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Identification and prioritization of relevant prevention issues for work-related musculoskeletal disorders (MSD)

Work Package 3

Documentation of indices and indicators concerning the effects of particular MSDs when determining prioritization of relevant prevention topics

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Institut für Arbeits-, Sozial- und Umweltmedizin

This is the final report in Work Package 3, “Documentation of indices and indicators concerning the effects of particular MSDs when determining prioritization of relevant prevention topics”, which is part of the project entitled “Identification and prioritization of relevant prevention issues for work-related musculoskeletal disorders (MSDs)“ commissioned by the German Social Accident Insurance (DGUV).

Authors: Prof. Dr. oec. troph. Eva Münster, MPH

Dr. rer. soc. Luis Carlos Escobar Pinzón

Dr. med. Dorothea Nitsche

Dipl.-Soz. Matthias Rau

Dipl.-Soz. Ulrike Zier

With the assistance of: Heiko Rüger, M.A.

cand. soz. Tanja Martini

cand. med. Janina Schmies

Dipl.-Psych. Michael Unrath

University Medical Center of the Johannes Gutenberg University Mainz

Institute of Occupational, Social and Environmental Medicine

Obere Zahlbacher Straße 67

55131 Mainz, Germany

Note: To improve readability only the masculine form is used in the following report. Naturally both genders are always implied.

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1 Introduction

The following is a summary of the findings of Work Package 3, “Documentation of indices and indicators concerning the effects of particular MSDs when determining how to prioritize relevant prevention topics”, within the context of the overall project “IPP-MSD” commissioned by the German Social Accident Insurance (Deutsche Gesetzliche Unfallversicherung – DGUV). From January to August 2009, the Institute for Occupational, Social and Environmental Medicine of the University Medical Center at the Johannes Gutenberg University in Mainz was commissioned to address the following issues:

- Are the following indices available for the particular musculoskeletal disorders in the relevant areas
  - Number of jobs affected
  - Treatment costs
  - Proportion of days of sick leavers
  - Extent of costs due to loss of production/loss of gross value added
  - Number and cost of compulsory early retirement
  - Number and cost of occupational diseases
- What indices are applicable for preventive measures by the Deutsche Gesetzliche Unfallversicherung (German Social Accident Insurance-DGUV)?

The following sources were among those used in an effort to elicit the most comprehensive information about the indices and indicators of MSD in Germany:

- Health monitoring system; information from the statutory health insurance fund
- Data from the statutory accident insurance fund
- Data from the statutory pension insurance fund
- Data from the 2003 telephone survey on health (Robert Koch Institute)
- National and international scientific publications

The findings of these sections are summarized in chapters, each of which ends with its own conclusion. The findings are then compiled and discussed in Chapter 7 “Discussion”. In the appendix, “Synopsis”, there is a closing summary of all literature consulted.

2 Evaluating the statutory health insurance data

About 90% of the German population is insured under the statutory health insurance plan (gesetzliche Krankenversicherung– GKV), and the remaining approximately 10% are covered by private health insurance (private Krankenversicherung – PKV). When evaluating the indices and indicators regarding the effects of work-related MSDs, the health insurance data, especially that of the GKV, is of prime importance.

2.1 Health reports and current statistics

Table 1 provides an overview of the structure of the GKV in Germany. The local health care fund (Allgemeine Ortskrankenkasse – AOK) has 23.95 million insured individuals, making it the largest health insurance fund, followed by substitute health insurance funds with 23.65 million insured. The five largest substitute funds are the Techniker Krankenkasse (TK) with 7.2 million insured, the Barmer with 6.8 million insured, the Deutsche Angestellten-Krankenkasse (DAK) with 6.1 million insured, the KKH-Allianz with 1.9 million insured and the Gmünder Ersatzkasse (GEK) with 1.6 million insured. The Bundesverbände der Betriebskrankenkassen (Federal Associations of Health Insurance – BKK) and the Innungskrankenkasse (Guilds Health Insurance Fund – IKK) occupy third and fourth place with 13.93 and 6.28 million insured respectively. The GKV has a total of 70.33 million insured.

