing-sector/Hairdressing%20sector.pdf

²⁹ <https://osha.europa.eu/en/tools-and-publications/publications/e-facts/efact34/view>

³⁰ https://osha.europa.eu/sites/default/files/publications/documents/en/publications/promotional_material/oiraproject-case-study-at-the-cutting-edge-of-risk-assessment/OiRA_case-studies_en.pdf

Table 2: Physical, psychomental and environmental risk factors in the hairdressing sector

Physical, psychomental and environmental risk factors in the hairdressing sector	
Physical	Psychomental
<ul style="list-style-type: none"> • Repetitive arm movements • High levels of exertion in the hands • Working above shoulder height • Static postures • Frequent twisting of the trunk • Frequent bending of the trunk • Long periods of standing • Combined movements (exertion and repetition) • Flexing and extending the wrist 	<ul style="list-style-type: none"> • Time and performance pressures • High customer frequency • Few or next to no breaks • Overtime • Monotony – constantly recurring tasks • Sustained attention • Multitasking • Interpersonal conflicts • Client-specific emotional labour (e.g. suppressing own feelings when dealing with demanding customers) • Unforeseeable events (e.g. salon does not offer appointments) • Work-life/work-privacy conflict
Work environment	
<ul style="list-style-type: none"> • Uncomfortable room temperature • Bad lighting • Noise • Slip, trip and fall hazards • Non-ergonomic furniture and equipment 	

5.2. Musculoskeletal complaints during pregnancy

As described in Chapter 1, the majority of workers in the hairdressing sector are young women. It can be assumed that many of them will become pregnant. Physiological and anatomical changes caused by pregnancy can put strain on the musculoskeletal system. Almost all women experience musculoskeletal complaints during pregnancy. Approximately 25% of pregnant women suffer from severe lumbar back pain, which is temporarily accompanied by significant impairments of daily life [123]. Possible causes for back pain are enlarged uterus, weight gain, lumbar hyperlordosis, vascular compression or the laxity of the ligaments [123, 124]. Hand pain is the second most common musculoskeletal complaint in pregnancy, often caused by CTS. CTS is predominantly diagnosed in the third trimester of pregnancy. The hormone prolactin and associated fluid retention in conjunction with prolonged, unfavourable wrist positioning can cause CTS. The symptoms of CTS often disappear within a few days to weeks after delivery. However, CTS can also occur during breastfeeding [125].

Continued standing, working in a forced or inclined posture are then associated with difficulties. An ergonomic workplace design, the possibility of sitting down, regular breaks and compensatory exercises are particularly important for pregnant women. The same applies to nursing hairdressers. In the phase after pregnancy, the musculoskeletal system is still vulnerable and breastfeeding requires additional energy. A good work organisation with the possibility of breaks and retreat is particularly important in this phase.

An assessment of the working conditions for expectant or breastfeeding mothers regarding the type, extent and duration of possible risks is particularly important. The pregnant woman or nursing mother should be involved in the risk assessment process. In the event of any health hazards, suitable protective measures should be taken immediately.



Annex

Annex 1 Summary of study characteristics (N = 44)

Annex 2 Extracted and pooled MSD prevalence of the spine segments

Annex 3 Extracted and pooled MSD prevalence of the upper and lower extremities

Annex 4 Possible risk factors for WRMSD or WRULD in hairdressing sector

Annex 1: Summary of study characteristics (N = 44)

