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Identification and prioritisation of relevant prevention issues for work-related musculoskeletal disorders (MSDs)

Work Package 1:

Overview of work-related musculoskeletal disorders structured according to affected areas of the body and diagnoses, and their prevalence in various fields of activity/occupational groups.



This report is a final summary of Work Package 1, entitled “Overview of work-related musculoskeletal disorders, structured according to the affected areas of the body and diagnoses, and their prevalence in various fields of activity/occupational groups“, within the framework of the project “Identification and prioritization of relevant prevention issues for work-related musculoskeletal disorders (MSDs)“ commissioned by the German Social Accident Insurance (DGUV).

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Note: To improve readability only the masculine form is used in the following report.

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References

1. Introduction

The term “musculoskeletal disorder” (MSD) covers a very heterogeneous group of symptoms and illnesses. In some cases, the illnesses are specific, that is, they have a known anatomical or physiological cause or are due to a known pathogenic mechanism and can be clearly distinguished from each other. However, a large number of the illnesses among MSDs are classified as non-specific, i.e. these are illnesses for which the pathophysiological origin is not yet completely understood, such as, for example, “non-specific back pain” [1; 2]. Given the large number of illnesses and functional disorders that are subsumed as MSDs [3], it is unsurprising that efforts to deal with the problem of work-related MSDs through effective preventive measures have met with little success to date. This is despite the fact that there is a need for action in this area for the sake both of the workers affected and of the general public who have to bear the considerable direct and indirect costs (cf. Work Package 3). This need for action seems to be increasing year by year because on the basis of evaluations of health reports published by German health insurance companies it can be concluded that, in addition to psychological illnesses, musculoskeletal disorders in particular, and among them especially non-specific conditions, are increasing.

In this context, working groups who have taken up the cause of the prevention of musculoskeletal disorders suggest that, aside from further exploration and research of causal factors and research into possible interactions between these factors, research and prevention measures should now be directed towards preventing negative secondary effects of MSDs, such as long periods due to sick leave and illness-related disability in daily life [4]. Naturally, the long-term aim and duty remains to identify the causes of the various MSDs in order to develop efficient and targeted preventive measures. At the moment, it is assumed that the development, continuation and also the worsening of MSDs is linked to various factors, such as physical stress in the workplace, lifestyle factors and psychological and psycho-social factors in both the private and professional environment. It is essential to establish prevention concepts for the working population which alleviate the individual afflictions of those workers affected by MSDs on the one hand, while counteracting the high direct and indirect costs that result from the high number and lengthy duration of musculoskeletal disorders on the other. In addition to primary, secondary,

and tertiary preventive measures to counteract medical causal factors, the consequences of musculoskeletal disorders, such as incapacity for work, should also be taken into account, since for these consequences factors additional to the known causes, such as the structure of the social security system, also have to be taken into account [5].

The German Social Accident Insurance (DGUV) has set itself the target of collecting the existing data concerning links in the causal chain between occupation and MSDs in order to provide well-directed support for promising research projects and their implementation over the next few years. This involved researching the existing scientific literature to answer the following questions:

What are the frequency distributions of musculoskeletal disorders, structured according to body areas affected and diagnoses, in the various fields of activity/occupational groups in Germany?

Is it possible to identify a disorder hierarchy (relevant to non-relevant) from this information? Where possible, the prevalence of MSDs in various occupations/fields of activity should be shown structured according to body areas and diagnoses.

2. Methodology

In order to obtain an overview of the MSDs outlined above and depict these MSDs with regard to occupation, a literature research was carried out based on two pillars, namely the evaluation of existing health reports and the evaluation of the scientific literature.

2.1. National health reporting

On the one hand, a literature research was carried out on health reports from Germany, i.e. accessible reports from German institutions involved in public health, occupational health and safety or occupational medicine were collected and reviewed. General health reporting in Germany is mostly carried out by the statutory health insurance funds. Occasionally, it is also carried out in cooperation with the

relevant statutory industrial accident insurance associations, thereby focusing on specific occupational groups (which would be an ideal setting for the purpose of this study). The health reports of various statutory health insurance funds (Betriebskrankenkasse (BKK) [6], Innungskrankenkasse (IKK) [7], Techniker Krankenkasse [8], Deutsche Angestellten Krankenkasse (DAK) [9], BARMER-Ersatzkasse [10]) were collected, reviewed and evaluated. In addition to statutory health insurance funds and private health insurance companies, other institutions that can be involved in health reporting and therefore in showing work-related MSDs include statutory accident insurers, first and foremost the German Social Accident Insurance association (DGUV), the DGUV's Institute for Occupational Safety and Health (BGIA) and all independent German accident insurers, such as the industrial accident insurance associations for construction, welfare work, chemicals, metal, and for the quarrying sector (BG Bau, BGW, BG Chemie, BG Metall and BG Steinbruch respectively). These associations have already examined the subject of work-related musculoskeletal disorders with varying degrees of intensity. On the governmental side, the Federal Institute for Occupational Safety and Health (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (BAuA)) carries out research projects regarding work-related illnesses and publishes reports. Progress and research reports from all of these actors in the field of occupational health and safety in Germany were reviewed to identify information relevant to this study. In addition, texts from the relevant Ordinance on Occupational Diseases (explanatory notes on medical examination for occupational diseases published by the responsible German government ministry) were reviewed and occupational disease statistics (BK-DOK) were included in the evaluation.

Cases of incapacity for work (ifw cases) and days of incapacity for work (ifw days)
Evaluating German health reports involves, above all, presenting and discussing the situation regarding incapacity for work. To assess the situation at hand, the number of Ifw cases and Ifw days are important. The former give an idea of the frequency of the condition and the latter of its severity. In the framework of this study, which will focus mainly on the prevalence of occupation-specific MSDs, the cases of incapacity in particular are to be taken into account.

ICD-9 and ICD-10

In some German health reports, depending on the date of creation, reference is made to the ICD-9 or ICD-10 classification of diseases (ICD: International Statistical Classification of Diseases and Related Health Problems). The precise differences between the numeric, three-character ICD-9 classification and the ICD-10 classification comprising a string and numerical part and the development from ICD-9 to ICD-10 will not be discussed in further detail at this point. However, should further information be required, please refer to the website of the German Institute of Medical Documentation and Information (DIMDI: <http://www.dimdi.de>).

2.2. European information

In addition to searching for national data sources, the website of the European Agency for Safety and Health at Work (<http://osha.europa.eu/en>) was screened and, in particular, the “European Network-Germany” area was evaluated.

2.3. Scientific literature research

In addition to searching for national and European health reports (with an emphasis on Germany) to answer our research question, we also searched the international scientific literature. Due to the relatively short duration of the project and the large volume of original articles on the topic of work-related MSDs, particular attention was given to searching for review articles. The search approach was designed in such a way that it focused on findings showing the distribution of MSDs in various occupations in industrial nations that can be assumed to have similar occupational exposure to that in Germany. In total, two databases, namely Pubmed and EMBASE, were searched for the combinations of keywords listed in Table 1 (see Table 1). This search returned a total of 2553 hits.

Table 1: Search Strategy in Pubmed and EMBASE, Limits: Human, Language German and English

Condition reference	AND	Occupation reference	AND	Prevalence or risk
musculoskeletal disease, musculoskeletal disorder tendon, ligament, tendonitis, tendinopathy joint, arthrosis, arthritis, arthralgia spine, spinal, spondylitis, spondylosis bursitis, synovitis Rheuma bone, cartilage, disc mucle, muscul, myopath*, myositis impingement, degeneration, prolapse carpal tunnel, repetitive strain		job occupation* work employ* industr*		prevalence OR incidence OR risk

The results obtained were then restricted to those between the year 2000 and the present. Two people read the accompanying abstracts to identify the studies that could be considered relevant for our research question. If the abstract did not provide sufficient information to determine their relevance, the original article was referred to in order to decide whether or not it should be included in the evaluation. After this preparatory work was completed, a total of 61 reviews were presented in a table and evaluated with regard to occupations and activities.

To assess the quality of the review articles included in the study, all of the reviews considered were assessed using the AMSTAR criteria for reviews [11]. The assessment of the studies is included in the tables to enable better classification of the quality of each review. However, we must point out that not only reviews of high methodical quality were included in the study.

3. Results

3.1. Work-related musculoskeletal disorders in Germany

3.1.1. General health reporting in Germany

The following evaluation is based on the (health) reports listed below that were found and evaluated during the literature research:

- Safety and Health at Work 2007 and 2002 [12, 13]
- BKK health report [6]
- DAK health report [9]
- BARMER health report [10]
- Techniker Krankenkasse health report [8]
- IKK health report [7]

The most recent report, “Safety and Health at Work 2007” (Sicherheit und Gesundheit bei der Arbeit 2007), published by the Federal Institute for Occupational

Safety and Health in 2009 [12], presents various occupational groups and the incidence of ifw cases in these groups due to MSDs (per 100 insured persons). The prevalences of incapacity for work shown below are based on information on over 31 million people who are insured with the following six national associations of statutory health insurance companies: Federal Association of Local General Health Insurance Funds (Bundesverband der Allgemeinen Ortskrankenkassen (AOK)), Federal Association of Company Health Insurance Funds (Bundesverband der Betriebskrankenkassen (BKK)), Federal Association of Trade Guild Health Insurance Funds (Bundesverband der Innungskrankenkassen (IKK)), Federal Association of Agricultural Health Insurance Funds (Bundesverband der landwirtschaftlichen Krankenkassen), the Federation of Employee's Health Insurance Funds (Verband der Angestellten-Krankenkassen) and the Worker's Private Health Insurance Fund (Arbeiter-Ersatzkassen-Verband). As mentioned in the report, evaluation of the data according to occupations was not available from all health insurance funds. As a result, only a part of the data could be used for our evaluation. The report does not specify the health insurance funds from which data was included, which means that the results may have been slightly distorted because experience shows that members of certain health insurance funds often come from specific occupational fields. Despite these methodological uncertainties, the following table lists all of the occupational fields examined and their respective percentage distributions of Ifw cases caused by MSDs (Table 2).

Table 2: MSD without exact localisation details, from Safety and Health at Work 2007, OSHA [12]

Industry	Ifw cases (%) caused by MSDs
Metal production and foundries	41.6
Ceramic and glass industry	38.3
Chemical and plastics industry	37.9
Assembly line work	37.1
Forestry workers	36.4
Occupations in dispatch	34.4
Paper production and printing industry	33.5
Construction industry	33.4
Upholsterers and interior decorators	32.9
Textile and clothing industry	32.1

Painters, varnishers	30.4
Miners, mineral extractors and refiners, stone workers, building materials manufacturers	30.2
Transport occupations	29.8
Occupations in leather manufacturing and processing	29.7
Metal and mechanical engineering occupations	29.4
Occupations in wood and plastics processing	28.7
Unskilled labourers	26.4
Other service occupations	26.4
Agriculture, forestry, horticulture	25.2
Machine operators	24.5
Food professions	23.9
Occupations in law enforcement and security	23.7
Occupations in the electrical sector	23.4
Occupations in social work and education	16.6
Occupations in the health sector	15.8
Technicians	15.5
Goods traders	14.7
Other workers	13.7
Organizational, administrative and clerical occupations	12.8
Service traders	11.5
Writing, artistic occupations	11.1
Engineers, chemists, physicists, mathematicians	7.2

In addition to this, the report “Safety and Health at Work 2002” [13] describes the correlation between health complaints during or after work and various occupational fields. This correlation should also be taken into account with regard to this report, although we must point out that the criterion for musculoskeletal conditions was restricted to reports of pain. In this respect, distinction was made between pain in the lower back (lumbago), pain in the neck/shoulder area, pain in the arms and hands, pain in the hips, pain in the knees, and pain in the legs and feet and swollen legs. Tables 3 to 5 present the occupation-specific listings in numerical order (from most frequent to least frequent in terms of prevalence).

Table 3: Pain in the spine (low-back pain or neck/shoulder pain) during or after work by specific occupational group from “Safety and Health at Work 2002” [13]

Occupation	lfw cases (%) caused by MSDs
Pain in Lumbar Spine	
Occupations in agriculture, livestock farming, forestry and horticulture	54.6
Construction occupations	54.5
Transport occupations	46.9
Manufacturing occupations, miners, mineral extractors	43.2
Service occupations, other workers	35.7
Traders	30.6
Administrative/clerical occupations	26.9
Technical occupations	24.4
Pain in Neck/Shoulders	
Occupations in agriculture, livestock farming, forestry and horticulture	34.0
Administrative/clerical occupations	32.3
Construction occupations	30.6
Transport occupations	29.3
Manufacturing occupations, miners, mineral extractors	28.4
Service occupations, other workers	27.8
Traders	24.0
Technical occupations	23.8

Table 4: Pain in the upper extremities during or after work by specific occupational group, from “Safety and Health at Work 2002” [13]

Occupation	lfw cases (%) caused by MSDs
Pain in Arms and Hands	
Construction occupations	28.1
Occupations in agriculture, livestock farming, forestry and horticulture	24.3
Manufacturing occupations, miners, mineral extractors	17.7
Transport occupations	15.3
Service occupations, other workers	10.7
Traders	7.2
Administrative/clerical occupations	6.4
Technical occupations	4.9

Table 5: Pain in lower extremities during or after work by specific occupational group, from “Safety and Health at Work 2002” [13]

Occupation	lfw cases (%) caused by MSDs
Pain in Hips	
Occupations in agriculture, livestock farming, forestry and horticulture	11.9
Construction occupations	9.9
Transport occupations	7.2
Manufacturing occupations, miners, mineral extractors	7.0
Service occupations, other workers	5.3
Traders	3.6
Administrative/clerical occupations	3.1
Technical occupations	2.7
Pain in Knee	
Construction occupations	30.4
Occupations in agriculture, livestock farming, forestry and horticulture	20.1
Manufacturing occupations, miners, mineral extractors	15.9
Transport occupations	13.9
Service occupations, other workers	9.4
Traders	7.5
Technical occupations	4.8
Administrative/clerical occupations	4.3
Pain in Legs and Feet	
Occupations in agriculture, livestock farming, forestry and horticulture	23.4
Construction occupations	18.5
Sales workers	18.4
Manufacturing occupations, miners, mineral extractors	18.3
Transport occupations	17.5
Service occupations, other workers	17.0
Administrative/clerical occupations	6.3
Technical occupations	5.6

A provisional appraisal on the basis of the two reports by the Federal Institute for Occupational Safety and Health and Tables 2 - 5 shows that the top five work-related MSDs (in general) are headed by metal manufacturers/foundry workers, and that agriculture, livestock farming, and forestry workers suffer most frequently from MSD pain in the lumbar spine, neck and shoulders, hips and legs/feet, while construction occupations have the highest prevalence of pain in the knees and arms/hands. The

high prevalence of pain in the neck/shoulders in administrative and clerical occupations and in the legs and feet for sales workers is particularly striking. Moreover, this prevalence is considerably higher than that in the general population.

The 2008 BKK health report [6] published by the BKK federal association lists the ifw cases for employed compulsory members according to industry groups. For the occupational fields of people insured with the BKK, the cases of illness are listed per 1,000 insured persons (see Table 6). The report does not clearly show whether the cases of illness, unlike the ifw cases specified in the other health reports, relate to individuals, which could explain the considerably lower prevalence rate compared to the ifw cases examined so far. What can be noted is that waste disposal and recycling, postal and courier services and metal manufacturing are the sectors particularly affected by cases of illness caused by MSDs (Table 6). On the one hand, this highlights the high number of MSDs in the metal manufacturing industry, as already detailed in the report by the Federal Institute for Occupational Safety and Health, but it also identifies other occupational fields, such as waste disposal/recycling and delivery workers, as particularly high-risk occupations.