Health monitoring in Germany is predominantly carried out by the federal associations of statutory health insurance and by individual substitute funds. Reports on occurrences of invalidity, outpatient and inpatient care, as well as medical rehabilitation are published on a regular basis [1]. In addition, institutions such as the Federal Institute for Occupational Safety and Health (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin– BAuA) and the German Federal Office of Statistics (Statistisches Bundesamt – DESTATIS) have extensive GKV data.

Table 1: Monthly statistic on statutory health insurance – Composition of the insured population as at June 2008

Health insurance		Members and co-insured family members		Members		Pensioners		Students, trainees without salary		Unemployed (ALG I + ALG II)		Members without pensioner, students, unemployed	
		N*	%**	N*	%**	N*	%**	N*	%**	N*	%**	N*	%**
AOK	Male	11.33	47.3	8.83	36.9	2.85	11.9	0.071	0.3	1.07	4.5	4.84	20.2
	Female	12.61	52.6	8.71	36.4	4.31	18.0	0.066	0.3	0.84	3.5	3.49	14.6
	Total	23.95	100	17.53	73.2	7.16	29.9	0.137	0.6	1.90	7.9	8.33	34.8
BKK	Male	6.88	49.4	5.27	32.2	1.12	8.0	0.042	0.3	0.26	1.9	3.85	27.6
	Female	7.05	50.6	4.49	37.8	1.24	8.9	0.036	0.3	0.24	1.7	2.97	21.3
	Total	13.93	100	9.77	70.1	2.36	16.9	0.077	0.6	0.50	3.6	6.83	49.0
IKK	Male	3.38	53.8	2.67	42.5	0.41	6.5	0.012	0.2	0.22	3.5	2.03	32.3
	Female	2.90	46.2	1.80	28.7	0.39	6.2	0.010	0.2	0.14	2.2	1.26	20.1
	Total	6.28	100	4.47	71.2	0.79	12.6	0.022	0.4	0.36	5.7	3.30	52.5
EK* blue-collar workers**	Male	0.89	53.0	0.69	41.1	0.14	8.3	0.006	0.35	0.05	3.0	0.50	29.8
	Female	0.79	47.0	0.47	28.0	0.11	6.5	0.006	0.35	0.03	1.8	0.32	19.0
	Total	1.68	100	1.17	69.0	0.25	14.9	0.012	0.7	0.08	4.8	0.83	49.4
EK* white-collar workers**	Male	9.29	42.3	6.90	31.4	1.86	8.5	0.140	0.6	0.42	1.9	4.47	20.3
	Female	12.68	57.7	9.26	42.1	3.23	14.7	0.129	0.6	0.50	2.3	5.40	24.6
	Total	21.97	100	16.16	73.6	5.09	23.2	0.270	1.2	0.93	4.2	9.87	44.9
Substitute funds total	Male	10.18	43.0	7.59	32.1	2.00	8.5	0.147	0.6	0.47	2.0	4.97	21.0
	Female	13.47	57.0	9.73	41.1	3.33	14.1	0.135	0.6	0.53	2.2	5.74	24.3
	Total	23.65	100	17.33	73.3	5.33	22.5	0.282	1.2	1.01	4.3	10.71	45.3
GKV total	Male	33.04	47.0	25.47	36.2	6.97	9.9	0.276	0.4	2.05	2.9	16.17	23.0
	Female	37.28	53.0	25.55	36.3	9.92	14.1	0.250	0.35	1.76	2.5	13.62	19.4
	Total	70.33	100	51.02	72.5	16.89	24.0	0.526	0.7	3.81	5.4	29.79	42.4

*in million; **relating to all insured persons of the respective health insurance; ***substitute funds

Source: Federal ministry of health - substitute funds: http://www.krankenkassen.de/gesetzliche-krankenkassen/krankenkassen-liste/.

2.1.1 Introduction and method

In Work Package 3, health reports from the health insurance funds were included as the primary source of general information. As these reports for the most part provide little information about the indices and indicators to be investigated, the federal associations for the statutory and private health insurance funds as well as individual health insurance funds were contacted by telephone or in writing and asked to provide the following information for the last five years:

- Data regarding days of sick leavers due to MSD per ICD-10 diagnosis
- Outpatient and inpatient treatment costs due to MSD per ICD-10 diagnosis
- Information pertaining to the particular collective: number, age, gender and employment

In addition, the BAuA was contacted for current GKV statistics.