#	Author (year)	Study place	Design; Publication type	Population	N hairdressers (females)	Methodology	Measurements (outcome or/and exposure)
1	Adewumi-Gunn et al. (2016) [93]	USA	cross-sectional; peer review	black hair care workers	22 (18 females)	questionnaire-based study with face to face interviews	(1) MSD (point prevalence) in different body sites
2	Amodeo et al. (2004) [94]	France	cross-sectional; non-peer review	hairdressers	389 (not specified)	questionnaire-based study during annual visits to the occupational health service	(1) MSD (12-month prevalence); (2) MSD severity (impeded work) in different body sites
3	Arokoski et al. (1998) [80]	Finland	evaluation (pre-post); peer review	hairdressers with chronic MS pain	21 (all females)	evaluation of rehabilitation course (1.5-years follow-up)	(1) neck and back pain; (2) work-related strains; (3) changes in work techniques
4	Arokoski et al. (2002) [81]	Finland	evaluation (pre-post); peer review	hairdressers, loggers, police, farmers with MSD	61 (all females)	evaluation of VOMR® rehabilitation course (1.5-years follow-up) – group comparisons	(1) neck and back pain; (2) physical and mental strain; (3) use of health-care services; (4) work absenteeism; (5) physical activity/performance
5	Aweto et al. (2015) [95]	Nigeria	cross-sectional; peer review	hairdressers	299 (242 females)	questionnaire-based study during annually visits to the occupational health service	(1) MSD in different body sites using NQ (12-month prevalence)
6	Bertozzi et al. (2011) [82]	Italy	evaluation (pre-post); peer review	hairdressers	28 (all female)	evaluation of a 6-week exercise program for the lumbar and cervical spine in addition to an ergonomic brochure	(1) neck pain and LBP by using VAS; (2) perceived level of disability as a result of MSD using the RMDQ and ODI Index;
7	Boyles et al. (2003) [83]	USA	evaluation (pre-post); peer review	hairdressers	44 (41 female)	evaluation of new ETD scissors (bend in the handles of 90°) in comparison to standard scissors	(1) grip strength; (2) perceived pain; (3) frequency of wrist in bent or neutral position or above shoulder; (4) usability
8	Bradshaw et al. (2011) [96]	England	case-control; peer review	hairdressers	147 (all female)	questionnaire-based study – group comparisons	(1) MSD in different body sites using the NQ (3-month prevalence)
9	Chen et al. (2010) [71]	Taiwan	measurement study; peer review	hairdressers/barbers	21 (10 females)	measurement study of upper extremities – group comparisons	(1) wrist angles; (2) forearm extensor and flexor; (3) velocity and repetitiveness
10	Crippa et al. (2007) [84]	Italy	evaluation (pre-post); peer review	hairdressing trainees	154 (144 female)	questionnaire-based study at the start and at the end of the school training (3 years later)	(1) health complaints; (2) preventive measures; (3) change in work activities; (4) knowledge of occupational risks
11	Cruz & Dias-Teixeira (2015) [97]	Portugal	cross-sectional; unknown	hairdressers	30 (not specified)	questionnaire-based study	(1) MSD in different body sites (point prevalence); (2) MSD duration, intensity, onset; (3) subjectively assumed risk factors
12	De Smet et al. (2009) [98]	Belgium	cross-sectional; peer review	hairdressers	145 (119 females)	questionnaire-based study	(1) WRULD intensity (pain during the activity >1 day or chronic pain); (2) gripping force