The 2003 health report by the DAK health insurance fund [9] focused not only on general MSDs, but in particular on back disorders. The DAK report can be used to identify which industry groups were affected to what extent in ifw days (per 100 insured persons) due to back disorders: health sector: 199 days; building and construction industry: 192 days; transport and communication: 184 days; food and consumables: 181 days; agriculture, forestry and energy sector: 174 days; public administration: 172 days; other manufacturing industry: 167 days and other services: 165 days. The group comprising workers employed in the health sector has the highest number of ifw days. However, we must emphasize that here days, and not cases, of incapacity for work were listed, which prevents comparisons with the information in the other health reports and also provides little information regarding MSD prevalence

With regard to the issue of MSDs, the most recent health report from the Techniker Krankenkasse health insurance fund [8] contains an occupation-specific presentation of absence days caused by back conditions (ICD-10: M40-54 and M54 alone). This

description is also based on ifw days per 100 insured person years (IPY) (Table 7 and 8).

Here, too, the description of days, rather than cases, of incapacity for work also prevents any comparison that would have been useful for the question of this study. However, in general, occupations in the following sectors also appear to be particularly affected by MSDs: metalworking, construction, transport and warehousing, chemicals and plastics processing.

Table 6: MSDs without exact localisation details, from BKK health report 2008 [6]

Industry	Cases of illness per 1,000 insured persons
Tertiary sector: waste disposal and recycling	29.7
Tertiary sector: postal and courier services	25.2
Manufacturing industry: metal manufacturing	25.2
Tertiary sector, railways and transport services	25.0
Manufacturing industry: glass, ceramics, non-metallic minerals	24.3
Tertiary sector: post and telecommunications	23.9
Manufacturing industry: metal processing	23.4
Manufacturing industry: chemical	23.3
Tertiary sector: public administration, social security	22.2
Tertiary sector: transport	22.1
Construction industry	22.1
Manufacturing industry: furniture and other products	21.4
Tertiary sector: telecommunications	21.2
Energy and water supply	21.0
Manufacturing industry: textiles, clothing, leather	20.0
Manufacturing industry: wood, paper, printing, publishing	19.9
Manufacturing industry: food and consumables	19.2
Tertiary sector: services to companies	15.8
Tertiary sector: wholesale	15.3
Tertiary sector: commerce	15.2
Tertiary sector: services	15.0
Tertiary sector: retail	14.2
Tertiary sector: health and social services	14.2
Tertiary sector: education and teaching	13.3
Tertiary sector: representation of interests, associations	13.2

Tertiary sector: catering	12.4
Tertiary sector: credit and insurance industry	11.1
Tertiary sector: culture, sports and entertainment	10.9
Tertiary sector: data processing and research	10.6

Table 7: Days of incapacity for work (per 100 IPY) due to non-specific back pain (ICD-10: M54), from the Techniker Krankenkasse health report [8]

Occupation	lfw days
Metalworking occupations: metal manufacturing and processing	142
Construction, secondary construction jobs and lumber occupations	135
Transport and warehouse occupations	134
Chemical industry workers, plastics processors:	126
Hairdressers, hospitality workers, housekeepers, cleaners	126
Agricultural occupations, environmental occupations	114
Food occupations	111
Metalworking occupations: installation and shopwindow building	109
Paper manufacturers, processors and printers	95
Occupations in the electrical sector	88
Occupations in public order and security	86
Occupations in the health sector	57
Goods and services traders	52
Social and education occupations, pastors	50
Administrative, economics/social sciences occupations	37
Media, humanities and arts occupations	36
Technical and scientific occupations	35

Table 8: Days of incapacity for work (per 100 IPY) due to general back pain (ICD-10: M40-54), from the Techniker Krankenkasse health report [8]

Occupation	lfw days
Construction, secondary construction jobs and lumber occupations	254
Transport and warehouse occupations	239
Metalworking occupations: metal manufacturing and processing	232
Chemical industry workers, plastics processors:	219
Hairdressers, hospitality workers, housekeepers, cleaners	218
Food occupations	203
Agricultural occupations, environmental occupations	195

Metalworking occupations: installation and shopwindow building	194
Paper manufacturers, processors and printers	168
Occupations in the electrical sector	166
Occupations in public order and security	155
Occupations in the health sector	113
Goods and services traders	99
Social and education occupations, pastors	91
Administrative, economics/social sciences occupations	70
Media, humanities and arts occupations	67
Technical and scientific occupations	66

The 2008 health report by the BARMER health insurance fund [10] describes the situation regarding musculoskeletal-related incapacity for work in 2007. The main subject of the report itself is back health and it therefore refers to various individual MSD diagnoses. Unfortunately, it provides no concrete occupation-specific analyses, merely pointing out that the ten largest occupational groups insured with the BARMER health insurance fund are teachers, bank specialists, doctor's/dentist's receptionists, wholesale and retail clerks, office clerks, home/hostel wardens, social education workers and stenographers/typists/shorthand typists as well as social workers, sales assistants and nursing staff. The 9 most common individual diagnoses of MSDs are shown for this collective (see Table 9) and it is clear that back pain, followed by "other soft-tissue disorders" are the main problem for this group of insured persons. Therefore, a more specific occupational group comparison is carried out for uncomplicated back pain (M53/54), showing that when the five main occupational groups represented at BARMER are compared, sales personnel and social workers in particular have a high risk of ifw days caused by MSDs. Taking into account a stratification in terms of gender, the number of ifw days detected for female and male sales assistants was approx. 18 and 15.5 respectively, for female and male social workers approx. 17.8 and 15.2 respectively, for female and male home/hostel wardens approx. 11.3 and 14.1 respectively, for female and male office clerks approx. 12.0 and 12.7 respectively and for female and male bank specialists approx. 11.6 and 9.7 respectively. For all other MSD diagnoses apart from uncomplicated back pain (M53/M54), the highest number of ifw days was again found among female sales assistants. Approx. 31.5 ifw days were recorded for them, while for male sales assistants the figure was approx. 25.5; for female social workers approx. 30.5, for male social workers approx. 20.5; for female home/hostel wardens approx. 23 and

for male home/hostel wardens approx. 23.9; for female office clerks approx. 21.5, for male office clerks approx. 21; for female bank specialists approx. 20.3 and for male bank specialists approx. 18.5. It can be concluded that the BARMER health report shows that female sales assistants have the highest number of days of incapacity for work due to MSDs. Ifw Cases were not analyzed.

Table 9: Cases of incapacity for work due to MSDs in BARMER health report [10]

Localization	MSD	ICD	Occupation	Ifw cases
Spine	Back pain	M54	10 BARMER occupational groups	44.1
General	Soft tissue disorders	M75, 77, 79	10 BARMER occupational groups	11.7
General	Other joint disorders	M23 u 25	10 BARMER occupational groups	7.5
Spine	Other dorsopathies, not elsewhere classified	M53	10 BARMER occupational groups	5.4
Spine	Other intervertebral disc disorders	M51	10 BARMER occupational groups	4.6
General	Biomechanical lesions, not elsewhere classified	M99	10 BARMER occupational groups	4.2
General	Synovitis and tenosynovitis	M65	10 BARMER occupational groups	3.2
General	Inflammatory polyarthropathies	M06, 10, 13	10 BARMER occupational groups	2.2

The 10 largest BARMER occupational groups are: teachers, bank specialists, doctor's/dentist's receptionists, wholesale and retail clerks, office clerks, home/hostel wardens, social education workers, typists, social workers, sales assistants and nurses.

Another source that provides details on MSD prevalence in specific occupations is the 2008 health report from the IKK health insurance fund, Work and Health in the Craft Sector (IKKimpuls – Arbeit und Gesundheit im Handwerk) [7], where data from 2007 were evaluated. Overall, for craftsmen, who make up the majority of those insured with IKK, it is shown that 17.5 % of all ifw cases and 25.6 % of all ifw days are caused by musculoskeletal disorders. Furthermore, the percentage of ifw days due to MSDs is specified for the individual categories of craft (Table 10).

Construction and building workers are at the top of this list. Unfortunately, here, too, details of ifw cases are not provided.

Table 10: MSD without exact localisation information, from the IKK health report [7]

Industry	Ifw days (%) due to MSDs	Absolute Ifw days per 100 IPY
Construction/building	33	617
Wood	31	471
Electronics/metal	28	426
Textile/leather	27	n.k.
Glass/paper	26	n.k.
Food	26	388
Health/cleaning	25	372

IPY: insured person years; n.k. not known

In a document published by the association of national associations of public health insurance funds (the federal associations of AOK, BKK, IKK, the agricultural, the miner's and mine employee's and the white-collar employee's health insurance funds, the association of the substitutional social health insurance funds and the national association of statutory health insurance funds) [14], under the item "Joint and unified spheres of action and criteria of national associations of public health insurance funds for implementing §20 and §20a of the German Social Code Volume 5 of 21 June 2000, as amended on 2nd June 2008", reference is made to work-related physical stress and the need for preventive measures as a result of the risk of MSDs. It reports that approx. 25 % of all ifw days are caused by MSDs – mainly by non-specific dorsopathies (ICD M53.9). Precision engineering, glass, steel and rubber production, construction, municipal waste disposal, public transport, postal services and railways are the sectors most affected. No numerical data about the prevalence of MSDs in the various occupations was available, which means that it is difficult to create a comparative classification of the occupations in a ranking list. However, the document lists many of the problem areas identified in the individual reports.

3.1.2. Summary of German health reporting in general

National health reporting can currently contribute to addressing the subject of this study only to a limited extent. Although some health reports identify industries whose employees suffer from MSDs to a particularly high extent, a precise occupation-specific and localisation-specific analysis is not possible. This is partly because such data analysis was not carried out by the statutory health insurance funds and also because the non-standardized analysis of the various data records makes it difficult to draw any comparison between the funds or with the general population. An additional factor that makes evaluation even more difficult is that the collectives of persons insured with the various statutory health insurance funds are composed differently. At any rate, the actual prevalence situation is distorted due to the fact that the evaluations focus on ifw days and ifw cases (although details of the days are usually preferred, since in many cases, sickness costs result from days rather than cases of incapacity for work). In conclusion, it can be stated that the main concentration of MSDs, as far as ifw cases are concerned and irrespective of localisation, is to be found in the following sectors: metal manufacturing/foundry, construction, waste disposal/recycling, agriculture and forestry, transport/warehousing, parcel delivery and sales. Pain symptoms during or after work occur mainly in agriculture and in the construction and manufacturing sectors, as well as in transport occupations. With regard to localisation, it has to be said that workers in the construction industry are most likely to suffer pain in the hand/arm and knee areas, whereas occupations in agriculture and forestry lead all the other pain localisations mentioned. Apart from that, there is a conspicuously high number of neck/shoulder pain cases in clerical occupations and leg/foot pain and swollen legs among sales assistants.

3.1.3. Industry-sector specific health reporting in Germany

When searching for industry-sector-specific health reports, it quickly became clear that these reports focused on three main sectors: construction, building materials and health service/(physical)care.

In the health report for the building materials industry by the quarrying industry accident insurance association, entitled "Is the Industry Healthy?" [15], cooperation between the industry insurance association, the scientific institute of the AOK health insurance fund and the Federal Association of the BKK made it possible to merge data and findings from accident and health insurance regarding incapacity for work and occupational diseases, accidents, hazards and stress. In addition to data about ifw cases, this report also contains data about ifw days, since the sickness rate is mainly determined by longer-term conditions. According to the report, most of the ifw days are caused by MSDs, and particularly MSDs affecting the back and joints. With regard to these conditions, in 2001, 483 ifw days were recorded per 100 insured persons in the building materials industry compared to 393 Ifw days per 100 insured persons in the population of BKK members as a whole. The building materials industry also lay above the BKK average for ifw cases, with 27.4 cases compared to 22.4 cases per 100 insured persons. This result indicates that the building materials industry, compared to other occupational groups, has a relatively high proportion of days and cases of incapacity for work due to MSDs and should therefore be considered a risk group.

The 2005 health report from the BGW-IKK health insurance fund [16] specifically examines hairdressers and working conditions and health in the hairdressing sector. The ifw days were listed according to disease type. Again, MSDs are at the top of the list for hairdressers with 20.8 % of all days (2004). For ifw cases (2004), which are more useful for estimating prevalence, MSDs are in second position after respiratory system disorders, with 15.1 % of all cases. Compared to the results in the building materials industry, however the prevalence of MSD-related ifw cases seems to be lower.

The 2003 health report from the BGW-DRK health insurance fund [17] concerning geriatric nurses states that musculoskeletal disorders accounted for 25.1 % of the ifw days and 16.2 % of cases in 2001. This would place geriatric nurses between building materials manufacturers and hairdressers (ifw cases).

The DRK-BGW health report [18] on outpatient care was published in 2006. Most workers in outpatient care are nurses (47%), nursing auxiliaries (19%) and social

carers (34%). In 2004, MSDs contributed to incapacity for work among these occupations to the largest extent, with 21.7 % of the days and 15.6% of the ifw cases (factor 0.99 compared to the general population). This was mainly due to the long invalidity period, with an average of 17.1 days. The most common individual diagnoses of ifw cases related to musculoskeletal disorders in 2004 were back pain (M54), with 8.0 % of ifw cases, other intervertebral disc disorders (M51), with 0.7 % of cases, other dorsopathies (M53), with 1.3 % of cases, shoulder lesions (M75), with 0.7 % of cases and internal derangement of the knee (M23), with 0.6 % of cases. These 5 disease types had a share of 15.1 % of the total sickness rate. It can therefore be stated that back pain and spinal and back disorders in particular are a significant factor for outpatient nurses and carers.

Another relevant report for the study is “Work-Related Health Risks in the Construction Industry – ARGO” (a project of the construction industry’s accident insurance association in Hanover, Lower Saxony), from the series “Safety at Work and Occupational Medicine in the Construction Industry” [19]. In this case, a pilot project was conducted in which data from statutory health insurance funds (AOK and IKK) and the construction industry’s accident insurance association were analysed on an occupation-related basis. For the ICD category “diseases of the musculoskeletal system”, the number of persons (men, irrespective of occupation) for whom at least one case of incapacity for work associated with musculoskeletal disorders (ICD classification) was reported in 2000 was shown according to occupation. The occupational groups that showed an above-average number of ifw cases in the ICD category “diseases of the musculoskeletal system” were scaffolders (42.6 %, standardized morbidity ratio (SMR): 1.49), screed and terrazzo workers (38.3 %, SMR: 1.39), roofers (34.4 %; SMR: 1.21), stucco plasterers, ladders, caulkers (32.3 %; SMR: 1.13), concrete workers (32.0 %; SMR: 1.12), interior decorators (30.8 %; SMR: 1.08), building labourers (30.8 %; SMR: 1.08), tilers (30.5 %; SMR: 1.07), road and construction workers (29.3 %; SMR: 1.03), bricklayers (29.2 %; SMR: 1.02), glaziers (29.0 %; SMR: 1.02), locksmiths (28.9 %; 1.01) and carpenters (28.7 %; SMR: 1.01). For all of these groups, the prevalences were shown to be above those of the collectives as a whole (28.5 %). Overall, dorsopathies (ICD 720-724) are the most common form of MSD. The relative risks of at least one case of incapacity for work due to dorsopathies, arthropathies and internal knee joint damage were also

shown according to occupation. This permits the rough estimate that the relative risks (RR) of dorsopathies are highest for scaffolders (RR 1.35) and screed and terrazzo workers (RR 1.3). For screed and terrazzo workers, the relative risk of the occurrence of an arthropathy is also significantly increased with 1.5 and the same is also true for roofers with 1.25 and tilers with 1.30. The relative risk of at least one ifw case caused by internal knee joint damage is 1.75 for screed and terrazzo workers, 1.60 for tilers and 1.45 for roofers, which is considerably higher than for installers with 1.20 and painters/varnishers with 1.1. These results lead to the conclusion that in the “problem industry” of construction further differentiation is required between the different occupations. Scaffolders, roofers, screed and terrazzo workers, tilers, painters/varnishers and installers, in particular, could be predestined to MSDs with a variety of localisations.