Table 2 shows the institutions contacted

Table 2: Contacted institutions within chapter 2.1

Gesetzliche Krankenkassen (statutory health insurance funds)
Der Bundesverband der allgemeinen Ortskrankenkassen (AOK) über das wissenschaftliche Institut der AOK (Wido), Berlin.
Der Bundesverband der Betriebskrankenkassen (BKK Bundesverband) über spectrumK GmbH (BKK Gemeinschaftsunternehmen von Betriebskrankenkassen und BKK-Landesverbänden), Berlin.
Die Techniker Krankenkasse (TK), Pressestelle, Hamburg.
Die Deutsche Angestellten Krankenkasse (DAK), Pressestelle, Hamburg.
Die Barmer, Abteilung Unternehmenspolitik/Kommunikation, Wuppertal.
Die Gmünder Ersatzkasse (GEK), Presseabteilung, Berlin.
Die gemeinsame Vertretung der Innungskrankenkassen e.V. (IKK e.V.), Berlin.
Private Krankenkassen (private health insurance funds)

Verband der privaten Krankenversicherung e.V. (PKV), Pressestelle, Berlin.
Debeka Hauptverwaltung, Abteilung KV/L, Koblenz.
Weitere Institutionen (Further institutions)
Gesundheitsberichterstattung des Bundes - Das Informationssystem der Gesundheitsberichterstattung des Bundes, Bonn.
Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (BAuA), Dortmund.

For the analyses in chapter 2.1, the reports that deal primarily with MSDs and their effects were looked at first. They are as follows:

- the 2008 Barmer Health Report (Barmer Gesundheitsreport 2008), focusing primarily on back health [2]
- the 2003 DAK Health Report (DAK Gesundheitsreport 2003), focusing primarily on back conditions [3]
- the BAuA Report on Project F 1996 "Job-specific invalidity as a result of musculoskeletal disorders in Germany" (Berufsspezifische Arbeitsunfähigkeit durch Muskel- Skelett- Erkrankungen in Deutschland) [4].

Furthermore, the following sources also provided valuable information about the GKV:

- Federal Ministry of Labor and Social Affairs (Bundesministerium für Arbeit und Soziales – BMAS), BAuA – Safety and health at work 2006 and 2007 – Accident prevention paper (Sicherheit und Gesundheit bei der Arbeit 2006 und 2007 - Unfallverhütungsbericht Arbeit (SUGA 2008 and 2009) [5, 6]
- DAK Health Report 2008 [7]
- Various statistics and figures provided by the following health insurance funds: AOK [8, 9], BKK [10, 11] and TK [12-14].

Although the time available to collect the information for this project was very small and some health insurance funds were unable to conduct individual calculations for this reason, it was nevertheless possible to compile, inspect and evaluate extensive data. Unfortunately the PKV did not provide any data for the project.

2.1.2 Results

Indices regarding unfitness for work

Table 3 summarizes the almost universally available indices regarding invalidity, taken from the figures provided or from reports based on GKV data, in reference to the MSD diagnostic chapter [2-4, 6-8, 10, 11, 14].

In addition to two relevant reports (SUGA 2007, Project F 1996), the information of the insurance companies with more than 6 million insured was included in the table. The IKK was unable to provide any data. However, those insured by IKK are accounted for in the calculations of the SUGA 2007 report. In addition to the general view of the MSD, the most important ICD10 – MSD diagnosis, M54 Dorsalgia, is listed as an example. The collectives examined are made up of employed persons insured by the GKV. To provide a detailed description, the information regarding the sources of origin was transferred and documented in the footnotes. Due to a lack of information it is not always possible to draw conclusions as to the actual groups included.