13	Demiryurek & Gündođdu, 2017 [111]	Turkey	case-control; peer review	hairdressers	70 (all females)	measurement and questionnaire-based study of hairdressers and matched controls – group comparisons	CTS measurements: (1) Electroneuromyography (ENMG); (2) Boston CTS Questionnaire; (3) VAS
14	Deschamps et al. (2014) [99]	France	cross-sectional; peer review	self-employed (SE) vs. wage earning (WE) hairdressers	311 (275 females; SE=199; WE=112)	questionnaire-based study during occupational health examination – group comparisons	(1) MSD related to repetitive movements (point prevalence); (2) work-related stress
15	Diab et al. (2014) [75]	Sweden	cross-sectional (qualitative); peer review	hairdressers	14 (all females)	qualitative study with face to face open ended interviews	(1) physical, (2) social, (3) psychological work environment
16	Douwes et al. (2001) [100]	Netherlands	cross-sectional; non-peer review	hairdressers; screen workers	280 (267 females)	questionnaire-based study – group comparisons	(1) Repetitive Strain Injury (RSI); (2) work-related risk factors; (3) tasks and aids available
17	Figueiredo da Rocha et al. (2012) [113]	Brazil	cross-sectional; peer review	hairdressers/ beauticians	50 (tasks analysis n=4)	ergonomic job analysis of ergonomic risks of the working situation	(1) postures and movements during work; (2) other occupational exposures
18	Foss-Skiftesvik et al. 2017 [110]	Denmark	cohort; peer-review	hairdressing apprentices	248 (239 females)	questionnaire-based longitudinal-study (3-years follow-up) – group comparisons	(1) discontinuation of hairdressing; (2) health symptoms (e.g. NOSQ) and occupational exposures
19	Guo et al. (1995) [76]	USA	cross-sectional; peer review	multiple jobs (hairdressers/ cosmetologist)	not specified N total 5,256	data analysis of occupation-specific data from National Health Interview Survey (NHIS), based on Bureau of the Census occupational codes – group comparisons	(1) LBP lasting over a week or more (population-based 12-month prevalence ratios)
20	Hanvold et al. (2013) [88]	Norway	cohort; peer review	hairdressers; electricians; media/ design trainees	15 (all females)	measurement- and questionnaire-based longitudinal study (2.5-years follow-up) – group comparisons	(1) shoulder pain during the preceding 4 weeks; (2) upper-trapezius muscle activity by using EMGmax
21	Hanvold et al. (2014) [89]	Norway	cohort; peer review	hairdressers; electricians; media/ design trainees	167 (163 females)	measurement- and questionnaire-based longitudinal study (6.5-years follow-up) – group comparisons	(1) neck and shoulder pain during the < 4 weeks
22	Hanvold et al. (2015) [90]	Norway	cohort; peer review	hairdressers electricians; media/ design trainees	15 (all females)	measurement- and questionnaire-based longitudinal-study (2.5-years follow-up) – group comparisons	(1) shoulder pain during the <4 weeks; (2) work with elevated arms by using inclinometers
23	Hassan & Bayomy (2015) [101]	Egypt	case-control; peer review	hairdressers; office workers	80 (all females)	questionnaire-based study of hairdressers and matched controls – group comparisons	(1) WRMSD in different body sites using the NQ (12-month prevalence); (2) chronic pain (≥3 months); (3) doctor visits or sickness absence due to WRMSD
24	Kaushik & Patra (2014) [91]	India	cross-sectional; unknown	hairdressers	59 (all males)	questionnaire-based study	1) MSD using the NPDI and DASH index; (2) measurement of pinch strength
25	Kitzig et al. (2015) [66]	Germany	cross-sectional; peer review	hairdressers	5 (all females)	(1) analysis of routine data from health insurance companies; (2) analysis of data from accident insurance; (3) observational study of video recordings of five hairdressers	(1) sick leave; (2) occupational diseases; (3) ergonomic postures during frequent tasks
26	Kitzig et al. (2017) [87]	Germany	measurement study; peer review	hairdresser	1 female	measurement study of postures and movements during work by using the CUELA system	(1) body postures and movements
27	Leino et al. (1999) [72]	Finland	cross-sectional; peer review	hairdressers	85 (not specified)	questionnaire-based study and assessment of physical and chemical work environment	(1) work factors most hazardous to health or caused a disease; (2) MSD diagnosis by physician
28	Leino et al. (1999) [109]	Finland	case-control; peer review	hairdressers; commercial work	3484 (all females)	questionnaire-based study on hairdressers and controls – group comparisons	(1) reasons for leaving the hairdressing trade within 15 years of follow-up (1980-1995)