With reference to occupational health screenings that were also analysed in the report, detailed examination of individual occupations compared to the collective as a whole showed that glaziers (44.1 %, SMR: 1.5), tilers (37.7 %; SMR: 1.3), interior decorators (36.7 %; SMR: 1.2), locksmiths (35.5 %, SMR: 1.2) and screed and terrazzo workers (35.3 %; SMR: 1.2) in particular displayed musculoskeletal symptoms more frequently in occupational health screenings. The five occupational groups that showed the greatest difference from the collective as whole in occupational health screenings with regard to dorsopathies of the lumbar spine and thoracic spine (without deformities) (ICD 720-724) were: screed and terrazzo workers (24.9 %; SMR: 1.5), tilers (20.8 %; SMR: 1.2), bricklayers (20.3 %; SMR: 1.2), locksmiths (19.6 %; SMR: 1.2), installers (19.2 %; SMR: 1.1). Dorsopathies of the cervical and upper thoracic spine were detected most often in interior decorators (8.1%). Glaziers (18.1%), tilers (15.6%) and interior decorators (13.5%) in particular were affected by arthropathies of the lower extremities. Arthropathies of the upper extremities were detected most often in glaziers (18.2%) and screed and terrazzo workers (13.3%).

Comparing the results of the IKK data and occupational health screening data shows clearly for the first time that there may be differences between actual ifw cases and symptoms found in occupational health screening, which means we cannot assume that people with occupations that demonstrate a high number of musculoskeletal

symptoms in screening will also contribute to the number of ifw cases to a significant extent. The two examination modes should therefore be considered separately.

The second part of this series (“Work-Related Health Risks in the Construction Industry – ARGO”) [20] is primarily concerned with three occupational groups in the construction industry, namely scaffolders, bricklayers and carpenters. The results are summarized in the table below (Table 11).

Table 11: Prevalence of symptoms found in occupational health screenings (from: Work-Related Health Risks in the Construction Industry [20])

	General MSDs	Back pain (Lower thoracic and lumbar spine)	Back pain (cervical and thoracic spine)	Arthropathy of lower extremity	Arthropathy of upper extremity
Bricklayers	34.4%	21.1%	3.0%	10.2%	7.1%
Scaffolders	30.6%	20.6%	-	11.5%	9.3%
Carpenters	30.3%	16.3%	2.4%	10.4%	6.7%

For scaffolders, a differentiated examination of the information provided showed a higher prevalence of function impairment of the shoulder joints in this group compared to the collective as a whole. With regard to upper extremity disorders, bricklayers were found to have function impairments of the shoulder joint in particular and with regard to the lower extremities, function impairments of the knee joints were higher than in the collective as a whole. Impairments of the shoulder and knee joints in particular were more common than in the collective as a whole.

Overall, it can therefore be stated that in the construction industry, scaffolders, screed and terrazzo workers, roofers, stucco plasterers, ladders, caulkers, concrete workers, interior decorators, building laborers, tilers, road and construction workers, bricklayers, glaziers, locksmiths and carpenters in particular should be considered as high-risk groups for MSDs, although separate analysis of ifw days and symptoms found in occupational health screening results in different rankings. The following conditions in particular seem to occur more frequently in the construction sector compared to the population as whole: disorders of the lumbar spine, shoulder joints and knee joints.

The report for the series Safety at Work and Occupational Medicine in the Construction Industry entitled “Musculoskeletal Disorders in the Building and Construction Industry – Occupational Health Findings – Risk Characteristics and Prevention Recommendations”, by the authors Hartmann and Seidel [21] focuses again on the construction industry. Occupational health screening results are examined in an analysis of secondary data.

Firstly, the occupations of those persons who personally reported back and shoulder complaints were listed. This information must be considered to be very subjective, but due the fact that it is actually recorded during any examination, it is included in the study. The 10 occupations in the construction industry for which back complaints are most frequently reported are: glaziers (54.9 %), stove fitters (52.0 %), installers (51.0 %), interior decorators (50.0 %), locksmiths (48.9 %), carpenters (48.6 %), tilers (48.2 %), stone workers (48.0 %), screed workers (47.3 %) and concrete workers (46.5 %). The 10 occupations that report joint complaints most frequently are: tilers (40.5 %), installers (39.2 %), screed layers (38.6 %), stucco plasterers (38.4 %), interior decorators (37.1 %), glaziers (36.7 %), carpenters (36.2 %), stove fitters (36.0 %), concrete workers (34.8 %) and bricklayers (33.3 %). In addition, objective physical findings are reported according to occupation. The table below (Table 12) lists the significant findings in a comparison with clerical workers.

Table 12: Findings of occupational health screenings and occupations in the construction industry consequently identified as high risk [21]

	High-risk occupations
Impaired movement in cervical and thoracic spine	Glaziers, bricklayers, locksmiths, installers
Hardening of muscles in cervical spine	Painters, carpenters, glaziers, clerical occupations
Muscle tension in cervical spine, neck	Clerical occupations
Hardening of muscles in thoracic spine	Screed workers, stone workers, carpenters, glaziers, bricklayers, painters, roofers
Symptoms in shoulder joints	Scaffolders, glaziers, stucco plasterers, carpenters, screed layers, bricklayers, installers
Symptoms in elbows	Bricklayers, installers, painters, roofers, carpenters, concrete workers, scaffolders, civil engineers, stucco plasterers, stove fitters
Symptoms in wrists	Concrete makers, crane drivers

Symptoms in hips	Tilers, concrete makers, machine drivers, concrete workers
Symptoms in knees	Installers, tilers, bricklayers, painters, concrete workers, interior decorators, joiners, screed workers

3.1.4. Summary of industry-sector-specific health reporting in Germany

On reviewing the available industry-sector-specific health reports in Germany as a whole, it can be concluded that more concerted efforts were made in three sectors in particular to record and analyze the incidence of incapacity for work due to MSDs. These three sectors are the construction industry, the building materials industry and the health/(physical) care sector. In these sectors, most of the MSDs are related to back pain. Using the reports available, specific high-risk occupations can be identified in these sectors, thus permitting more precise analysis of the MSD problems. However, there is no cross-industry description of the MSD situation in Germany, which means that analysis of the available data cannot be used to focus on prevention strategies that are based on comparison between industries.

3.1.5. Health reporting on occupational diseases (OD)

For the purpose of this study, data on occupational diseases was collated and reviewed so that reference could be made to the explanatory notes on the Ordinance on Occupational Diseases (cf. Ch. 2.1), too. For **OD 2101 (conditions affecting the tendon sheaths or the peritendinous tissue or the insertions of tendons or muscles)**, no high-risk occupations are specified in the explanatory notes [22]. For **OD 2102 (meniscus lesions caused by excessive physical load on the knee joints either sustained or repeated over several years)** [22a], above-average strain is assumed in the working lives of underground miners, stove fitters, pavers or parquet layers, shunters, and professional athletes and of occupations in confined spaces. **OD 2103 (conditions caused by vibration during work with pneumatic or similar tools or machines)** [22b] lists the following high-risk occupational activities: building, tunneling, quarry and stone working, mining, boiler shops, fettling shops, shipbuilding and road construction. The explanatory notes on occupational diseases No. **2104 (circulatory disorders of the hands)** [22c] identifies workers in the forestry, building and metal processing industries and in shipbuilding in particular

as high-risk workers. The explanatory notes on occupational diseases No. **2105 (chronic disorders of the mucous bursae caused by constant pressure)** [22d] lists the following workers whose occupations involve often placing pressure on their knees, elbows and shoulder joints: miners, floor layers and removers, tilers, road builders, pavers, cleaners, glass and stone grinders and porters. The explanatory notes on occupational diseases No. **2106 (pressure-induced nerve damage)** [22e] lists occupational groups mostly affected, e.g. professional musicians, grinders, butchers, grocers, workers in frozen foods production, supermarket cashiers and floor cleaners. Damage could also be caused by practising certain types of sport, e.g. cyclists, golfers, bowlers, horse riders. No particularly affected occupational groups are listed in the explanatory notes on **occupational disease no. 2107 (strain fractures of the spinous processes)** [22f]. In the explanatory notes on **occupational disease no. 2108 (disc-related diseases of the lumbar spine caused by lifting or carrying heavy loads over many years or in an extremely bent posture over many years...)** [22g], the following occupations are considered as particularly high risk: underground miners, bricklayers, stone workers, reinforced concrete workers and building labourers, dockers, furniture removal workers, carriers of coal, meat and other loads, farmers, fishermen, forestry workers, workers in nursing and care of the elderly and disabled. The explanatory notes on **occupational disease no. 2109 (disc-related diseases of the cervical spine caused by carrying heavy loads on the shoulder over many years)** [22h] lists only the group of workers who carry half or quarter animals on their head or shoulders as a particularly high-risk occupational group. The explanatory notes on **OD 2110 (disc-related diseases of the lumbar spine caused by the predominantly vertical impact of whole-body vibration in a seated position over many years...)** [22i] lists drivers of the following vehicles and mobile machinery as particularly at risk: construction site vehicles, agriculture and forestry tractors, off-road forestry equipment, excavators with high vibration levels, e.g. during demolition work, graders (pavement, road, and earth graders), for high vibration levels only, e.g. mainly for rough planning, scrapers, dumpers and skips, wheel and chain loaders, wheel dozers, forklifts on uneven roads (raised areas, cobbles, and so on), off-road military vehicles, water craft that glide through the swell. Finally, the creation of the new **occupational disease No. 2112, gonarthrosis caused by activities carried out while kneeling or similar pressure on the knee with a cumulative effect during**

the working life of at least 13,000 hours and a minimum effect duration of 1 hour per shift [22j], lists the following risks or high-risk occupational groups: tilers and similar, plasterers, roofers, installers, painters, concrete workers, underground miners, welders, shipbuilders, shipyard metal workers, gardeners and shunters. A **scientific explanation of carpal tunnel syndrome** [22k] is also provided. In this regard, international epidemiological literature shows the following occupations to be at risk: meat packers, assembly line workers in the automotive industry, forestry workers using handheld vibrating tools (e.g. power saws, augers or similar), poultry processors, cashiers in supermarkets who move loads, masseurs, upholsterers, etc.

When collecting data on the prevalence of MSDs in Germany, the prevalence of musculoskeletal disorders in statistics on notification of occupational disease should also be considered. In the documentation on occupational disease in Germany (published by the German Social Accident Insurance association in 2005 [23]), the number of notices of suspicion of occupational disease is listed according to economic sector. It gives the following data on notices of suspicion of occupational disease related to MSDs in 2005 (see Table 13). No comparison with data on the general public is possible.

3.1.6. Summary of OD reporting

In the framework of OD reporting, it can be shown that in the construction industry there is a particularly high number of notices of suspicion of occupational disease in the musculoskeletal system. OD 2102 and 2108 are the most numerous conditions. OD 2109, which also ranks high in numerical terms, affects health service workers in particular, as expected, while OD 2110 particularly affects those employed in the transport sector. No statistics are available for the new OD 2112 gonarthrosis.

Table 13: High-risk areas for notices of suspicion of occupational disease linked to musculoskeletal disorders, from OD documentation 2005 [23]

OD number	Industry	%	Total
2101	Construction	16.6	743
	Commerce and administration	16.6	
	Health service	14.0	
	Metal	10.6	
	Food and luxury commodities	8.1	

2102	Construction	35.4	1607
	Mining	25.4	
	Metal	9.3	
	Commerce and administration	8.7	
	Civil service	4.2	
2103	Construction	36.0	420
	Mining	26.4	
	Metal	19.3	
	Precision and electrical engineering	4.5	
	Commerce and administration	3.8	
2104	Construction	36.4	66
	Metal	21.2	
	Civil service	19.7	
	Mining	9.1	
	Non-metallic minerals	4.5	
2105	Construction	70.2	494
	Commerce and administration	8.7	
	Metal	7.9	
	Textiles and leather	2.6	
	Precision and electrical engineering	1.8	
2106	Construction	20.9	86
	Commerce and administration	18.6	
	Metal	12.8	
	Precision and electrical engineering	8.1	
	Health service	8.1	
	Civil service	8.1	
2108	Construction	25.5	5482
	Health service	22.1	
	Metal	10.8	
	Commerce and administration	8.8	
	Transport	6.7	
2109	Health service	25.9	1029
	Precision and electrical engineering	25.3	
	Construction	18.0	
	Transport	12.9	
	Metal	10.8	
2110	Transport	24.7	299
	Construction	21.1	
	Commerce and administration	14.4	
	Civil service	8.7	
	Non-metallic minerals	7.0	

3.1.7. Research reports

In the volume entitled “Industrial health management and prevention of work-related health risks (Volume 32)” [24] Bienek and colleagues report on the prevalence of back pain, orthopaedic symptoms and performance of the trunk muscles in working people (results of early diagnostic spinal examination). The early diagnostic spinal examination was conducted between 1995 and 1997 within the framework of the health and work programme KOPRAS, a cooperation between the federal association of company health insurance companies and the association of industrial accident insurance associations. A total of 334 workers in companies participating in KOPRAS took part in the study. Work and pain case histories were compiled, with each person undergoing an orthopaedic examination of the spine and measurement of the extent of mobility and the maximum strength of the trunk muscles. The report contains the findings regarding the prevalence of pain according to body area in various professions. In this case a distinction was made between the NSA area, comprising the sites cervical spine, shoulder girdle and shoulder joints, the area of the thoracic spine, which is regarded as a separate entity, and the LPH area which comprises the lumbar vertebrae, the pelvis, the coccyx and the hip joints. Grouped according to type of workplace, the following prevalence figures were found for **NSA pain**: sales (food) 60 %, sales (non-food) 44 %, sanders 41 %, office 34 %, straightening machines 31 %, warehouse 22 %, fitters 9 %, truck drivers 8 % and other 28 %. In the area of the **thoracic spine** pain prevalence was distributed as follows: sales (non-food) 10 %, warehouse 9 %, fitters 9 %, office 7 %, sales (food) 7 %, straightening machines 6 %, sanders 3 %, truck drivers 0 % and other 6 %. In the area of the **lower spine and the lower extremity** the following prevalence was found: sales (food) 73 %, fitters 71 %, sanders 69 %, straightening machines 69 %, truck drivers 68 %, sales (non-food) 62 %, office 50 %, warehouse 48 %, and other 66 %.

In another study conducted for the Federal Agency for Occupational Health and Safety and Industrial Medicine “Case-control study on disc prolapses in the cervical spine due to occupational stress” [25] by the authors Elsner et al., odds ratios are given for the occurrence of disc prolapses in the cervical vertebrae in certain professions. The reference group for calculating the occupational group-specific odds

ratios consisted of all test persons who had worked mainly in white-collar professions (service professions with the exception of nursing, warehouse work or refuse removal). The odds ratios were stratified for duration of employment (1-10 years of employment and f more than 10 years of employment in individual occupational groups), and were adjusted for age, gender, study centre and smoking (pack years). Using these analyses, it is possible to deduce increased odds ratios for some occupational groups (see Table 14). In examining the findings presented there, it is necessary to bear in mind the fact that for some occupations no data was available for employment with a duration of more than 10 years.

Finally, there is an article by the authors Schneider, Lipinski and Schiltenwolf dating from 2006 [26] which lists the occupations that have a high risk of self-reported back pain. The 10 occupations with the highest prevalence of **back pain reports** (7-day prevalence) were: foremen in industry and technical fields, traders 52,8 %, plasterers, concrete workers 47,9 %, translators, librarians 47,4 %, hairdressers, beauticians 47,3 %, printing workers, bookbinders 45,6 %, service personnel, sales assistants 45,1 %, plumbers and assembly-line workers 43,5 %, nurses and supervisors 43,0 %, saddlers, shoemakers, leather workers and tailors 42,3 %, labourers (unskilled) 40,6 %.