Table 3: Analysis of health reports and statistics from the statutory health insurance funds (ICD10)

	AOK[1] (data 2007)	Barmer 2008[2] (data 2007)	TK 2008[3] (data 2007)	BKK 2008/2009[4] (data 2007)	SUGA 2007[5] (data 2007)	DAK 2008[6] (data 2007)	DAK 2003[7] (data 2002)	BAuA[8] project F 1996 (data 2003)
Days of sick leavers per 100 IPY for all diagnostic categories	1,643.4d[9] ♂ -; ♀ -	ca.,.593.0d ♂ -; ♀ -	1,100d ♂ 1,000; ♀ 1,230	1,280d ♂ 1,317; ♀ 1,237	1,530d ♂ 1,520; ♀ 1,530	1,151d ♂ 1,111; ♀1,207	1,284d ♂ 1,239; ♀ 1,349	n.s.
Days of sick leavers due to MSDs per 100 IPY	513.5d ♂ 540.9; ♀ 475.7	ca. 374.4d ♂ -; ♀ -	218d ♂ 217; ♀ 218	337.2d ♂ 384.2; ♀ 282.9	374.6d ♂ 396.9; ♀ 341.8	251.8d ♂261.4; ♀ 238.3	300.0d ♂ 309.5; ♀ 286.7	n.s.
Days of sick leavers due to M54 per 100 IPY	229.1d ♂ 252.5; ♀198.4	n.s.	58.7d ♂ 60.2; ♀ 56.6	108.2d[10] ♂ 123.4; ♀ 88.5	n.s.	- d ♂ 89.5; ♀ 73.6	Back conditions (M45-M54) 160.1d ♂ 167.1; ♀ 150.4	- d ♂156.0; ♀ 115.7
Average duration of invalidity for all diagnostic categories	11.6d ♂ -; ♀ -	13.5d ♂ 13.5; ♀ 13.5	11.8d ♂ 11.8; ♀ 11.8	12.1d ♂ 12.5; ♀ 11.7	11.9d ♂ 12.2; ♀ 11.4	10.8d ♂ 11.0; ♀ 10.6	11.5d ♂ 11.6; ♀ 11.4	n.s.
Average duration of invalidity due to MSDs	16.0d ♂ 15.3; ♀17.2	19.7d ♂ 18.7; ♀ 20.3	17.8d ♂ 17.2; ♀ 18.7	18.4d ♂ 17.9; ♀ 19.2	16.8d ♂ 16.2; ♀ 17.8	16.5d ♂ 15.8; ♀ 17.5	17.5d ♂ 16.7; ♀ 18.8	n.s.
Average duration of invalidity due to M54	11.7d ♂ 11.2; ♀ 12.5	14.1d ♂ -; ♀ -	12.3d ♂ -; ♀ -	15.0d[10] ♂ 14.9; ♀ 15.2	n.s.	n.s.	(M45-M54) 16.0d ♂ 15.5; ♀ 16.8	- d ♂ 12.7; ♀ 13.3
Invalidity cases per 100 IPY due to MSD	32.1 ♂ 35.4; ♀ 27.7	n.s.	12.2 ♂ 12.6; ♀ 11.7	18.34 ♂ 21.44; ♀ 14.77	22.3 ♂ 24.5; ♀ 19.2	15.3 ♂ 16.5; ♀ 13.6	17.1 ♂ 18.5; ♀ 15.3	n.s.
Invalidity cases per 100 IPY due to M54	19.6 ♂22.5; ♀15.9	n.s.	5.07 ♂ 5.33; ♀ 4.70	7.21[10] ♂ 8.27; ♀ 5.84	n.s.	- ♂ 7.4; ♀ 5.7	(M45-M54) ♂ 10.8; ♀ 9.0	- ♂ 12.3; ♀ 8.7