29	Lysdal et al. 2011 [6]	Denmark	cross-sectional; peer-review	hairdressing graduates	5239 (5015 females)	Register-based questionnaire study of graduates from 1985-2007	(1) reasons for leaving the hairdressing trade; (2) health symptoms (e.g. NOSQ) and occupational exposures
30	Mahdavi et al. (2013) [102]	Iran	cross-sectional; peer review	hairdressers	172 (all females)	questionnaire-based study and task analysis	(1) MSD using the NQ (no time frame); (2) ergonomic analysis using REBA
31	Mandira-cioglu et al. (2009) [103]	Turkey	cross-sectional; unknown	hairdressers, barbers	1284 (not specified)	questionnaire-based study after training in occupational health	(1) MS discomfort (12-month prevalence)
32	Mastro-minico et al. (2007) [112]	Italy	cross-sectional; unknown	hairdressers	12 (7 females)	observational study of hairdressing tasks by using the OCRA check list	(1) OCRA index (score >4.6 risk for ULD)
33	Mussi & Gouveia (2008) [104]	Brazil	cross-sectional; peer review	hairdressers	220 (not specified)	questionnaire-based study	(1) MSD using the NQ (lasted > 6 months with a frequency of at least once a month)
34	Nanyan & Charada, (2018) [79]	France	register data analysis; peer-review	hairdressers	>90% females	register-based data of compensation claims for WRMSDs from the French National Health Insurance Fund	(1) number of claims (WRMSD) (2) permanent disability (2) lost work days
35	Nevala-Puranen et al. (1998) [85]	Finland	evaluation (pre-post); peer review	hairdressers with history of MSD	10 (all females)	evaluation of rehabilitation course of hairdressers on sick leave due to MSD for max. 60 days (1.5-years follow-up)	(1) muscle activity (%MVC); (2) physical capacity (VO2max); (3) muscle strength/endurance; (4) MS pain intensity; (5) perceived work ability; (6) workspace redesign
36	Nordander et al. (2013) [105]	Sweden	cross-sectional; peer review	multiple jobs (hairdressers)	78 (all females)	questionnaire- and measurement-based study of 27 occupations – group comparisons	(1) MSD using the NQ (12-month and 7-day prevalence); (2) wrist postures and velocity; (3) muscular load; (4) psychosocial exposure
37	Omokhodion et al. (2009) [107]	Nigeria	cross-sectional; peer review	hairdressers (i.a. trainees)	355 (all females)	questionnaire-based study with face to face interviews	(1) self-reported illnesses; (2) occupational accidents
38	O'Loughlin (2010) [106]	Australia	cross-sectional; non-peer review	hairdressers	238 (all females)	questionnaire-based study	(1) MSD and other health problems (12-month prevalence)
39	Puckree (2009) [108]	South Africa	cross-sectional; peer review	hairdressers	75 (all females)	questionnaire-based study	(1) MSD (point prevalence); (2) pain intensity; (3) arm posture, bending
40	Roquelaure et al. 2008 [77]	France	surveillance data analysis; peer-review	multiple jobs (hairdressers)	not specified	epidemiologic surveillance data from Maine and Loire regions for the years 2002 to 2004	(1) attributable risk fractions of CTS among exposed persons
41	Schneider et al. (2006) [78]	Germany	cross-sectional; peer review	multiple jobs (hairdressers/beauticians)	26 (not specified)	analysis of occupation-specific data from First National Health Survey – group comparisons	(1) LBP (7-day and 12-month prevalence)
42	Tsigonia et al. (2009) [92]	Greece	cross-sectional; peer review	cosmetologist	102 (95 females)	questionnaire-based study	(1) MSD in neck and shoulder using the NQ (12-month prevalence); (2) health status; (3) physical & psychosocial exposure;
43	Veiersted et al. (2008) [86]	Norway	evaluation (pre-post); peer review	hairdressers	188 (all females; 38 in the intervention group)	(1) questionnaire and measurement study; (2) evaluation of working instructions (follow-up of 2 months)	(1) MSD in neck and shoulder using the NQ (12-month prevalence); (2) arm elevation using inclinometer; (3) muscular load of m. trapezius
44	Wahlström et al. (2010) [68]	Sweden	measurement study; peer review	hairdressers	28 (all females)	ergonomic measurement study of upper arm postures and movements	(1) upper arm postures (2) customer and non-customer tasks