Table 14: Disc prolapses in cervical spine area, adjusted odds ratios in comparison with reference group of white-collar workers, from case-control study on disc prolapses in cervical spine area, from Elsner [25]

Occupation (in)	OR	95%KI
Livestock farming, farming, forestry and gardening (>10 years)	2	0.3-13.8
Chemicals and plastics(<10 years)	2	0.4-9.7
Paper production, processing, printing (<10 years)	1.8	0.3-10.5
Paper production, processing, printing (>10 years)	2.7	0.4-16.7
Metal production and processing(< 10 years)	5.6	1.3-24.5
Metal construction, mechanical engineering and (unskilled) metalworking (<10 years)	1.8	0.8-3.8
Metal construction, mechanical engineering and (unskilled) metalworking (>10 years)	4.4	1.8-10.6
Electrical sector (<10 years)	1.6	0.5-4.9
Electrical sector (>10 years)	3.5	1.1-11.1
Food sector (<10 years)	1.2	0.3-4.1
Food sector (>10 years)	2.3	0.5-10.3
Construction (<10 years)	3.4	1.2-9.7
Fillers, upholsterers (<10 years)	1.5	0.2-9.4
Painters, paint shop workers (<10 years)	1.2	0.2-8.3
Goods inspectors, mail order packers (<10 years)	11.9	1.3-107.0
Labourers (<10 years)	1.6	0.5-4.9

Machine operatives (<10 years)	2.6	0.4-17.4
Nurses, warehouse workers, refuse removal workers (<10 years)	2	0.8-4.9
Nurses, warehouse workers, refuse removal workers (>10 years)	1.6	0.6-4.6
Soldiers (<10 years)	2.5	0.5-12.7

Reference group: white-collar workers (1-10 years of employment and >10 years of employment), adjusted for age, gender, study centre, smoking

In the publication of the findings of the German Spine Study ("Deutsche Wirbelsäulenstudie") by the authors Michaelis et al. of 2007 [27] which focuses on "High-risk sectors and occupations for the development of disorders of the lumbar spine due to disc prolapses - results of the German Spine Study", cases of radiologically proven disc prolapse and those with advanced narrowing of the intervertebral disc of the lumbar spine with motor or sensory radiculopathy respectively were compared with age-matched and gender-matched control subjects. Adjusted odds ratios were calculated for the statement that an occupation had ever been practised and for the statement that an occupation had been practised for at least 10 years. Increased odds ratios (s: statistically significant; ns: not statistically significant) were recorded for the occupations listed in Table 15.

Table 15: Adjusted odds ratios for the connection between occupation and occurrence of disc prolapses in the cervical spine area (depending on sex and duration of employment), from Michaelis et al. [27]

Occupation (in)	Gender	Duration of employment *	Odds ratio	Significance
Livestock farming, farming, forestry and gardening	M	ever	1.2	ns
Livestock farming, farming, forestry and gardening	M	>10 years	1.3	ns
Mining, mineral extraction and processing	M	ever	1.7	ns
Chemicals and plastics	M	ever	1.3	ns
Chemicals and plastics	M	>10 years	1.9	ns
Paper production, processing, printing	M	ever	2.9	s
Paper production, processing, printing	M	>10 years	2.5	ns
Paper production, processing, printing	F	ever	1.4	ns
Metal production and processing	M	> 10 years	1.2	ns
Metal production and processing	F	ever	1.3	ns
Metal construction, mechanical engineering and (unskilled) metalworking	M	ever	1.3	s
Metal construction, mechanical engineering and (unskilled) metalworking	M	> 10 years	1.4	ns
Electrical sector	M	ever	1.2	ns
Electrical sector	M	> 10 Years	1.3	ns
Electrical sector	F	ever	1.4	ns

Assembly and metalworking, not including (unskilled) metalworking	F	ever	2.2	ns
Textiles and clothing	F	ever	1.2	ns
Leather production and processing, hide and pelt processing	M	ever	2.2	ns
Leather production and processing, hide and pelt processing	F	ever	1.5	ns
Nutrition sector	M	ever	1.6	ns
Nutrition sector	F	ever	2.3	s
Construction	M	> 10 years	1.1	ns
Fillers, upholsterers	M	ever	1.7	ns
Painters, paint shop workers	M	ever	1.7	ns
Painters, paint shop workers	M	>10 years	2.0	ns
Goods inspectors, mail order packers	F	ever	2.6	ns
Labourers	F	> 10 years	4.2	ns
Machine operators	M	> 10 years	3.5	s
Trade clerks	M	> 10 years	2.0	s
Trade clerks	F	ever	1.5	s
Trade clerks	F	> 10 years	1.4	ns
Transport, including storekeepers, warehouse workers, transport workers	M	ever	1.5	s
Transport, including storekeepers, warehouse workers, transport workers	M	> 10 years	1.9	s
Other services besides warehouse work, i.e. housekeeping, catering/hotels, cleaning/waste collection, hygiene	F	ever	1.3	ns
Other services besides warehouse work, i.e. housekeeping, catering/hotels, cleaning/waste collection, hygiene	F	> 10 years	1.8	s

M: male; F: female; ever: occupation ever practised; >10 years: occupation practised for more than 10 years; ns: not significant, s: significant

On the basis of these findings, it was possible to identify occupations for men and women respectively which this study showed to be associated with – in some cases – significantly increased odds ratios and which therefore were defined as a type of “high-risk occupation“:

- Men
(occupation ever practised)
- Welders 4.5 s,
 - Printers 3.1 s,
 - Drivers (particularly bus and truck drivers) 1.7 s,
 - Meat and fish processing workers (particularly butchers) 2.1 ns,
 - Chemicals workers 1.8 ns
 - Food preparers (particularly cooks, kitchen assistants) 1.8 ns,
 - Light metalworking and related occupations (particularly precision mechanics, dental technicians, gold and silver smiths) 1.6 ns,
 - Farmers 1.5 ns,
 - Installers (particularly heating installers, gas and water installers, plumbers) 1.5 ns

- Warehouse, transport, port workers 1.4 ns.
 - Mechanical engineering and maintenance occupations, in particular machine and machine tool construction workers, shop mechanics 1.4 ns,
 - Bricklayers, concrete workers 1.2 ns,
- Women
(occupation ever practised)
- Food preparers (particularly cooks, kitchen assistants) 2.3 s,
 - Sales personnel (particularly clothing and food sales) 1.5 s,
 - Farmers 1.6 ns,
 - Textile processing (particularly dressmakers, seamstresses) 1.3 ns,
 - Nurses, nursing auxiliaries 1.3 ns,
 - Hospitality personnel (particularly restaurant and hotel staff) 1.3 ns,
 - Cleaning personnel (particularly indoor cleaners) 1.,3 ns.
 - Hygiene (particularly hairdressers) 1.2 ns,

A German publication by Elsner et al. in the journal “Sozialmedizin Präventivmedizin” from 1996 examines the connection between knee joint arthrosis and work-related factors [27a]. Odds ratios are calculated for various occupations for men with knee joint arthrosis. The findings are shown in Tables 16 and 17

Table 16: High-risk occupations for knee joint arthrosis (men), from Elsner et al. [27a]

Occupations studied	Odds ratio	95% CI	
Office workers	0.6	0.29	1.30
White-collar workers	0.6	0.33	1.26
Construction	1.03	0.64	3.02
Metalworking	2.02	1.45	7.07
Butchers, bakers	1.4	0.31	6.69
Forestry workers, farmers	1.4	0.32	6.83
Hotel and catering workers	0.90	0.31	3.06
Caretakers, cleaners	1.0	0.14	8.04
Retail employees	0.4	0.13	1.82
Law enforcement occupations	2.5	0.73	9.06
Postal workers	3.12	0.37	25.62
Drivers	1.3	0.53	3.45
Graduates (technical professions)	0.8	0.34	2.02
Electrical, mechanical, telecommunications workers	0.5	0.24	1.44
Printers, setters and related occupations	0.4	0.1	1.82
Other services	0.7	0.16	3.65
Other industrial occupations	3.1	1.2	8.22

95%CI: 95% confidence interval

Table 17: High-risk occupations for knee joint arthrosis (women), from Elsner et al. [27a]

Occupations studied	Odds ratio	95% CI
Shorthand typists, office workers, secretaries	1.3	0.66- 2.55
Executives	0.4	0.18- 0.89
Hotel, catering and domestic workers	1.4	0.55- 3.98
Cleaners	1.0	0.25- 4.56
Retail employees	2.6	0.90- 7.52
Hairdressers and hygiene occupations	1.1	0.25- 5.42
Postal workers	1.1	0.25- 5.42
Graduates (technical professions)	1.05	0.03- 73.40
Textile occupations	0.8	0.22- 2.90
Nurses, nursery nurses	1.2	0.33- 4.43
Other health sector occupations	5.1	0.87- 30.28
Other industrial occupations	0.9	0.20- 2.50

95%CI: 95% confidence interval

Table 18: High-risk occupations for MSD, from Enderlein et al., "Data from occupational health screenings regarding the state of health of workers in Western and Eastern Germany" [28]

	High-risk occupations, men, OR (95% confidence interval)
Degenerative spinal changes (ICD 721-724, 732.0)	Metalworkers, assembly workers WG 1.21 (1.19-1.24), Goods transport and sales WG (1.24-1.34), Goods transport and sales EG 1.07 (1.05-1.09), Foundry workers WG 2.21 (2.10-2.32), Foundry workers EG 1.56 (1.52-1.59), Non-cutting metal shapers WG 1.10 (1.02-1.18), Metal welders, separators WG 1.12 (1.07-1.17), Electricians WG 1.30 (1.21-1.40), Paint shop workers WG 1.57 (1.41-1.75), Transport workers, goods inspectors WG 1.32 (1.26-1.37), Transport workers, goods inspectors EG 1.07 (1.05-1.09), Drivers EG 1.35 (1.33-1.38), Building and plant cleaners WG 1.50 (1.35-1.66) Wood processing workers EG 1.10 (1.08-1.13).
Degenerative joint changes (mainly arthrosis) (ICD 715, 717-718)	Metalworkers, assembly workers WG 1.20 (1.13-1.28), Metalworkers, assembly workers EG 1.05 (1.03-1.07), Goods transport and sales WG 1.18 (1.06-1.23), Foundry workers WG 1.59 (1.34-1.89), Foundry workers EG 1.56 (1.48-1.64), Non-cutting metal shapers WG 1.30 (1.09-1.55), Fitters, mechanics, installers WG 1.12 (1.02-1.23), Fitters, mechanics, installers EG 1.07 (1.04-1.10), Electricians WG 1.53 (1.28-1.83), Transport workers, goods inspectors WG 1.19 (1.06-1.33), Building and plant cleaners WG 2.10 (1.65-2.68),

	Wood processing workers WG 1.34 (1.05-1.71), Wood processing workers EG 1.10 (1.05-1.15)
	High-risk occupations, women, OR (95% confidence interval)
Degenerative spinal diseases	Chemicals and plastics sector workers WG 1.23 (1.11-1.36), Metalworkers, assembly workers WG 1.53 (1.45-1.62), Goods transport and sales WG 1.34 (1.23-1.46), Fitters, mechanics, installers WG 1.44 (1.30-1.60), Transport workers, goods inspectors WG 1.38 (1.26-1.51), Building and plant cleaners WG 1.59 (1.47-1.72).

EG: East Germany, WG: West Germany; no figures for degenerative diseases of the joints were listed for women in this research report.

The series of publications by the Federal Institute for Occupational Safety and Health (FB 825) contains a report by the authors Enderlein et al. entitled "Data from occupational health screenings regarding the state of health of workers in Western and Eastern Germany" [28]. This research report is based on two extensive sets of data gathered in occupational-medical health examinations (OHE): 1. OHE West, carried out by the occupational health practitioners at the occupational-medical centres belonging to TÜV Rheinland in North Rhine-Westphalia and Rhineland-Palatinate in the years 1982 to 1991, and 2. OHE East, carried out by the occupational health practitioners working in the industrial health service of the former German Democratic Republic from 1983 to 1990. This produced an extensive tabular work that in some cases considers individual diagnostic groups. The data were used to calculate standardised relative risks for the incidence of certain diseases (Table 18).

A current and very relevant source for finding an answer to the research question might be the closing report of research project F1996 of the Federal Institute for Occupational Safety and Health by the authors Liebers and Caffier [29]. In this work the authors report on occupation-specific incapacity for work due to MSD in Germany. They had evaluated the aggregated data on incapacity for work due to MSD (both the number of days of incapacity and the frequency of incapacity in the year 2000) from 4 statutory health insurers (AOK, BKK, Techniker Kasse and GEK). The data were stratified according to occupation (3-digit coding), age (5 age groups) and gender. The age-standardized relative risks of the occurrence of ifw cases and ifw days were calculated for all the occupations examined. This study is the only one to have systematically evaluated the correlation between specific MSD and occupations in Germany. At present it can be considered the best source for an

extensive, occupation-specific, epidemiological representation of musculoskeletal disorders in Germany. The five occupations for which the highest risks were calculated are listed in the Tables 19 to 22 below.

Table 19: MSD without localisation, Liebers and Caffier [29] (not translated)

MSE	ICD		Beruf	relatives Risiko*	95%	KI
Polyarthrose	M15	Männer	Waldarbeiter, Waldnutzer	2,68	1,27	5,62
Polyarthrose	M15		sonstige Tiefbauer	2,32	1,31	4,09
Polyarthrose	M15		Fleischer	2,23	1,15	4,30
Polyarthrose	M15		Straßenreiniger	2,07	1,32	3,25
Polyarthrose	M15		Abfallbeseitiger	2,06	1,55	2,73
Polyarthrose	M15	Frauen	Kunststoffverarbeiter	2,20	1,50	3,24
Polyarthrose	M15		Metallarbeiter	2,03	1,43	2,95
Polyarthrose	M15		Warenaufmacher, Versandfertigmacher	1,9	1,50	2,40
Polyarthrose	M15		Hauswirtschaftliche Betreuer	1,68	1,38	2,03
Polyarthrose	M15		Warenprüfer, Sortierer	1,66	1,14	2,42
sonstige Arthrose	M19	Männer	Waldarbeiter, Waldnutzer	2,31	1,71	3,14
sonstige Arthrose	M19		sonstige Papierverarbeiter	2,13	1,51	3,01
sonstige Arthrose	M19		Straßenreiniger, Abfallbeseitiger	2,12	1,74	2,60
sonstige Arthrose	M19		Gerüstbauer	1,98	1,25	3,15
sonstige Arthrose	M19		Straßenbauer	1,95	1,54	2,47
sonstige Arthrose	M19	Frauen	Fleisch-, Wurstwarenhersteller	2,66	1,43	4,95
sonstige Arthrose	M19		Verpackungsmittelhersteller	2,56	1,28	5,14
sonstige Arthrose	M19		Drahtverformer, -verarbeiter	2,54	1,24	5,20
sonstige Arthrose	M19		Blechpresser, -zieher, -stanzer	2,4	1,07	5,37
sonstige Arthrose	M19		sonstige Papierverarbeiter	2,06	1,06	4,01
Synovitis und Tenosynovitis	M65	Männer	Polsterer, Matratzenhersteller	4,29	2,73	6,73
Synovitis und Tenosynovitis	M65		Fleisch-, Wurstwarenhersteller	3,03	2,25	4,06
Synovitis und Tenosynovitis	M65		Straßenwarte	2,22	1,69	2,92
Synovitis und Tenosynovitis	M65		Halbzeugputzer und sonstige Formgießerberufe	2,17	1,73	2,73
Synovitis und Tenosynovitis	M65		Formgießer	2,03	1,48	2,78
Synovitis und Tenosynovitis	M65	Frauen	Papier-, Zellstoffhersteller	2,85	1,23	6,60
Synovitis und Tenosynovitis	M65		Fleisch-, Wurstwarenhersteller	2,75	1,98	3,82
Synovitis und Tenosynovitis	M65		Bauhilfsarbeiter	2,73	1,21	6,16
Synovitis und Tenosynovitis	M65		Mehl-, Nahrungsmittelhersteller	2,49	1,53	4,07
Synovitis und Tenosynovitis	M65		Buchbinderberufe	2,42	1,80	3,26
KH Synovialis und Sehnen	M67	Männer	Polsterer, Matratzenhersteller	2,42	1,28	4,57
KH Synovialis und Sehnen	M67		Halbzeugputzer und sonstige Formgießerberufe	2,04	1,35	3,08
KH Synovialis und Sehnen	M67		Straßenreiniger, Abfallbeseitiger	1,92	1,48	2,50