	AOK[1] (data 2007)	Barmer 2008[2] (data 2007)	TK 2008[3] (data 2007)	BKK 2008/2009[4] (data 2007)	SUGA 2007[5] (data 2007)	DAK 2008[6] (data 2007)	DAK 2003[7] (data 2002)	BAuA[8] project F 1996 (data 2003)
MSD share of all days of sick leavers	24.2% ♂ 25.5% ♀ 22.6%	23.5% ♂ 25.5% ♀ 22.6%	19.9% ♂ 21.7% ♀ 17.7%	26.3% ♂ 29.2% ♀ 22.9%	24.6% ♂ 26.2% ♀ 22.3%	21.9% ♂ 23.5% ♀ 19.7%	23.4% ♂ 25.0% ♀:21.3%	n.s.
MSD share of all invalidity cases	17.7% ♂ 19.6% ♀ 14.9%	14.9% ♂ 17.4% ♀ 14.1%	13.1% ♂ 14.8% ♀ 11.2%	17.4% ♂ 20.4% ♀ 13.9%	17.4% ♂ 19.7% ♀ 14.3%	14.4% ♂ - ♀ -	15.4% ♂ 17.4% ♀ 12.9%	n.s.
M54 share of all days of sick leavers	7.1% ♂ 4.4%; ♀ 2.6%	6.4%	5.6%	n.s.	n.s.	7.2%	7.9 %	n.s.
M54 share of all invalidity cases	7.1% ♂ 4.6%; ♀ 2.5%	6.1%	5.8%	n.s.	n.s.	6.3%	6.8%	n.s.
Ranking[11] days of sick leavers according to IDC-10 diagnosis chapters (total; male; female)	Rank 1: Respiratory system 22.2%; ♂ 21.6%; ♀23.1% Rank 2: MSD 17.7%; ♂ 19.6%; ♀14.9%	Rank 1: Respiratory system 28.7% Rank 2: MSD 14.9%	Rank 1: Respiratory system 30.9%; ♂ 30.2%; ♀ 31.7% Rank 2: Digestive system 13.3%; ♂ 13.8%; ♀ 12.7% Rank 3: MSD 13.1%; ♂ 14.8%; ♀ 11.2%	Rank 1: Respiratory system 28.8%; ♂: 27.3%; ♀: 30.5% Rank 2: MSD 17.4%; ♂: 20.4%; ♀: 13.9%	Rank 1: Respiratory system 24.4%; ♂ 23.8%; ♀ 25.3% Rank 2: MSD 17.4%; ♂ 19.7%; ♀ 14.3%	Rank 1: Respiratory system 29.1% Rank 2: MSD 14.4%	Rank 1: Respiratory system 28.6% ♂ 27.8%; ♀29.7% Rank 2: MSD 15.4% ♂ 17.4%; ♀12.9%	n.s.
Ranking[12] days of sick leavers accoriding to ICD-10 diagnosis chapters (total; male; female)	Rank 1: MSD 24.2%; ♂ 25.3%; ♀22.6% Rank 2: Injuries: 24.2% ♂ 16%;	Rank 1: MSD 23.5% Rank 2: mentel or behaviour disorders	Rank 1: MSD 19.9%; ♂ 21.7%; ♀ 17.7% Rank 2: Respiratory system 15.8%;	Rank 1: MSD 26.3%; ♂ 29.2%; ♀ 22.9% Rank 2: Respiratory system	Rank 1: MSD 24.6%; ♂ 26.2%; ♀ 22.3% Rank 2: Injuries/ intoxications	Rank 1: MSD 21.9% ♂ 23.5%; ♀ 19.7% Rank 2: Respiratory system	Rank 1: MSD 23.4% ♂ 25.0%; ♀ 21.3% Rank 2: Respiratory system	n.s.

	AOK[1] (data 2007)	Barmer 2008[2] (data 2007)	TK 2008[3] (data 2007)	BKK 2008/2009[4] (data 2007)	SUGA 2007[5] (data 2007)	DAK 2008[6] (data 2007)	DAK 2003[7] (data 2002)	BAuA[8] project F 1996 (data 2003)
	♀ -%	15.8%	♂ 15.2%; ♀ 16.4%	15.7%; ♂ 14.7%; ♀ 17.0%	13.8%; ♂ 17.4%; ♀ 8.8%	16.8%; ♂ 23.5%; ♀ 19.7%	16.2% ♂ 15.4%; ♀ 17.1%	