Abbreviations: DASH, Disability of Arm, Shoulder, Hand Index; CTS, Carpal Tunnel Syndrome; CUELA, Computer-Assisted Recording and Long-term Analysis of Musculoskeletal Loads; EMGmax, Maximum Muscle Contractions; ETD, Ergonomic Tool Design; LBP, Low back pain; MS, musculoskeletal; MSD, Musculoskeletal Disorders; NPDI, Neck Pain Disability Index; NQ, Nordic Questionnaire; NOSQ, Nordic Occupational Skin Questionnaire; OCRA, Occupational Repetitive Action check list; ODI, Oswestry Disability Index; RMDQ, REBA, Rapid Entire Body Assessment; Roland Morris Disability Questionnaire; ULD, Upper Limb Disorders; VAS, Visual Analogue Scale; VO2max, maximum oxygen intake in milliliters; WRMSD, Work-Related Musculoskeletal Disorders; WRULD, Work-Related Upper Limb Disorders; %MVC, Maximum Voluntary Contraction in %.

Annex 2: Extracted and pooled MSD prevalence of the spine segments

#	First author, year	Country	N ^a	lower back n (%)		neck n (%)		upper back n (%)		overall MSD n (%)
				point	12-month	point	12-month	point	12-month	12-month (*point)
Prevalence				point	12-month	point	12-month	point	12-month	12-month (*point)
1	Adewumi-Gunn, 2016	US	22	8 (36)						
2	Amodeo, 2004	FR*	389		181 (47)		142 (37)		140 (36)	
3	Aweto, 2015	NI	299		228 (76)		138 (46)		14 (5)	226 (76)
4	Bradshaw, 2011	UK*	147	62 (42)		46 (31)		40 (27)		
5	Cruz, 2015	PO*	30	30 (100)		23 (77)		5 (17)		
6	De Smet, 2009	BE*	145							59 (41) ⁺
7	Deschamps, 2014	FR*	199	53 (27)		39 (20)				133 (67) ⁺
8	Douwes, 2001 ^c	NL*	280	64 (23)	94 (34)		146 (52)			136 (49)
9	Hassan, 2015	EG	80		10 (13)		7 (9)			
10	Mahdavi, 2013	IR	172		101 (59)		90 (52)		68 (40)	
11	Mandiracioglu, 2009	TU	1284		347 (27)					410 (32)
12	Mussi, 2008	BR	220		86 (39)		103 (47)			156 (71)
13	O'Loughlin, 2010	AS	238		170 (71)					
14	Omokhodion, 2009	NI	355	67 (19)						
15	Puckree, 2009	SF	75	29 (39)				8 (11)		45 (60) ⁺
16	Schneider, 2006 ^c	GE*	26	12 (47)	18 (70)					
17	Tsigonia, 2009	GR*	102		54 (53)		59 (58)			
18	Veiersted, 2008 ^c	NO*	188			53 (28)	89 (47)			
Pooled prevalence (95% CI) – all countries				34.0 (25.1-42.7)	47.5 (35.5-59.5)	30.8 (19.7-41.9)	43.1 (31.0-55.1)	18.2 (6.8-29.6)	26.5 (1.1-51.9)	55.3 (40.1-69.7)
I² statistics^b in % (n studies)				83.3 (n=8)	95.8 (n=10)	81.0 (n=4)	93.9 (n=8)	76.1 (n=3)	98.4 (n=3)	48.6 (n=7)
Pooled prevalence (95% CI) – European countries				38.7 (25.5-51.9)	45.0 (34.9-56.8)	/	47.4 (37.7-57.0)	/	/	/
I² statistics^b in % (n studies)				85.6 (n=5)	75.4 (n=4)	/	77.6 (n=4)	/	/	/

^aOnly hairdressers;

^bI² statistics: 25% considered low, 50% moderate and 75% high heterogeneity;

^cstudies provided point and 12-month prevalence.