KH Synovialis und Sehnen	M67		Glaser	1,9	1,00	3,58
KH Synovialis und Sehnen	M67		Straßenwarte	1,72	1,10	2,71
KH Synovialis und Sehnen	M67	Frauen	Blechpresser, -zieher, -stanzer	2,63	1,06	6,55
KH Synovialis und Sehnen	M67		Fleisch-, Wurstwarenhersteller	2,54	1,40	4,62
KH Synovialis und Sehnen	M67		sonstige Papierverarbeiter	2,37	1,13	4,97
KH Synovialis und Sehnen	M67		Verpackungsmittelhersteller	2,32	1,17	4,61
KH Synovialis und Sehnen	M67		Metallarbeiter	2,03	1,58	2,62
KH Weichteilgewebe bei (Über)Beanspruchung und Druck	M70	Männer	Raumausstatter	5,25	3,12	8,82
KH Weichteilgewebe bei (Über)Beanspruchung und Druck	M70		Fliesenleger	4,48	2,98	6,74
KH Weichteilgewebe bei (Über)Beanspruchung und Druck	M70		Dachdecker	3,12	2,41	4,05
KH Weichteilgewebe bei (Über)Beanspruchung und Druck	M70		Ofensetzer, Luftheizungsbauer	2,58	1,01	6,57
KH Weichteilgewebe bei (Über)Beanspruchung und Druck	M70		Zimmerer	2,55	2,05	3,17
KH Weichteilgewebe bei (Über)Beanspruchung und Druck	M70	Frauen	Maler, Lackierer (Ausbau)	4,29	1,14	
KH Weichteilgewebe bei (Über)Beanspruchung und Druck	M70		Mehl-, Nahrungsmittelhersteller	3,77	1,08	
KH Weichteilgewebe bei (Über)Beanspruchung und Druck	M70		Fleisch-, Wurstwarenhersteller	3,04	1,49	6,19
KH Weichteilgewebe bei (Über)Beanspruchung und Druck	M70		Gummihersteller, -verarbeiter	2,8	1,18	6,67
KH Weichteilgewebe bei (Über)Beanspruchung und Druck	M70		sonstige Papierverarbeiter	2,68	1,14	6,30
Enthesopathien	M77	Männer	Polsterer, Matratzenhersteller	2,77	2,13	3,60
Enthesopathien	M77		Waldarbeiter, Waldnutzer	2,53	2,16	2,96
Enthesopathien	M77		Straßenwarte	2,37	1,93	2,90
Enthesopathien	M77		Straßenreiniger, Abfallbeseitiger	2,19	1,97	2,42
Enthesopathien	M77		Halbzeugputzer und sonstige Formgießerberufe	2,15	1,84	2,52
Enthesopathien	M77	Frauen	übrige spanende Berufe	2,91	1,01	8,38
Enthesopathien	M77		Verpackungsmittelhersteller	2,78	2,00	3,85
Enthesopathien	M77		Blechpresser, -zieher, -stanzer	2,49	1,70	3,62
Enthesopathien	M77		sonstige Papierverarbeiter	2,47	1,77	3,44
Enthesopathien	M77		Fleisch-, Wurstwarenhersteller	2,43	1,88	3,15
Osteochondropathien	M93	Männer	Bauhilfsarbeiter	2,1	1,22	3,63
Osteochondropathien	M93		Maurer	1,63	1,18	2,25
Osteochondropathien	M93		Rohrinstallateure	1,56	1,12	2,18
Osteochondropathien	M93		Lager-, Transportarbeiter	1,53	1,24	1,89

Osteochondropathien	M93		Warenaufmacher, Versandfertigmacher	1,53	1,06	2,19
Osteochondropathien	M93	Frauen	Köche	1,68	1,23	2,29
Osteochondropathien	M93		Raum-, Hausratreiniger	1,54	1,28	1,84
Osteochondropathien	M93		Hauswirtschaftliche Betreuer	1,53	1,05	2,24
Osteochondropathien	M93		Sozialarbeiter, Sozialpfleger	1,46	1,07	1,99
Fibromatosen	M72	Männer	Maschinenwärter, Maschinistenhelfer	1,90	1,04	3,48
Fibromatosen	M72		Straßenreiniger, Abfallbeseitiger	1,77	1,22	2,56
Fibromatosen	M72		Transportgeräteführer	1,57	1,11	2,20
Fibromatosen	M72		Eisenbahnbetriebsregler, Schaffner	1,56	1,03	2,35
Fibromatosen	M72		Chemiebetriebswerker	1,45	1,16	1,82
Fibromatosen	M72	Frauen	Helfer in der Krankenpflege	1,71	1,14	2,56
Fibromatosen	M72		Lager-, Transportarbeiter	1,6	1,05	2,44
Fibromatosen	M72		Köche	1,45	1,10	1,92
Fibromatosen	M72		Hauswirtschaftliche Betreuer	1,42	1,00	2,00
Fibromatosen	M72		Raum-, Hausratreiniger	1,34	1,14	1,56
KH Weichteilgewebe	M79	Männer	Fleisch-, Wurstwarenhersteller	2,19	1,71	2,82
KH Weichteilgewebe	M79		Polsterer, Matratzenhersteller	2,12	1,55	2,92
KH Weichteilgewebe	M79		Metallpolierer	2,1	1,30	3,34
KH Weichteilgewebe	M79		Straßenwarte	2,01	1,55	2,60
KH Weichteilgewebe	M79		Halbzeugputzer und sonstige Formgießerberufe	1,95	1,57	2,42
KH Weichteilgewebe	M79	Frauen	Fischverarbeiter	2,66	1,47	4,82
KH Weichteilgewebe	M79		Soldaten, Grenzschutz, Polizeibedienstete	2,6	1,35	5,02
KH Weichteilgewebe	M79		Blechpresser, -zieher, -stanzer	2,48	1,54	4,90
KH Weichteilgewebe	M79		Fleisch-, Wurstwarenhersteller	2,39	1,73	3,29
KH Weichteilgewebe	M79		Metallbearbeiter o. n. A.	2,22	1,92	2,56
biomechanische Funktionsstörung	M99	Männer	Waldarbeiter, Waldnutzer	2,09	1,75	2,50
biomechanische Funktionsstörung	M99		Stahlschmiede	1,79	1,44	2,23
biomechanische Funktionsstörung	M99		Ofensetzer, Luftheizungsbauer	1,77	1,03	3,04
biomechanische Funktionsstörung	M99		Polsterer, Matratzenhersteller	1,65	1,29	2,10
biomechanische Funktionsstörung	M99		Halbzeugputzer und sonstige Formgießerberufe	1,63	1,37	1,92
biomechanische Funktionsstörung	M99	Frauen	Tabakwarenmacher	2,6	1,23	5,51
biomechanische Funktionsstörung	M99		Fischverarbeiter	2,49	1,45	4,28
biomechanische Funktionsstörung	M99		Fleisch-, Wurstwarenhersteller	2,18	1,64	2,90
biomechanische Funktionsstörung	M99		Blechpresser, -zieher, -stanzer	2,18	1,42	3,34
biomechanische Funktionsstörung	M99		Gummihersteller, -verarbeiter	1,15	1,50	3,09
periphere Gefäßkrankheiten	I73	Männer	Verpackungsmittelhersteller	2,48	1,01	6,10
periphere Gefäßkrankheiten	I73		Straßenreiniger, Abfallbeseitiger	2,16	1,50	3,12
periphere Gefäßkrankheiten	I73		sonstige Papierverarbeiter	1,9	1,05	3,44
periphere Gefäßkrankheiten	I73		Wächter, Aufseher	1,79	1,38	2,31

periphere Gefäßkrankheiten	I73		Maschinen-, Behälterreiniger und verwandte Berufe	1,69	1,04	2,74
periphere Gefäßkrankheiten	I73	Frauen	Wächter, Aufseher	3,02	1,17	7,81
periphere Gefäßkrankheiten	I73		Metallarbeiter o. n. A.	2,3	1,23	1,08
periphere Gefäßkrankheiten	I73		Lagerverwalter, Magaziner	2,26	1,08	4,73
periphere Gefäßkrankheiten	I73		Wäscher, Plätter	2,08	1,04	4,15
periphere Gefäßkrankheiten	I73		Elektrogeräte-, Elektroteilemontierer	2,01	1,16	3,48

*altersstandardisiert; KH: Krankheit

Table 20: MSD upper extremity, Liebers, Caffier [29] (not translated)

MSE	ICD		Beruf	relatives Risiko*		
Mononeuropathien der oberen Extremitäten	G56	Männer	Polsterer, Matratzenhersteller	3,26	1,82	5,85
Mononeuropathien der oberen Extremitäten	G56		Fleischer	2,69	1,98	3,64
Mononeuropathien der oberen Extremitäten	G56		Halbzeugputzer und sonstige Formgießerberufe	2,63	1,84	3,75
Mononeuropathien der oberen Extremitäten	G56		Waldarbeiter, Waldnutzer	2,49	1,81	3,43
Mononeuropathien der oberen Extremitäten	G56		Gerüstbauer	2,44	1,51	3,93
Mononeuropathien der oberen Extremitäten	G56	Frauen	Polsterer, Matratzenhersteller	3,04	1,82	5,06
Mononeuropathien der oberen Extremitäten	G56		Verpackungsmittelhersteller	2,61	1,70	4,00
Mononeuropathien der oberen Extremitäten	G56		sonstige Papierverarbeiter	2,57	1,63	4,04
Mononeuropathien der oberen Extremitäten	G56		Drahtverformer, -verarbeiter	2,55	1,66	3,93
Mononeuropathien der oberen Extremitäten	G56		Schuhwarenhersteller	2,39	1,44	3,96
Schulterläsionen	M75	Männer	Gerüstbauer	2,45	1,90	3,15
Schulterläsionen	M75		Polsterer, Matratzenhersteller	2,39	1,85	3,10
Schulterläsionen	M75		Fleisch-, Wurstwarenhersteller	2,26	1,85	2,76
Schulterläsionen	M75		Metallzieher	2,22	1,59	3,10
Schulterläsionen	M75		Lederhersteller, Darmsaitenmacher	2,18	1,25	3,81
Schulterläsionen	M75	Frauen	Bauhilfsarbeiter	2,75	1,30	5,80
Schulterläsionen	M75		sonstige Papierverarbeiter	2,59	1,82	3,68
Schulterläsionen	M75		Papier-, Zellstoffhersteller	2,58	1,28	5,21
Schulterläsionen	M75		Blechpresser, -zieher, -stanzer	2,37	1,61	3,47
Schulterläsionen	M75		Schienenfahrzeugführer	2,33	1,24	4,35
Rhizarthrose	M18	Männer	Dreher	2,42	1,37	4,28
Rhizarthrose	M18		Straßenreiniger, Abfallbeseitiger	2,40	1,12	5,13
Rhizarthrose	M18		sonstige Montierer	2,01	1,05	3,85
Rhizarthrose	M18		Kraftfahrzeuginstandsetzer	2,01	1,30	3,09
Rhizarthrose	M18		Metallarbeiter, o. n. A.	1,88	1,28	2,78
Rhizarthrose	M18	Frauen	Kunststoffverarbeiter	2,72	1,63	4,53
Rhizarthrose	M18		Buchbinderberufe	2,59	1,03	6,55
Rhizarthrose	M18		sonstige Montierer	2,41	1,48	3,91

Rhizarthrose	M18		Metallarbeiter o. n. A.	2,36	1,50	3,72
Rhizarthrose	M18		Chemiebetriebswerker	2,26	1,18	4,31

*altersstandardisiert

Table 21: MSD lower extremity, Liebers, Caffier [29] (not translated)

MSE	ICD		Beruf	relatives Risiko*		
Enthesopathien der unteren Extremität mit Ausnahme des Fußes	M76	Männer	Straßenwarte	2,44	1,34	4,44
Enthesopathien der unteren Extremität mit Ausnahme des Fußes	M76		Straßenreiniger, Abfallbeseitiger	2,26	1,66	3,08
Enthesopathien der unteren Extremität mit Ausnahme des Fußes	M76		Waldarbeiter, Waldnutzer	2,08	1,37	3,17
Enthesopathien der unteren Extremität mit Ausnahme des Fußes	M76		Postverteiler	2,05	1,43	2,94
Enthesopathien der unteren Extremität mit Ausnahme des Fußes	M76		Blechpresser, -zieher, -stanzer	1,79	1,20	2,68
Enthesopathien der unteren Extremität mit Ausnahme des Fußes	M76	Frauen	Chemiebetriebswerker	2,17	1,23	3,80
Enthesopathien der unteren Extremität mit Ausnahme des Fußes	M76		Kunststoffverarbeiter	2,14	1,43	3,21
Enthesopathien der unteren Extremität mit Ausnahme des Fußes	M76		Warenaufmacher, Versandfertigmacher	1,93	1,50	2,50
Enthesopathien der unteren Extremität mit Ausnahme des Fußes	M76		Helfer in der Krankenpflege	1,85	1,47	2,34
Enthesopathien der unteren Extremität mit Ausnahme des Fußes	M76		Metallarbeiter o. n. A.	1,79	1,26	2,55
Coxarthrose	M16	Männer	Straßenwarte,	2,48	1,55	3,97
Coxarthrose	M16		Waldarbeiter, Waldnutzer	2,37	1,69	3,33
Coxarthrose	M16		Straßenreiniger, Abfallbeseitiger	1,97	1,59	2,43
Coxarthrose	M16		Bauer, Mälzer	1,92	1,05	3,50
Coxarthrose	M16		Fleischer	1,85	1,38	2,47
Coxarthrose	M16	Frauen	Verpackungsmittelhersteller	2,04	1,07	3,91
Coxarthrose	M16		sonstige Papierverarbeiter	2,00	1,01	3,96
Coxarthrose	M16		Kunststoffverarbeiter	1,86	1,43	2,42
Coxarthrose	M16		Helfer in der Krankenpflege	1,75	1,49	2,05
Coxarthrose	M16		Oberbekleidungsnäher	1,71	1,17	2,51
Gonarthrose	M17	Männer	Raumausstatter	2,21	1,59	3,06
Gonarthrose	M17		Estrich-, Terrazzoleger	2,21	1,33	3,66
Gonarthrose	M17		Fliesenleger	2,13	1,63	2,78
Gonarthrose	M17		Straßenreiniger, Abfallbeseitiger	2,09	1,81	2,42
Gonarthrose	M17		Stauer, Möbelpacker	2,08	1,46	2,95
Gonarthrose	M17	Frauen	Maler, Lackierer (Ausbau)	3,01	1,04	8,68
Gonarthrose	M17		Melker	2,69	1,26	5,75
Gonarthrose	M17		Maschenwarenfertiger	2,60	1,10	6,15
Gonarthrose	M17		Fleisch-, Wurstwarenhersteller	2,18	1,49	3,17