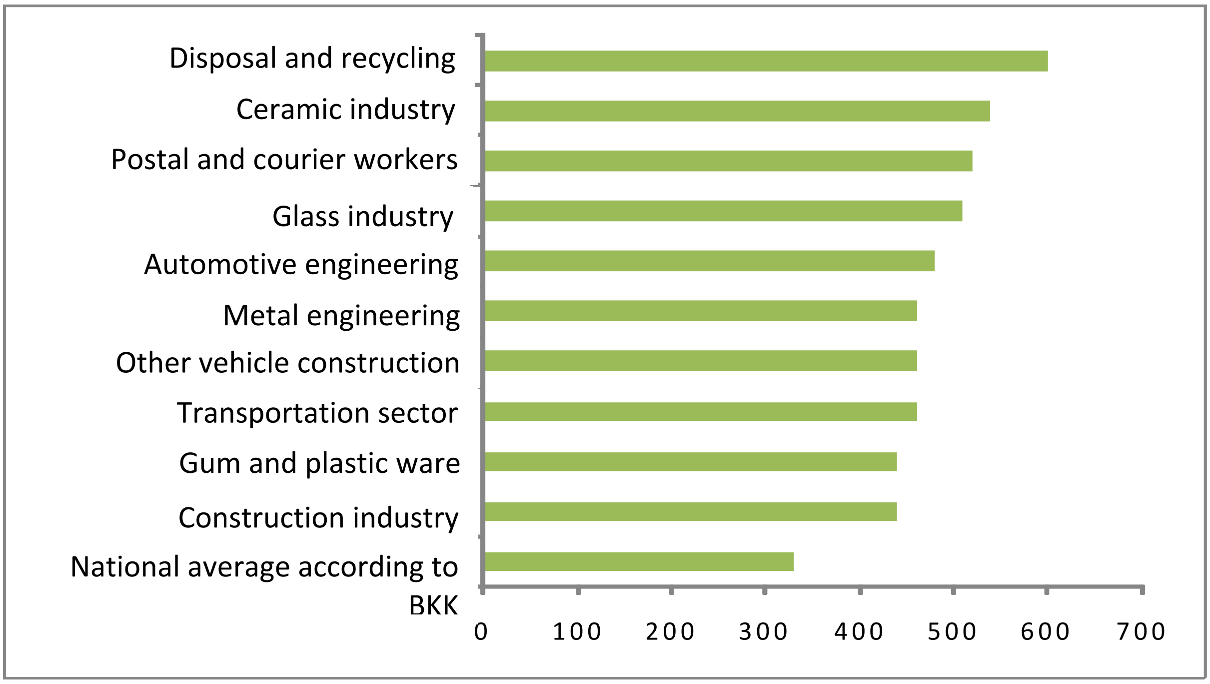
[1] Specifications refer to employed persons (employees and voluntarily insured persons) insured by the AOK in 2007. There exists no health status coverage at federal level in the form of a health report of the AOK. However there are specifications in the annual Fehlzeitenreport. Specifications of the AOK account for multiple diagnosis, also therefore it is possible that several values exhibit larger divergences.
[2] Specifications refer to actively employed persons insured by the Barmer in 2007.
[3] Specifications refer to employed persons (employees subject to social insurance contribution and unemployed with self-contained membership) insured by the TK in 2007.
[4] Specifications refer to employed persons compulsorily insured by the BKK in 2007.
[5] Specifications refer to 31 million persons compulsorily and voluntarily insured by the GKV in 2007.
[6] Specifications refer to actively employed persons insured by the DAK in 2007.
[7] Specifications refer to actively employed persons insured by the DAK in 2002.
[8] Specifications refer to employees insured by the AOK, BKK, TK, GEK in 2003.
[9] At place only main diagnosis are taken into account.
[10] All three values refer here to members without pensioners of the BKK in 2007.
[11] The ranking describes the relative share of listed diagnosis chapters according to IDC-10 related to all invalidity cases. The ranks have been determined by the total share of the diagnosis chapters. If the shares were examined stratified by gender the first ranks could change depending on gender, see for example data of TK for specifications for males rank 2 and rank 3.
[12] The ranking describes relatives listed diagnosis chapters according to ICD-10 shares of all days of sick leavers. The ranks have been determined by the total share of the diagnosis chapters. If the shares were examined stratified by gender the first ranks could change depending on gender.