*European countries

Annex 3: Extracted and pooled MSD prevalence of the upper and lower extremities

#	First author, year	Country	N ^a	shoulder n (%)		hand/wrist n (%)		finger n (%)	elbow n (%)	knee n (%)	feet n (%)
				point	12-month	point	12-month	point (*12-month)	12-month (*point)	12-month	12-month (*point)
Prevalence											
1	Adewumi-Gunn, 2016	US	22			12 (54)		12 (54)			
2	Amodeo, 2004	FR*	389		107 (28)		73 (19)		17 (4)		
3	Aweto, 2015	NI	299		180 (60)		76 (25)	81 (27)*	45 (15)	98 (33)	71 (24)
4	Bradshaw, 2011	UK*	147	55 (37)		43 (29)			11 (7)*		51 (35)*
5	Cruz, 2015	PO*	30	25 (83)		13 (43)					
6	Deschamps, 2014	FR*	199	56 (28)		20 (10)		18 (9)	16 (8)*		
7	Douwes, 2001	NL*	280		134 (48)		73 (26)		20 (7)		
8	Hassan, 2015	EG	80		10 (13)		9 (11)		11 (14)	3 (4)	8 (10)
9	Mahdavi, 2013	IR	172		85 (49)		84 (49)		24 (14)	71 (41)	35 (20)
10	Mussi, 2008	BR	220		108 (49)						
11	O'Loughlin, 2010	AS	238								105 (44)
12	Nordander, 2013	SE*	78			26 (33)	38 (49)				
13	Tsigonia, 2009	GR*	102		36 (35)		54 (53)			29 (28)	
14	Veiersted, 2008 ^c	NO*	188	61 (32)	99 (53)						
Pooled prevalence (95% CI) – all countries				36.6 (26.1-47.1)	41.6 (30.1-53.2)	30.6 (15.6-45.7)	31.5 (22.2-40.8)	24.6 (7.3-41.9)	11.4 (5.0-17.8)	26.3 (7.0-45.6)	26.8 (17-36.7)
I² statistics^b in % (n studies)				74.1 (n=4)	93.4 (n=8)	88.2 (n=5)	90.8 (n=7)	93.4 (n=3)	78.1 (n=7)	96.6 (n=4)	88.8 (n=5)
Pooled prevalence (95% CI) – European countries				/	40.6 (27.7-53.4)	/	34.7 (21.5-47.8)	/	/	/	/
I² statistics^b in % (n studies)				/	89.4 (n=4)	/	90.6 (n=4)	/	/	/	/

^aOnly hairdressers;

^bI² statistics: 25% considered low, 50% moderate and 75% high heterogeneity;

^cstudy provided point and 12-month prevalence.