Gonarthrose	M17		sonstige Papierverarbeiter	2,02	1,31	3,10
Binnenschädigung des Kniegelenks	M23	Männer	Fliesenleger	1,92	1,63	2,27
Binnenschädigung des Kniegelenks	M23		Rohrinstallateure	1,7	1,60	1,81
Binnenschädigung des Kniegelenks	M23		Straßenreiniger, Abfallbeseitiger	1,7	1,54	1,87
Binnenschädigung des Kniegelenks	M23		Artisten, Berufssportler, künstlerische Hilfsberufe	1,67	1,22	2,28
Binnenschädigung des Kniegelenks	M23		Waldarbeiter, Waldnutzer	1,65	1,44	1,90
Binnenschädigung des Kniegelenks	M23	Frauen	Maler, Lackierer (Ausbau)	2,38	1,34	4,22
Binnenschädigung des Kniegelenks	M23		Maschenwarenfertiger	2,22	1,11	4,47
Binnenschädigung des Kniegelenks	M23		sonstige Papierverarbeiter	1,78	1,25	2,54
Binnenschädigung des Kniegelenks	M23		Melker	1,72	1,03	2,86
Binnenschädigung des Kniegelenks)	M23		Milch-, Fettverarbeiter	1,68	1,01	2,79

*altersstandardisiert

Table 22: MSD of the spine, Liebers, Caffier [29] (not translated)

MSE	ICD		Beruf	relatives Risiko		
Kyphose und Lordose	M40	Männer	Straßenreiniger, Abfallbeseitiger	2,38	1,20	4,74
Kyphose und Lordose	M40		Bauhilfsarbeiter	1,99	1,15	3,44
Kyphose und Lordose	M40		Kunststoffverarbeiter	1,97	1,29	3,00
Kyphose und Lordose	M40		Transportgeräteführer	1,85	1,01	3,37
Kyphose und Lordose	M40		Bauschlosser	1,65	1,04	2,63
Kyphose und Lordose	M40	Frauen	Kunststoffverarbeiter	2,5	1,21	5,13
Kyphose und Lordose	M40		Metallarbeiter o. n. A.	2,34	1,20	4,58
Kyphose und Lordose	M40		Warenaufmacher, Versandfertigtmacher	2,09	1,35	3,23
Kyphose und Lordose	M40		Helfer in der Krankenpflege	1,87	1,27	2,76
Kyphose und Lordose	M40		Hauswirtschaftliche Betreuer	1,78	1,23	2,58
Osteochondrose der WS	M42	Männer	Stauer, Möbelpacker	2,23	1,21	4,13
Osteochondrose der WS	M42		Straßenreiniger, Abfallbeseitiger	2,17	1,68	2,82
Osteochondrose der WS	M42		Stahlschmiede	1,94	1,22	3,08
Osteochondrose der WS	M42		Straßenbauer	1,93	1,44	2,59
Osteochondrose der WS	M42		Holzaufbereiter	1,85	1,39	2,46
Osteochondrose der WS	M42	Frauen	Gummihersteller, -verarbeiter	2,65	1,15	6,10
Osteochondrose der WS	M42		Fleisch-, Wurstwarenhersteller	2,06	1,14	3,74
Osteochondrose der WS	M42		sonstige Montierer	2,05	1,53	2,74
Osteochondrose der WS	M42		Metallarbeiter o. n. A.,	2,01	1,53	2,63
Osteochondrose der WS	M42		Buchbinderberufe	1,99	1,16	3,43

WS						
sonstige Deformitäten der WS und des Rückens	M43	Männer	Polsterer, Matratzenhersteller	2,02	1,21	3,37
sonstige Deformitäten der WS und des Rückens	M43		Halbzeugputzer und sonstige Formgießerberufe	1,98	1,38	2,83
sonstige Deformitäten der WS und des Rückens	M43		Waldarbeiter, Waldnutzer	1,82	1,32	2,50
sonstige Deformitäten der WS und des Rückens	M43		Straßenwarte	1,82	1,20	2,74
sonstige Deformitäten der WS und des Rückens	M43		Glaser	1,8	1,04	3,12
sonstige Deformitäten der WS und des Rückens	M43	Frauen	Fleisch-, Wurstwarenhersteller	2,49	1,35	4,59
sonstige Deformitäten der WS und des Rückens	M43		sonstige Papierverarbeiter	2,21	1,05	4,63
sonstige Deformitäten der WS und des Rückens	M43		Verpackungsmittelhersteller	2,21	1,10	4,40
sonstige Deformitäten der WS und des Rückens	M43		Gummihersteller, -verarbeiter	2,05	1,01	4,17
sonstige Deformitäten der WS und des Rückens	M43		Metallarbeiter o. n. A.	1,86	1,45	2,39
Spondylose	M47	Männer	Fischverarbeiter	2,5	1,17	5,34
Spondylose	M47		Lederhersteller, Darmsaitenmacher	2,32	1,05	5,12
Spondylose	M47		Tabakwarenmacher	2,32	1,03	5,25
Spondylose	M47		Vulkaniseure	2,22	1,14	4,32
Spondylose	M47		Straßenreiniger, Abfallbeseitiger	2,15	1,85	2,49
Spondylose	M47	Frauen	Fischverarbeiter	4,39	1,87	
Spondylose	M47		Tabakwarenmacher	2,76	1,11	6,87
Spondylose	M47		Fleisch-, Wurstwarenhersteller	2,59	1,77	3,77
Spondylose	M47		Gummihersteller, -verarbeiter	2,37	1,51	3,70
Spondylose	M47		Keramiker	2,36	1,48	3,76
sonstige Bandscheibenschäden	M51	Männer	Lederhersteller, Darmsaitenmacher	2,12	1,28	3,52
sonstige Bandscheibenschäden	M51		Lederbekleidungshersteller und sonstige Lederverarbeiter	1,96	1,05	3,64
sonstige Bandscheibenschäden	M51		Straßenwarte	1,95	1,63	2,34
sonstige Bandscheibenschäden	M51		Straßenreiniger, Abfallbeseitiger	1,92	1,75	2,10
sonstige Bandscheibenschäden	M51		Waldarbeiter, Waldnutzer	1,84	1,61	2,10
sonstige Bandscheibenschäden	M51	Frauen	Tabakwarenmacher,	2,83	1,27	4,47
sonstige Bandscheibenschäden	M51		Mehl-, Nahrungsmittelhersteller	2,21	1,47	3,32
sonstige Bandscheibenschäden	M51		Schienenfahrzeugführer	2,05	1,17	3,60
sonstige	M51		Soldaten, Grenzschutz,	1,99	1,24	3,19

Bandscheibenschäden			Polizeibedienstete			
sonstige Bandscheibenschäden	M51		Milch-, Fettverarbeiter	1,92	1,23	3,00
KH WS und Rücken	M53	Männer	Halbzeugputzer und sonstige Formgießerberufe	2,16	1,88	2,48
KH WS und Rücken,	M53		Straßenreiniger, Abfallbeseitiger	2,07	1,89	2,26
KH WS und Rücken	M53		Emaillierer, Feuerverzinker und andere Metalloberflächenveredler	2,01	1,55	2,60
KH WS und Rücken	M53		Straßenwarte	1,94	1,66	2,28
KH WS und Rücken	M53		Polsterer, Matratzenhersteller	1,89	1,57	2,28
KH WS und Rücken	M53	Frauen	Nieter,	4,12	1,20	
KH WS und Rücken	M53		Fischverarbeiter	3,9	2,08	4,33
KH WS und Rücken	M53		Bohrer	2,64	1,40	5,00
KH WS und Rücken	M53		Galvaniseure, Metallfärber	2,55	1,71	3,81
KH WS und Rücken	M53		Halbzeugputzer und sonstige Formgießerberufe	2,52	1,52	4,15
Rückenschmerzen	M54	Männer	Straßenreiniger, Abfallbeseitiger	1,97	1,91	2,04
Rückenschmerzen	M54		Straßenwarte	1,93	1,82	2,05
Rückenschmerzen	M54		Emaillierer, Feuerverzinker und andere Metalloberflächenveredler	1,92	1,74	2,12
Rückenschmerzen	M54		Halbzeugputzer und sonstige Formgießerberufe	1,9	1,81	2,00
Rückenschmerzen	M54		Waldarbeiter, Waldnutzer	1,83	1,75	1,91
Rückenschmerzen	M54	Frauen	Straßenwarte	3,48	1,48	8,16
Rückenschmerzen	M54		Fleisch-, Wurstwarenhersteller	3,48	2,26	2,71
Rückenschmerzen	M54		Fischverarbeiter	2,44	2,08	2,87
Rückenschmerzen	M54		Nieter	2,39	1,52	3,77
Rückenschmerzen	M54		Mehl-, Nahrungsmittelhersteller	2,36	2,05	2,72
Zervikale Bandscheibenschäden	M50	Männer	Straßenreiniger, Abfallbeseitiger	2,18	1,66	2,86
Zervikale Bandscheibenschäden	M50		Stahlschmiede	2,13	1,28	3,52
Zervikale Bandscheibenschäden	M50		Metallvergüter	1,94	1,06	3,54
Zervikale Bandscheibenschäden	M50		Waldarbeiter, Waldnutzer	1,88	1,31	2,70
Zervikale Bandscheibenschäden	M50		Stauer, Möbelpacker	1,85	1,04	3,31
Zervikale Bandscheibenschäden	M50	Frauen	Glasbearbeiter, -veredler	2,34	1,11	4,93
Zervikale Bandscheibenschäden	M50		sonstige Montierer	2,29	1,74	3,01
Zervikale Bandscheibenschäden	M50		Metallarbeiter o. n. A.	2,19	1,70	2,83
Zervikale Bandscheibenschäden	M50		Zucker-, Süßwaren-, Speiseeishersteller	2,09	1,22	3,59
Zervikale Bandscheibenschäden	M50		Keramiker	2,04	1,03	4,06

*altersstandardisiert

3.1.8. Summary of the research reports

Even within the relatively scarce German research reports gathered here, the data situation is very inhomogeneous. The work of Liebers, Caffier in particular is the only one to provide an overview of MSD structured according to localisation and depending on different occupations. Apart from some methodological problems, which in some cases were virtually unavoidable, this work is therefore the one with which the research question initially posed is most likely to be answered. The results of this work (considering the lack of other structured data) form the basis for Chapter 3.4. where we tried to present the research findings comprehensively.

3.2. Occupation-related musculoskeletal disorders in Europe

The website of the OSHA (European Agency for Safety and Health at Work; www.osha.europa.eu/de/topics/msds/index_html/facts_html) lists those occupations which are particularly frequently associated with the occurrence of musculoskeletal disorders (in general). These are:

- agricultural, forestry and fishing workers
- construction workers
- carpenters
- drivers
- nurses
- miners
- machine operators
- craft workers
- tailors
- retail workers
- hotel, restaurant and catering workers
- secretaries and typists
- loaders and unloaders.

Unfortunately, no other figures are available on localised or specific MSDs, nor are percentages showing the prevalence of the individual MSDs in the various occupational groups. For this reason, the information available can only be used to a limited extent to answer the research question.

Another source of data that refers less to Germany in particular than to the European area is the report entitled “Work and health in the EU - A statistical portrait“ [30], in which data from the European member states between 1994 and 2002 were evaluated. This report contains details on standardised prevalence rates of musculoskeletal problems caused or worsened by work. What is striking is that the prevalence of these health problems is at its highest in the health and social work, construction, transport and agricultural sectors. In the health and social work sector, the standardised prevalence rate is approx. 4250/100,000 workers, in the construction sector it is 3200/100,000, as it is in transport and communications. In the agricultural, hunting and forestry sector, the standardised prevalence rate is approx. 2800/100,000 workers. The prevalence rate in these sectors is therefore 2-3 times higher than in the hotel and restaurant or finance sectors. Other occupational areas that show a prevalence of over 20 % are production, sales, real estate, public services and defense and education.

3.3. Occupation-related musculoskeletal disorders in international scientific literature

On the basis of the methodical approach described in Chapter 2.1.3., a total of 61 review papers were selected for further examination towards answering the research question. All the reviews were examined with regard to the studies included, analysed or cited, the conclusions reached concerning admissibility of correlation between occupation or occupational activity and the prevalence of a/the risk of musculoskeletal disorder. The study was put into tabular form and subsequently structured according to the occupational groups examined. The results of the literature research are listed in Tables 23 to 42.

3.3.1. Results

A detailed description of the individual works can be dispensed with here in favour of the tabular presentation of the results. The following paragraphs state briefly the overall impression gained from analysis of the international literature.

Nine reviews contained information or studies on the construction sector [31; 32; 33; 34; 35; 36; 37; 38]. In this sector, the studies mainly focused on correlation between

occupation and shoulder/neck pains and knee-joint arthrosis (Table 23). The occupational categories particularly well studied are carpenters, screed workers and tilers.

For mining workers, a total of seven reviews were identified [32; 33; 38; 39; 40], presenting details on this occupational group. Their findings focused particularly on knee-joint arthrosis and lumbar spine pain (Table 24).

Many of the studies concerned office workers in one form or another [31; 37; 38; 40; 41; 42], in which occupations are included which mainly feature work at computer workstations. The study by Ijmker [42] in particular lists many individual studies on handling office aids, such as the keyboard and mouse. In terms of disorders, the focus is therefore clearly on those of the hand/wrist and elbow, although in some cases details of pain in the neck and lumbar spine areas were also examined (Table 25).

The very heterogeneous group constituted by factory workers was the subject of eleven studies [31; 33; 35; 36; 37; 40; 43; 44; 54; 74]. The main focus was on workers in the textiles and metalworking industries. As far as the actual occupational tasks were concerned, those examined most of all were of a repetitive nature, while the MSD range mainly included tendonitis in the elbow and wrist, as well as neck complaints (Table 26).

In three studies [31; 45; 46] there were very detailed reports on MSD in drivers, which mainly referred to drivers of forklifts, earth-moving machines or cranes. The central concern with regard to this group is the simultaneous combination of activity in a sitting position and the effect of whole-body-vibration, while the focus on disorders revolves around pain and complaints in the area of the lumbar spine (Table 27).

Another major occupational group that could be identified by means of literature research is that of workers in the meat and fish processing industry. These occupations were referred to in a total of 5 studies [31; 43; 44; 47; 48; 56] which mainly examined the incidence of carpal tunnel syndrome, epicondylitis and tenosynovitis, i.e. upper-extremity MSDs. One review dealt mainly with occupations in cold stores and also examined other MSD localizations, too (Table 28).

Seven reviews dealt with hospital workers [31; 35; 36; 37; 40; 49] and studied in particular the correlation between posture and strain due to heavy lifting and the effects of this activity on pain in the spinal area, especially the neck. In addition,

some reviews described strain on workers due less to direct activity than to working in a certain ward (e.g. intensive care unit) (Table 29).

Eleven reviews also included farmers in their studies [32; 33; 34; 46; 50; 51; 52; 53; 54; 55; 57], with dairy farmers forming a focal group within the farmers' group. The studies focused on back pain and hip-joint arthrosis (Table 30).

The correlation between teaching and MSD was addressed in two reviews, one of which mainly examined sports teachers [38; 57]. Here, particular attention was paid to hip and knee joint arthrosis (Table 31).

Five reviews [58; 59; 60; 61; 62,] centred upon the military sector. Particularly, the frequency of fatigue fractures was examined more intensively. Apart from that, most of these reviews focused on MSDs of the lower-extremities/foot and on MSDs in the lumbar spine (Table 32).

In contrast, the five reviews containing details of "musicians" [31; 63; 64; 65; 66] mainly examined upper-extremity MSDs and neck pain (Table 33).

Studies of ship and dock workers in a total of six reviews [31; 33; 38; 40; 57] provided occasional indications of knee and hip joint arthrosis, but on the whole no clear disorder priorities could be determined (Table 34).

There are three studies on professional athletes [54; 67; 68], but here, too, it is not possible to identify any clear MSD priority (Table 35).

Two studies deal more or less exclusively with professional dancers [31; 63] and focus on lower-extremity MSDs (foot) but also in great detail on injuries resulting from this occupation (Table 36).