The days of sick leavers due to MSDs per 100 insured person years (IPY) range from 218 to 374.6 days, based on the evaluation on the main-diagnosis, for the data in Table 3. These are based on a main diagnosis of MSD. All in all, the data points in the same direction - for example the average duration of invalidity due to an MSD ranges from 16.0 to 19.7 days. The figures are also consistent when examining gender trends. In terms of cases of invalidity per 100 IPY, men are afflicted considerably more often than women by MSDs but the duration of the invalidity is not as long. The usually somewhat lower values for back pain in the TK data can be attributed, according to TK, to the specific occupational spectrum of the members [13]. The overall significance of MSD as regards periods of invalidity can be seen by looking at the relative percentage of the total, indicated here as a ranking. Based on the total number of cases of invalidity, the MSDs follow in second place with 13.3% to 17.7% (with the exception of TK – third place) followed by the diagnostic category "respiratory system disorders" with 22.2% to 30.9%. As respiratory system disorders occur more frequently on the whole, but do not last as long as MSDs, the diagnostic chapters change places based on the percentage of days of sick leavers. MSDs account for between a quarter and a fifth of all days of sick leavers. Between 5.6% and 7.9% can be attributed solely to diagnosis M54 (Dorsalgia).

Based on individual diagnoses and economic groups, AOK data from 2003 to 2007 was analyzed [9]. In general, the diagnosis of dorsalgia (M54) dominates by far in all industries when it comes to cases of unfitness for work due to MSDs for those insured by AOK. Miscellaneous intervertebral disc disorders (M51) occupy second place in almost all industries. Positions three to five are often occupied by internal derangement of the knee (M23), shoulder lesions (M75) or other dorsopathies, not elsewhere classified (M53). When it comes to days of sick leavers caused by an MSD per 100 insured members of the industry, the construction industry with 619.3 days and public administration with 600.6 days occupied the top two places in 2007 [8]. The 2009 TK health report also contains some job-specific information for diagnoses M40-M54 (dorsopathies) [13]. According to the report, the occupational fields construction, construction and timber-related occupations (254 days of sick leavers per 100 insured person years), transport and warehousing (239 days of sick leavers per 100 insured person years) and metalworking trades (232 days of sick leavers per 100 insured person years) occupied places 1 to 3 in 2008 for employees with the highest number of absences from work.

The BKK health report also contains data linking days of sick leavers as a result of MSDs to individual professions and economic groups [11]. When it comes to days of sick leavers due to MSDs per 100 employed compulsory members of the BKK in 2007 for economic groups, as shown in Figure 1, employees in waste disposal and recycling recorded 600 days, followed by employees in the ceramic industry with 540 days, postal and courier workers with 520 days and employees in the glass industry with 510 days.

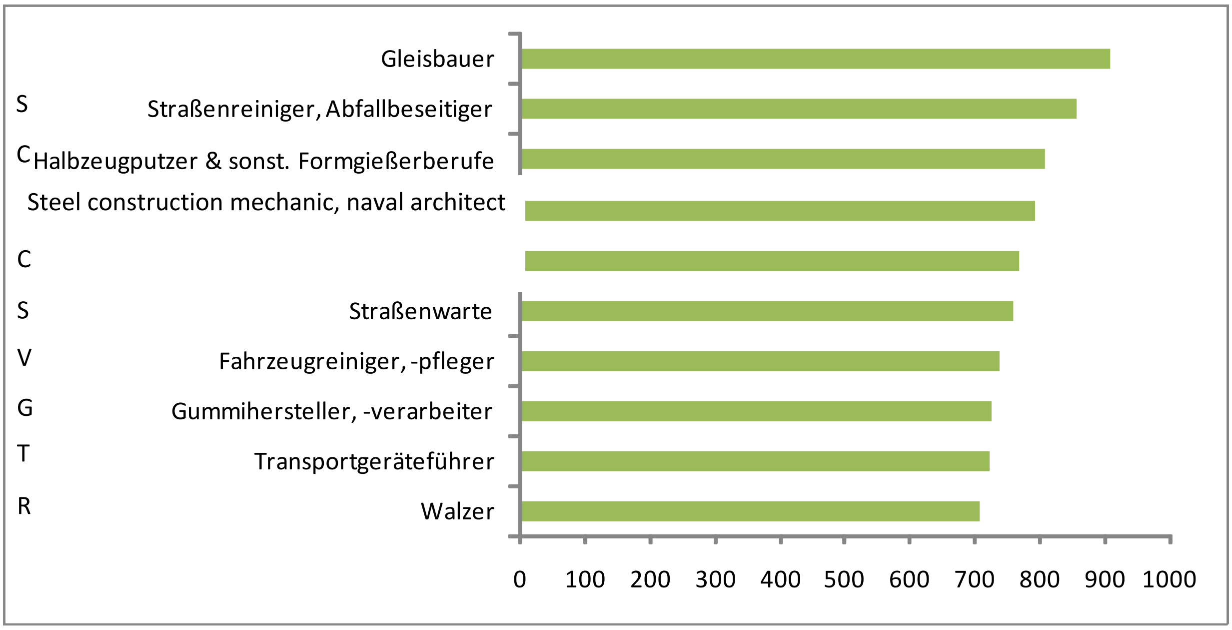
Figure 1: The ten most affected economic groups by days of sick leavers due to MSD per 100 employed Persons compulsory insured by BKK in 2007