*European countries

Annex 4: Possible risk factors for WRMSD or WRULD in hairdressing sector

Identified risk factors	Outcome	Comparison category	Statistical measure (% ^a ; OR; RR; r; p-value)	Author (year)
(1) Strenuous hand/arm postures and movements				
- repetition of a task	WRMSD	-	71%	Aweto et al. (2015)
- repetitive movements	WRMSD and diagnosis	-	66% and 5%	Leino et al. (1999)
- position of arms at or above shoulder level	back pain	-	sig. correlation (p<0.001)	Puckree (2009)
- working with equipment above shoulder level	WRMSD	-	63%	Cruz et al. (2015)
- strenuous shoulder movements	shoulder pain / hand/wrist pain	yes vs. no	OR 6.0 (95%CI 1.7-21.5) ^b / OR 25.3 (95%CI 2.8-229.1) ^b	Tsigonia et al. (2009)
- strenuous shoulder movements	neck pain / shoulder pain	yes vs. no	RR 2.4 (95%CI 1.4-4.1) ^c / RR 3.5 (95% CI 2.0-6.0) ^c	Hassan et al. (2015)
- working with elevated arms	shoulder pain (score)	% working time >60° % working time >60° >5s	RR 1.3 (95%CI 1.1-1.5) ^b / RR 2.0 (95%CI 1.5-2.6) ^b	Hanvold et al. (2015)
- working with hands above shoulder level 6-8 h/day	WRMSD	VDU vs. HD work	OR 8.4 (95%CI 4.1-15.8) ^c	Douwes et al. (2001)
- frequent elbow movements 6-8 hours/day	WRMSD		OR 2.4 (95%CI 1.7-3.3) ^c	
- extreme wrist extension/flexion 6-8 h/day	WRMSD		OR 2.6 (95%CI 1.4-4.8) ^c	
- frequent manual material handling	neck pain / hand/wrist pain	yes vs. no	RR 3.1 (95%CI 1.4-6.8) ^c / RR 2.6 (95%CI 1.3-4.9) ^c	Hassan et al. (2015)
- frequent manual material handling	neck pain / knee pain	yes vs. no	OR 12.6 (95%CI 2.1-75.5) ^b / OR 6.4 (95%CI 1.9-21.4) ^b	Tsigonia et al. (2009)
(2) Awkward postures and movements of the spine				
- working in static postures	WRMSD	-	91%	Aweto et al. (2015)
- bending or twisting back	WRMSD	-	28%	
- constantly twisting the spine	WRMSD	-	53%	Cruz et al. (2015)
- bending the spine forward >50% of the time	back pain	-	sig. correlation (p<0.001)	Puckree (2009)
- awkward back postures (back is bent or twisted)	WRMSD	-	64%	Tsigonia et al. (2009)
- working postures	WRMSD and diagnosis	-	81% and 5%	Leino et al. (1999)
- uncomfortable postures (body, neck, shoulders)	WRMSD	yes vs. no	OR 2.8 (95%CI 1.4-5.5) ^b	Mussi et al. (2008)
- working with spinal rotation	WRULD	yes vs. no	OR 2.1, p<0.05 ^b	DeSmet et al. (2009)
- awkward back postures	back pain	yes vs. no	RR >10 ^c	Hassan et al. (2015)
- working in static postures 6-8 hours/day	WRMSD	VDU vs. HD work	OR 1.6 (95%CI 1.1-2.2) ^c	Douwes et al. (2001)