Five studies were identified that examine workers in the telecommunications sector [31; 36; 37; 41; 69]. As their occupation mainly involves working at computer workstations in a sitting position, the studies report of pain in the neck and shoulder area, similar to that of office workers (Table 37).

With regard to sales personnel, the six reviews found on this occupational group produced indications of two important MSD localisations [31; 36; 37; 43; 48; 70]: pain in the neck and shoulder area and pain in the area of the lumbar vertebrae (Table 38).

The five reviews available on forestry workers [31; 33; 34; 37; 43,] principally examined their exposure to vibrating machinery, such as chain saws, and as a result reported upper-extremity MSDs and pain in the neck (Table 39).

Surprisingly, eight reviews were found examining dentists [31; 36; 37; 59; 47; 68; 71; 72], and dental personnel. These mainly examined the correlation between working posture and pain in the back and neck (Table 40).

The last easily distinguishable occupational group found in the course of the review analysis of Work Package 1 is that of newspaper workers [31; 36; 41] whose occupation also mainly involves working at computer workstations. The three reviews concerning this group reported mainly on shoulder and neck pain (Table 41).

Finally, Table 42 presents individual occupational groups that could not be allocated to any “main” occupational group in this overview [31; 33; 34; 40; 43; 47; 73].

[Tables 23 – 42 \(not translated\) see enclosure WP_1_Tables](#)

3.3.2. Summary of the results from the international literature

In view of the fact that only review papers were examined in Work Package 1, it is obvious that certain distortions have to be assumed regarding the occupational groups studied, for example. What can be said in favour of using review papers is the fact that one can assume that the occupational groups studied here are particularly relevant and well researched, which means that preventive measures could be particularly effective and practicable in these cases.

3.4. Overview and outlook regarding work-related MSDs in Germany

Finally, we attempted to compile a list of risk occupations according to MSD localisation, using the data available on the MSD situation in Germany. For the purpose of better comparability with the findings of Work Package 3 in particular, it was also attempted, as far as possible, additionally to provide the ICD-10 code of the corresponding disorder. The German data were subsequently compared with the summary of the key findings of the research described in the international literature which was drawn up within the framework of this Work Package.

[Tables 43 – 45 \(not translated\) see enclosure WP_1_Tables](#)

4. Discussion and recommendations

General health reporting in Germany:

A decisive factor in the attempt to extract information on the correlation between occupation and the incidence of MSD from health reports is the fact that most of the health reports do not focus specifically on the prevalence of diagnoses, but are mostly restricted to measuring ifw cases or ifw days. This measurement can only be seen as a substitute, with the result that the findings thus obtained at best constitute estimates. Many of the findings presented here, especially those which originate from health reports and refer to the number and duration of ifw cases, can therefore only at best be regarded as substitutes for the actual relevance of these disorders. Moreover, the examination of cases and duration of incapacity for work contains process-dependent errors, because reporting of the duration of incapacity for work is not consistent in all the institutions involved and, in addition, because the factor of presenteeism among employees, i.e. employees coming to work in spite of illness, is not taken into account. If the research question is to be answered on the basis of data from health reports alone, the figures presented are by no means sufficient. It should also be taken into consideration that individual statutory health insurance funds insure different groups of people some of whom work in very specific occupational fields. As many of the reports regard the prevalence of MSD incidence in certain occupational groups in relation to the total number of people insured with the respective health insurer, a numerical inter-insurer comparison of ifw cases is not useful. It would be more useful and desirable to have a nationwide presentation of all insurers, but to establish this would require agreement and coordination between all parties involved in work-related health reporting. Although such cooperative models were called for at EU level years ago, there are no signs at present of these demands being implemented in Germany. Systematic analysis of ifw cases or, better still, of ifw cases per individual, together with systematic recording of the findings of occupational health screenings, would be a basic necessity, however, in order to enable high-risk groups and occupations to be identified across industry boundaries and systematic preventive concepts to be derived from this.

Industry-related health reporting:

In this work it was possible to identify reports that examined three industries and intensively studied the correlation between MSDs and occupations within the respective industry. It is possible, if not probable, that other sectors have carried out such studies, but these are not readily available through simple literature research. It is therefore to be hoped that any industry-specific findings can be made available to a broader public in the future. The works available on the construction industry in particular are very comprehensive and indicate that there is a major need for action with regard to MSD prevention. With regard to this attempt to present an overall picture of occupation-related MSDs in Germany, these reports are almost too detailed in places to allow any comparison with the other, much more roughly drafted health reports. However, they do provide a good database for use in longitudinal studies to establish any changes, e.g. after implementation of preventive measures. The construction industry, which has already given such close attention to MSDs, is clearly ahead of other branches of industry in this respect.

Research reports

Numerous attempts have been made to record individual aspects of the incidence of MSDs more precisely for Germany. However, the focus here has been on particular disorders or particular occupational groups. It would be difficult to produce an overall picture for Germany on the basis of these individual reports were it not for a research report published only a few weeks ago by the authors Liebers and Caffier who are the first to have attempted to approach MSD incidence in Germany epidemiologically and present an overall picture of work-related MSDs in Germany. The fact that the authors of this report refer to cases and not to individuals suffering from MSDs might turn out to be problematic for the evaluation of the results, however. One individual can account for several ifw cases in one calendar year, for example, which means that the figures calculated here also have to be interpreted with caution. A further limitation of the study was the fact that the authors concentrated on musculoskeletal disorders which were known to have been associated with occupational physical influencing factors. A total of 26 diagnoses were selected here on the basis of the ICD-10 code (DIMDI, 1999/2000) combined with the Nordic adaptation of the

classification of occupationally relevant disorders (Nordic Council, 2000). In addition, basing the study on the four major statutory health insurance funds mentioned above involves the risk that certain occupational groups could be over- or underrepresented. Methodological problems will therefore probably have to be taken into consideration regarding the approach chosen, but these problems are partly due to the form of health reporting in Germany which has already been criticised above. Ultimately, however, Liebers and Caffier's work is the only one at the moment that provides an adequate overview of the situation in Germany.

Occupational disease reporting

In assessing risk occupations it is helpful to study the explanatory notes on the Ordinance on Occupational Diseases (cf. Ch. 3.1.5) on the respective occupational disorders of the musculoskeletal system, as the high-risk occupations referred to have been identified and listed on the basis of prior literature research. Evaluation of the incidence of occupational diseases, in particular the notices of suspicion of occupational disease evaluated here should be considered critically, because in cases of notification of suspicion of occupational disease it is not clear whether the causality or disease does in fact exist. Furthermore it should be taken into account that employees in the health service may be more likely to insist upon notification of suspicion of occupational disease than employees in the construction industry.

Occupation-related MSD reporting in Europe

Research into European reports was limited to the OSHA web site, as, according to the research assignment, the main focus was to be on reporting in Germany. The European pages of the web site appear to contain mainly summarised information from German health reports or international findings that have been applied to Germany.

Literature research

For this research assignment, due to the short time available the literature research conducted was based on a rather limited approach, focussing exclusively on review

articles. However, as any assessment of current scientific knowledge should in theory be based mainly on original works, one may assume that the exclusive study of reviews could lead to a distorted picture of current knowledge. Since further limitation of the assessment to high-quality reviews might have led to further distortion, and although the reviews were evaluated in accordance with the AMSTAR quality criteria within the framework of this assignment, in the end all the reviews found in the course of our research were in fact analysed and presented in Tables 23 to 42.

The literatur research conducted led to various occupational groups being identified and key areas of examination being defined within these occupational groups. Assuming that these key areas of examination were chosen because problems occur in these areas, these international findings can also be taken into account to derive recommendations for further research projects.

On the basis of the data collected in this research, with particular consideration to the Liebers/Caffier report, the following recommendations present themselves for future research /preventive measures:

Upper extremity:

Intervertebral disc-based neck complaints:

- Metalworking occupations(RR 1.9-2.1, OR 5.6)
- Waste disposal workers (RR 2.2)
- Forestry workers (RR 1.9)
- Warehouse workers, furniture packers (RR 1.9)
- Women in particular: glass and ceramics sector (RR 2.0-2.3), assembly workers (RR 2.3), food industry (RR 2.0), health service (BK 2109)

Shoulder-neck pain:

- Agriculture (OR 1.6-2.4)
- Office work (computer workstations) (OR 1.5-4.4)
- Construction work (scaffolding builders, interior decorators, unskilled labourers) (OR 2.3-3.2), particularly shoulder pain

Elbow (enthesopathy, epicondylitis):

- Upholsterers, mattress makers (OR 2.8)
- Forestry workers (OR 2.5),
- Waste disposal workers (OR 2.2-2.4),
- Shop-floor workers (assembly line, food industry) (RR 6.4-36.1; OR 1.5-7.0)
- Office workplaces (OR 2.9-6.2);
- Women in particular: metalworkers (industry) (RR 2.5-2.9), paper production and processing (OR: 2.5-2.8)

Hand/wrist (synovitis/tenosynovitis/mononeuropathy):

Rhizarthrosis:

- Metalworkers (RR: 2.0-2.4),
- Female assembly workers (RR 2.4)

Carpal tunnel syndrome:

- Upholsterers, mattress makers (RR 3.3)
- Meat/fish processing/factory/frozen foods (OR 8-36, RR 2.7-14.3),
- Metalworking occupations (semi-product conditioners, wire shapers) (OR 2.6)

Tendosynovitis, synovitis, hand (and wrist) complaints:

- Office (OR 2.0-4.2)
- Factory (assembly line (OR 1.1-9.0), packers (RR bis 14), food industry (OR 2.5-2.8), paper industry (RR 2.4-2.9))
- Metalworking occupations (2.0-2.6)
- Interior decorators (RR 2.5-5.3)

Lower extremity:

Intervertebral disc-based lumbar spine complaints:

- Metalworkers (fitters, shapers, OR 4.5)
- Printing and paper industries (OR 2.9-3.1),
- Transport and warehouse workers (OR 1.7-1.9).
- Construction workers (BK 2108)
- Women in particular: cooks (OR 2.3), sales assistants (OR 1.5) and cleaners (OR 1.6), health service (BK 2108)

Lumbar spine pain:

- Waste disposal (OR 1.9-2.1)
- Security personnel (police, military) (high prevalence, up to over 90%)
- Metalworking occupations (semi-product conditioners, enamellers): (OR 2.0-2.2)
- Women in particular: waste disposal (OR 3.5), food processing factory workers (OR 2.4-3.5), metalworking (riveters) (OR 2.4)

Hip:

- Forestry workers (RR 2.4; RR arthrosis in general: 2.7),
- Waste disposal workers (RR 2.0-2.5),
- Farmers (RR 2-4, OR 1.8-13.3)

Knee:

- Construction (screed and terrazzo workers, tilers, painters, carpenters: OR 1.4-5.1, RR 2.2-23.1)),
- Mining (OR: 2.77-14.8),
- Waste disposal (RR 2.0),
- Farmers (OR 3.2),
- Forestry workers (OR 2.1, RR arthrosis in general: 2.7)

Feet:

- Waste disposal workers (2.3-2.4)
- Forestry workers (RR 2.0),
- Soldiers

As a further step in selecting the “high-risk occupations“, for which prevention would seem particularly useful, in addition to the numbers of employees in the various industries (taken from the report on health and safety at work „Sicherheit und Gesundheit bei der Arbeit 2007“ [12]), the prevalences of disorders in the population in general, as described in Work Package 3, is also taken into account. The highest period prevalences (24.2%) in the population in general (of working age) are to be found in the ICD-10 group M54 (“simple back pain“). This is followed at a considerable distance by M53, M51, M47 and M75, which shows that lumbar spine

and shoulder disorders have the highest prevalences throughout Germany. Other relevant disorders are (teno)synovitis, enthesopathies and mononeuropathies. Coxarthrosis and gonarthrosis were not included in the table in Work Package 3. It should be noted that these disorders are mostly more serious and lead to more far-reaching restrictions of mobility than tendonitis, for example. Most of the health reports, as well as the research reports and international literature, also show that above all back pain/dorsopathies play a decisive part numerically. Other important disorders are disc damage and enthesopathies.

In addition, the distribution of employees in Germany should be taken into account in the TOP TEN. The ten sectors with the most employees (in thousands) are:

- 1) Administration and office 7.987
- 2) Social work and education 3.442
- 3) Goods traders 3.351
- 4) Other services 2.898
- 5) Health service 2.587
- 6) Transport 2.542
- 7) Metalworking and mechanical engineering 2.343
- 8) Service traders 1.533
- 9) Law enforcement and security 1.503
- 10) Technicians 1.373

From the above list we derived the following top ten risk occupations with the respective associated MSDs:

- 1) Lumbar spine – metalworking occupations
- 2) Lumbar spine - transport and warehouse occupations
- 3) Lumbar spine – construction occupations
- 4) Lumbar spine - law enforcement and security occupations
- 5) Lumbar spine – health service
- 6) Shoulder and neck complaints – metalworking occupations
- 7) Shoulder – construction occupations

- 8) Tenosynovitis, synovitis, CTS – office occupations
- 9) Enthesopathies – assembly line workers (especially in meat/fish production)
- 10) Hip and knee joint arthrosis – agricultural occupations and forestry workers

It should be pointed out, however, that the duration and degree of sickness were not taken into account to any major extent.

By and large, in concluding this work on the selection of high-risk occupations it is necessary to bear in mind that many people practise occupations only for a certain time and frequently change jobs [27]. One may therefore assume that a survey of risk-bearing activities might be more promising, although a survey on the basis of self-reporting by workers offers a degree of reproducibility that is only partially adequate [75].

References

1. Manek NJ, MacGregor AJ. 2005. Epidemiology of back disorders: prevalence, risk factors and prognosis. *Curr Opin Rheumatol* 17:134-40
2. Deyo RA, Weinstein JN. 2001. Primary care. Low back pain. *N Engl J Med* 344:363-370
3. Schmidt CO, Raspe H, Pflingsten M, Hasenbring M, Basler HD, Eich W, Kohlmann T. 2007. Back pain in the German adult population – prevalence, severity, and sociodemographic correlates in a multiregional survey. *Spine* 32:2005-11
4. Burton AK, Balagué F, Cardon G, on behalf of the COST B13 Working Group on Guidelines for prevention in low back pain. 2006. Chapter 2: European guidelines for prevention in low back pain. *Eur Spine J* 15: S136-S168
5. Nolting HD, Albota M, Niemann D, Storz P. Abschlussbericht: Arbeitsbezogene Belastungen des Muskel-Skelett-Systems – innovative und integrative Präventionsansätze – Sachverständigengutachten. *BAuA*.
6. BKK Bundesverband. 2008. BKK Gesundheitsreport 2008 - Seelische Krankheiten prägen das Krankheitsgeschehen. *BKK Bundesverband*
7. IKK-Bundesverband. 2008. Arbeit und Gesundheit im Handwerk. *IKK impuls, 2007*.
8. Gesundheitsreport 2009- Veröffentlichung zum betrieblichen Gesundheitsmanagement der TK. Techniker Krankenkasse, Hamburg, Band 21
9. IGES Institut für Gesundheits- und Sozialforschung GmbH. 2003. DAK Gesundheitsreport 2003. DAK Gesundheitsmanagement
10. Wieland R., (BARMER- Ersatzkasse). 2008. BARMER Gesundheitsreport 2008 Rückengesundheit- Rückhalt für Arbeit und Alltag, Barmer Ersatzkasse, Wuppertal
11. Shea BJ, Grimshaw JM, Wells BA, Boers M, Andersson N, Hamel C, Porter AC, Tugwell P, Moher D, Bouter LM. 2007. Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. *BMC Med Res Methodology* 7:10
12. Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. 2009. Sicherheit und Gesundheit bei der Arbeit 2007. Bundesministerium für Arbeit und Soziales
13. Bundesanstalt für Arbeitsschutz und Arbeitsmedizin 2002. Sicherheit und Gesundheit bei der Arbeit 2002. Bundesministerium für Arbeit und Soziales.

14. Arbeitsgemeinschaft der Spitzenverbände der Krankenkassen. Gemeinsame und einheitliche Handlungsfelder und Kriterien der Spitzenverbände der Krankenkassen zur Umsetzung von §§20 und 20a SGB V vom 21. Juni 2000 in der Fassung vom 2. Juni 2008. *IKK-Bundesverband, Bergisch Gladbach.*
15. Jansen N., Steinbruchs- Berufsgenossenschaft. Ist die Branche gesund? Gesundheitsbericht für die Baustoffindustrie. *Wissenschaftliches Institut der AOK, BKK*
16. Berger, J., Nolting H.; Küfner S., Justus M., 2005. BGW- IKK Gesundheitsreport 2005 Friseurinnen und Friseure. *BGW Berufsgenossenschaft für Gesundheitsdienst und Wohlfahrtspflege*
17. Berger J., Nolting H., Genz H., 2003. BGW- DAK Gesundheitsreport 2003 Altenpflege. *BGW Berufsgenossenschaft für Gesundheitsdienst und Wohlfahrtspflege*
18. Grabbe Y., Nolting H., Loos S., Krämer K., 2006. DAK- BGW Gesundheitsreport 2006. Ambulante Pflege. *Berufsgenossenschaft für Gesundheitsdienst und Wohlfahrtspflege, DAK Zentrale*
19. Arbeitsgemeinschaft der Bau-Berufsgenossenschaften. 2004. Arbeitsbedingte Gesundheitsgefahren in der Bauwirtschaft – ArGO. *Arbeitssicherheit und Arbeitsmedizin in der Bauwirtschaft*, 18.
20. Arbeitsgemeinschaft der Bau-Berufsgenossenschaften. 2004. Arbeitsbedingte Gesundheitsgefahren in der Bauwirtschaft – ArGO. *Arbeitssicherheit und Arbeitsmedizin in der Bauwirtschaft*, 18.1.
21. Hartmann B, Seidel D. 2007. Muskel-Skelett-Erkrankungen im Baugewerbe – betriebsärztliche Erkenntnisse. Schriftenreihe Arbeitssicherheit und Arbeitsmedizin in der Bauwirtschaft. *BG Bau. Frankfurt*
22. Bundesregierung. 2007. Erkrankungen der Sehnenscheiden oder des Sehngleitgewebes sowie der Sehnen- oder Muskelansätze. *Merkblatt zu BK Nr. 2101.*
- 22a. Bundesregierung. 2001. Meniskusschäden nach mehrjähriger andauernden oder häufig wiederkehrenden, die Kniegelenke überdurchschnittlich belastenden Tätigkeiten. *Merkblatt zur ärztlichen Untersuchung zur BK Nr. 2102.*
- 22b. Bundesregierung. 2005. Erkrankungen durch Erschütterung bei arbeit mit Druckluftwerkzeugen oder gleichartig wirkenden Werkzeugen und Maschinen. *Merkblatt zur Berufskrankheit Nr. 2103.*
- 22c. Bundesregierung. 2005. Vibrationsbedingte Durchblutungsstörung an den Händen. *Merkblatt zur Berufskrankheit Nr. 2104.*
- 22d. Bundesregierung. 2005. Chronische Erkrankungen der Schleimbeutel durch ständigen Druck. *Merkblatt zur Berufskrankheit Nr. 2105.*
- 22e. Bundesregierung. 2005. Durchschädigung der Nerven. *Merkblatt zur Berufskrankheit Nr. 2106.*
- 22f. Bundesregierung. 1964. Abrißbrüche der Wirbelfortsätze. *Merkblatt zur Berufskrankheit Nr. 2107*
- 22g. Bundesregierung. 2005. Bandscheibenbedingte Erkrankungen der Lendenwirbelsäule durch langjähriges Heben oder Tragen schwerer lasten oder durch langjähriger Tätigkeiten in extremer Rumpfbeugehaltung, die zur Unterlassung aller Tätigkeiten gezwungen haben, die für die Entstehung die Verschlimmerung oder das Wiederaufleben der Krankheit ursächlich waren oder seien können. *Merkblatt zur Berufskrankheit Nr. 2108.*
- 22h. Bundesregierung. 2005. Bandscheibenbedingte Erkrankungen der Halswirbelsäule durch langjähriges tragen schwerer Lasten auf der Schulter. *Merkblatt zur Berufskrankheit Nr. 2109.*
- 22i. Bundesregierung. Bandscheibenbedingte Erkrankungen der Lendenwirbelsäule durch langjährige, vorwiegend vertikale Einwirkung von Ganzkörperschwingungen im Sitzen, die zur Unterlassung aller Tätigkeiten gezwungen haben, die für die Entstehung, die Verschlimmerung oder das Wiederaufleben der Krankheit ursächlich waren oder sein können. *Merkblatt zur Berufskrankheit Nr. 2110*
- 22j. Landesamt für Gesundheit und Arbeitssicherheit des Landes Schleswig-Holstein. 2007. BK 2112. *Dezernat Arbeitsmedizin*
- 22k. Ärztlicher Sachverständigenbeirat Berufskrankheiten. 2009. Druckschädigungen des Nervus medianus im Carpaltunnel (Carpaltunnel-Syndrom) durch repetitive manuelle Tätigkeiten mit Beugung und Streckung der Handgelenke, durch erhöhten Kraftaufwand der Hände oder durch Hand-Arm-Schwingungen. *Ministerialblatt 27:573ff*
23. Haupt B, Drechsel- Schlund C, Guldner H, Rogosky E, Plinske W, Butz M. 2007. Dokumentation des Berufskrankheiten-Geschehens in Deutschland. *Deutsche Gesetzliche Unfallkrankenversicherung e.V. (DGUV)*
24. Bieniek S, Friedrichs M, Roex J, Bödeker W. 2004. Prävalenz von Rückenschmerzen, orthopädische Auffälligkeiten und Leistungen der Rumpfmuskulatur bei Berufstätigen. *Bremerhaven: Wirtschaftsverlag NW.*
25. Elsner G, Petereit G, Haerting J, Bergmann A, Bolm-Audorff U, Celik S, Müller M, Gül A, Jendrezok U, Ridder S, Straub R, Schuhmann B, Liebers F, Seidler A. 2009. Fall-Kontroll-Studie zu Bandscheibenvorfällen der Halswirbelsäule durch berufliche Belastungen. *BAuA: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin.*
26. Schneider S, Lipinski S, Schilttenwolf M. 2006. Occupations associated with a high risk of self- reported back pain: representative outcomes of a back pain prevalence study in the Federal Republic of Germany. *European Spine* 15: 821-33
27. Michaelis M, Hofmann F, Bolm-Audorf U, Bergann A, Ditchen D, Ellegast R, Elsner G, Grifka J, Haerting J, Jäger M, Linhardt O, Luttmann A, Nübling M, Petereit-Haack Gabriela, Seidler A. 2007. Risikobranchen und –berufe für die Entwicklung

- bandscheibenbedingter Erkrankungen der Lendenwirbelsäule – Ergebnisse der Deutschen Wirbelsäulenstudie. *Zbl Arbeitsmed* 57: 277-286.
- 27a. Elsner, G, Nnienhaus A, Beck W. 1996. Kniegelenksarthrose und arbeitsbedingte Faktoren. *Soz Präventivmed* 41: 98-106.
28. Enderlein G, Breckow J, Bräunlich A, Füchsel H., Heuchert G, Stark H, Wetzel A, Wulke P. 1998. Daten aus arbeitsmedizinischen Vorsorgeuntersuchungen zur Gesundheitslage von Erwerbstätigen in Deutschland-West und –Ost. Bremerhaven: Wirtschaftsverlag NW.
29. Liebers F., Caffier G. 2009. Berufsspezifische Arbeitsunfähigkeit durch Muskel-Skelett-Erkrankungen in Deutschland. Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. F1996 (im Druck)
30. European Commission. 2003. Work and Health in the EU – Data 1994-2002. *Panorama of the European Union*
31. Cote P, van der Velde G, Cassidy JD, Carroll LJ, Hogg-Johnson S, et al. 2008. The burden and determinants of neck pain in workers: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. *Spine* 33:S60-74
32. Jensen LK. 2008a. Hip osteoarthritis: influence of work with heavy lifting, climbing stairs or ladders, or combining kneeling/squatting with heavy lifting. *Occup Environ Med* 65:6-19
33. Jensen LK. 2008b. Knee osteoarthritis: influence of work involving heavy lifting, kneeling, climbing stairs or ladders, or kneeling/squatting combined with heavy lifting. *Occup Environ Med* 65:72-89
34. Schouten JS, de Bie RA, Swaen G. 2002. An update on the relationship between occupational factors and osteoarthritis of the hip and knee. *Curr Opin Rheumatol* 14:89-92
35. Lotters F, Burdorf A, Kuiper J, Miedema H. 2003. Model for the work-relatedness of low-back pain. *Scand J Work Environ Health* 29:431-4036.
36. van der Windt DA, Thomas E, Pope DP, de Winter AF, Macfarlane GJ, et al. 2000. Occupational risk factors for shoulder pain: a systematic review. *Occup Environ Med* 57:433-42
37. Ariens GA, van Mechelen W, Bongers PM, Bouter LM, van der Wal G. 2000. Physical risk factors for neck pain. *Scand J Work Environ Health* 26:7-19
- 37a. Ariens GA, van Mechelen W, Bongers PM, Bouter LM, van der Wal G. 2001. Psychosocial risk factors for neck pain: a systematic review. *Am J Ind Med* 39:180-93
38. McMillan G, Nichols L. 2005. Osteoarthritis and meniscus disorders of the knee as occupational diseases of miners. *Occup Environ Med* 62:567-75
39. Gallagher S. 2005. Physical limitations and musculoskeletal complaints associated with work in unusual or restricted postures: a literature review. *J Safety Res* 36:51-61
40. Hartvigsen J, Leboeuf-Yde C, Lings S, Corder EH. 2000. Is sitting-while-at-work associated with low back pain? A systematic, critical literature review. *Scand J Public Health* 28:230-9
41. Griffiths KL, Mackey MG, Adamson BJ. 2007. The impact of a computerized work environment on professional occupational groups and behavioural and physiological risk factors for musculoskeletal symptoms: a literature review. *J Occup Rehabil* 17:743-65
42. Ijmker S, Huysmans MA, Blatter BM, van der Beek AJ, van Mechelen W, Bongers PM. 2007. Should office workers spend fewer hours at their computer? A systematic review of the literature. *Occup Environ Med* 64:211-22
43. Palmer KT, Harris EC, Coggon D. 2007. Compensating occupationally related tenosynovitis and epicondylitis: a literature review. *Occup Med (Lond)* 57:67-74
44. van Rijn RM, Huisstede BMA, Koes BW, Burdorf A. 2009. Associations between work-related factors and specific disorders at the elbow: A systematic literature review. *Rheumatology (Oxford)* epub ahead of print
45. Waters T, Genaidy A, Deddens J, Barriera-Viruet H. 2005. Lower back disorders among forklift operators: an emerging occupational health problem? *Am J Ind Med* 47:333-40
46. Waters T, Genaidy A, Barriera Viruet H, Makola M. 2008. The impact of operating heavy equipment vehicles on lower back disorder. *Ergonomics* 51:602-36
47. Fagarasanu M, Kumar S. 2003. Work-related carpal tunnel syndrome: Current concepts. *Journal of Musculoskeletal Research*, 7:87–96
48. Pienimäki T. 2002. Cold exposure and musculoskeletal disorders and diseases. A review. *Int J Circumpolar Health* 61:173-82
49. Lorusso A, Bruno S, L'Abbate N. 2007. A review of low back pain and musculoskeletal disorders among Italian nursing personnel. *Ind Health* 45:637-44
50. Fuchs A, Kouimintzis D, Neumann G, Kirch W. 2007. Health risks related to crop farming in Europe. *Journal of Public Health* 15:233-44

51. Cimmino MA, Parodi M. 2005. Risk factors for osteoarthritis. *Semin Arthritis Rheum* 34:29-34
52. Fathallah FA, Miller BJ, Miles JA. 2008. Low back disorders in agriculture and the role of stooped work: scope, potential interventions, and research needs. *J Agric Saf Health* 14:221-45
53. Kirkhorn SR, Schenker MB. 2002. Current health effects of agricultural work: respiratory disease, cancer, reproductive effects, musculoskeletal injuries, and pesticide-related illnesses. *J Agric Saf Health* 8:199-214
54. Louw QA, Morris LD, Grimmer-Somers K. 2007. The prevalence of low back pain in Africa: a systematic review. *BMC Musculoskelet Disord* 8:105
55. Rautiainen RH, Reynolds SJ. 2002. Mortality and morbidity in agriculture in the United States. *J Agric Saf Health* 8:259-76
56. Hignett S. 2003. Intervention strategies to reduce musculoskeletal injuries associated with handling patients: a systematic review. *Occup Environ Med* 60:E6
57. Lievense A, Bierma-Zeinstra S, Verhagen A, Verhaar J, Koes B. 2001. Influence of work on the development of osteoarthritis of the hip: a systematic review. *J Rheumatol* 28:2520-8
58. Knapik JJ, Reynolds KL, Harman E. 2004. Soldier load carriage: historical, physiological, biomechanical, and medical aspects. *Mil Med* 169:45-56
59. Leggat PA, Kedjarune U, Smith DR. 2007. Occupational health problems in modern dentistry: a review. *Ind Health* 45:611-21
60. Fabrizio AJ. 2002. Work-related upper extremity injuries: prevalence, cost and risk factors in military and civilian populations. *Work* 18:115-21
61. Kaufman KR, Brodine S, Shaffer R. 2000. Military training-related injuries: surveillance, research, and prevention. *Am J Prev Med* 18:54-63
62. Pelham TW, White H, Holt LE, Lee SW. 2005. The etiology of low back pain in military helicopter aviators: prevention and treatment. *Work* 24:101-10
63. Hincapie CA, Morton EJ, Cassidy JD. 2008. Musculoskeletal injuries and pain in dancers: a systematic review. *Arch Phys Med Rehabil* 89:1819-29
64. Hoppmann RA. 2001. Instrumental musicians' hazards. *Occup Med* 16:619-31, iv-v
65. Brandfonbrener AG. 2003. Musculoskeletal problems of instrumental musicians. *Hand Clin* 19:231-9, v-vi
66. Wu SJ. 2007. Occupational risk factors for musculoskeletal disorders in musicians: A systematic review. *Med J Perform Art* 22:43-51
67. Felson DT. 2004. An update on the pathogenesis and epidemiology of osteoarthritis. *Radiol Clin North Am* 42:1-9,
68. Leggat PA, Smith DR. 2006. Military training and musculoskeletal disorders. *J Musculoskeletal Pain* 15:25-32
69. Collins JL. 2001. Health issues in journalism and reporting. *Occup Med* 16:583-94, iv
70. Mattioli S, Brillante R, Zanardi F, Bonfiglioli R. 2006. Occupational (and non-occupational) risk factors for musculoskeletal disorders. *Med Lav* 97:529-34
71. Yamalik N. 2007. Musculoskeletal disorders (MSDs) and dental practice Part 2. Risk factors for dentistry, magnitude of the problem, prevention, and dental ergonomics. *Int Dent J* 57:45-54
72. Valachi B, Valachi K. 2003. Mechanisms leading to musculoskeletal disorders in dentistry. *J Am Dent Assoc* 134:1344-50
73. Andersen E. 2004. Laboratory workers and musculoskeletal disorders--examining ergonomic risk factors and solutions. *AAOHN J* 52:366-7
74. Fraenkel L. 2002. Raynaud's phenomenon: epidemiology and risk factors. *Curr Rheumatol Rep* 4:123-8
75. Stock SR, Fernandes R, Delisle A, Vézina N. 2005. Reproducibility and validity of workers' self-reports of physical work demands. *Scan J Work Environ Health* 31:409-37