(3) Workload and biomechanical strain				
- stress and working overtime	WRMSD	-	83% and 97%	Cruz et al. (2015)
- no adequate uninterrupted breaks between clients	WRMSD	-	30%	Douwes et al. (2001)
- no adequate rest breaks	WRMSD	-	72.4%	Aweto et al. (2015)
- large number of clients per day and working overtime	WRMSD	-	92% and 94%	
- working at physical limit	WRMSD	-	34%	
- large number of clients per day	WRULD	<8 vs. 10-15 clients	OR 6.7, p<0.01 ^b	DeSmet et al. (2009)
- excessive work	WRULD	low vs. very high	OR 6.1, p<0.01 ^b	
- high perceived exertion	knee pain	yes vs. no	OR 5.3 (95%CI 1.4-21) ^b	Tsigonia et al. (2009)
- high job demands	hand/wrist pain	yes vs. no	OR 7.6 (95%CI 1.8-32.1) ^b	
- putting intense effort on hands	WRMSD	-	63%	Cruz et al.(2015)
- high mechanical workload	neck and shoulder pain / workload levels	workload score (0-24) / HD & EL vs. media & design trainees	RR 1.01 (95%CI 1.00-1.02) ^{d, b} RR 1.36 (95%CI 1.3-1.5) ^{d, b}	Hanvold et al. (2014)
- high sustained muscle activity	shoulder pain (score)	muscle activity (0-100%) ^a	median 52% (range 24-91%) r 0.2, p<0.001	Hanvold et al. (2015)
(4) Prolonged standing or sitting				
- standing during work >75% of the time	back pain	-	sig. correlation (p<0.01)	Puckree (2009)
- prolonged standing	WRMSD and diagnosis	-	65% and 1%	Leino et al. (1999)
- prolonged standing	feet/leg pain / knee pain	yes vs. no	RR 5.3 (95%CI 1.8-15.4) ^c / RR 21.0 (95%CI 2.8-156.7) ^c	Hassan et al. (2015)
- prolonged standing and sitting	hand/wrist pain	yes vs. no	OR 55.7 (95%CI 8.8-354.9) ^b	Tsigonia et al. (2009)
(5) Other factors				
- >15 years in the profession	WRMSD	<5 vs. 15-45 years	OR 3.0 (95%CI 1.2-7.9) ^b	Mussi et al. (2008)
- years of work experience	DASH score / NPDI score	-	r 0.7, /r 0.7, p<0.001	Kaushik & Patra (2014)
- lack of acknowledgment and uncomfortable postures	WRMSD	1-23 vs. 29-35 score	OR 3.5 (95%CI 1.5-8.3) ^b	Mussi et al. (2008)
- mental stress	WRMSD and diagnosis	-	51% and 2%	Leino et al. (1999)
- burnout	WRULD	low vs. very high	OR 8.6, p<0.001 ^b	DeSmet et al. (2009)
- bordering ambient temperature (high)	WRULD	yes vs. no	OR 2.5, p<0.05 ^b	
- female gender	WRULD	female vs. male	OR 3.1, p<0.05 ^b	
- sudden movements	WRMSD	-	12%	Aweto et al. (2015)
- low co-worker support	back pain/ hand/wrist pain	yes vs. no	OR 7.6 (95%CI 1.8-32.1) ^b / OR 5.1 (95%CI 1.2-21.4) ^b	Tsigonia et al. (2009)

(6) Hairdressing task as risk factor for MSD

- hair styling	WRULD	REBA index (% high & very high risk for MSD) ^f	69%	Mahdavi et al. (2013)
- hair dying	WRULD		66%	
- hair cutting	WRULD		64%	
- trimming face	WRULD		62%	
- doing make up	WRULD		53%	
- trimming eye brows	WRULD		49%	
- shampooing hair at least 50%/day	WRMSD	OCRA index ^g	index 5.0	Mastrominico et al. (2007)
- cutting hair at least 50%/day	WRMSD		index 8.1	
- styling hair at least 50%/day	WRMSD		index 9.4	
- dying hair at least 50%/day	WRMSD		index 9.0	

^aSelf-rated risk factors for WRMSD/WRULD;

^bResults from adjusted analysis;

^cData were calculated from the authors of the study

^dEach increase in mechanical workload was associated with 1% increase in neck and shoulder pain in women (the majority in the group were female hairdresser (n=163) compared to 5 female electrician trainees);

^eRelative time of sustained trapezius muscle activity during the working day: low (0-29%), moderate (30-49%) and high (50-100%).

^fREBA index: lower risk for MSD (<3), moderate risk (4-7), high risk (8-10), very high risk (11-15)

^gOCRA index: no risk for MSD (<4.5), moderate risk (4.6-9), high risk (>9)

Abbreviations:

DASH Disability of Arm, Shoulder, Hand Index,

EL Electrician,

HD hairdressers,

NPDI Neck Pain Disability Index,

OCRA Occupational Repetitive Action check list,

OR odds ratio,

REBA Rapid Entire Body Assessment,

RR relative risk,

VDU Visual Display Unit,

WRMSD work-related musculoskeletal disorders/discomfort,

WRULD work-related upper limb disorders.

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