Source: – own calculations based on data of BKK health report 2008 [11]

The federal average provided by the BKK is 330 days. Figure 2 shows the ten worst affected occupational categories according to days of sick leavers due to MSDs per 100 employed members of the BKK in 2007. MSDs were responsible for more than 30% of the absenteeism in most occupational categories that showed very high absenteeism in 2007. For street cleaners/waste removers and railway construction workers, the reported percentage of time off due to MSDs was over 35% to 37%, or 855-906 days, of all missed working days in the occupational group per 100 employees.

Figure 2: The ten most affected economic groups by days of sick leavers due to MSD per 100 employed Persons insured by BKK in 2007



Source: Composition of data from BKK health report 2008 [11]

<u>Indices for direct and indirect costs</u>

The GKV has information about the direct costs, i.e. the medical expenses (outpatient and inpatient medical treatment). The ICD-10 diagnostic code is used when billing health insurance companies for services. With inpatient stays and their associated costs in particular, there is often a main diagnosis indicated, with which other secondary diagnoses can be associated. It should be further noted that data aggregation is influenced by the coding of the doctors. Indirect costs, on the other hand, are rarely, if ever, recorded and must therefore be estimated.

Table 4 summarizes calculable data on costs from three different sources.

Table 4: Direct and indirect costs due to MSD

Source	Year[1]	MSD specification & base year	Direct cost	Indirect cost	
			Inpatient treatment	Cost of production loss based on labor cost	Loss of gross value
TK[2]	2009	all MSD 2006	∑: 83.1 m. € Ø: 2,996 € per case M51: ∑: 16.6 m.€; Ø: 2,989 € M53: ∑: 1.7 m.€; Ø: 3,260 € M54: ∑: 5.8 m.€; Ø:1,778 € M77: ∑: 0.8 m. €; Ø:2,267 €	n.s.	n.s.
	2009	all MSD 2007	∑: 87.0 m. € Ø: 2,905 € per case M51: ∑: 15.9 m.€; Ø: 2,841 € M53: ∑: 1.7 m.€; Ø: 3,400 € M54: ∑: 5.4 m.€; Ø:1,691 € M77: ∑: 0.7 m. €; Ø:2,104 €	n.s.	n.s.
	2009	all MSD 2008	∑: 95.6 m. € Ø: 2,953 € per case M51: ∑: 17.4 m.€; Ø: 2,893 € M53: ∑: 2.0 m.€; Ø: 2,983 € M54: ∑: 6.1 m.€; Ø:1,756 € M77: ∑: 0.7 m. €; Ø:1,979 €	n.s.	n.s.
GKV[3] (BMAS, BAuA)	2008	all MSD 2006		8.5 bn. €	15.4 bn. €
	2009	all MSD 2007		9.5 bn. €	17.3 bn. €
Barmer[4] (Gesundheitsreport 2008)	2008	all MSD 2007	Sickness benefit per case Cat.1: Ø: 661; ♂ 733; ♀ 610 Cat. 2: Ø: 1,291; ♂ 1,571; ♀ 1,141 Cat. 3: Ø: 6,319; ♂ 7,256; ♀ 5,761	n.s.	n.s.

[1] Year of publication/provision of data

[2] Provided data, specifications refer to labor force (employees subject to social insurance contribution and unemployed with self-contained membership) in 2007. Most health insurance funds do not collect data on indirect cost.

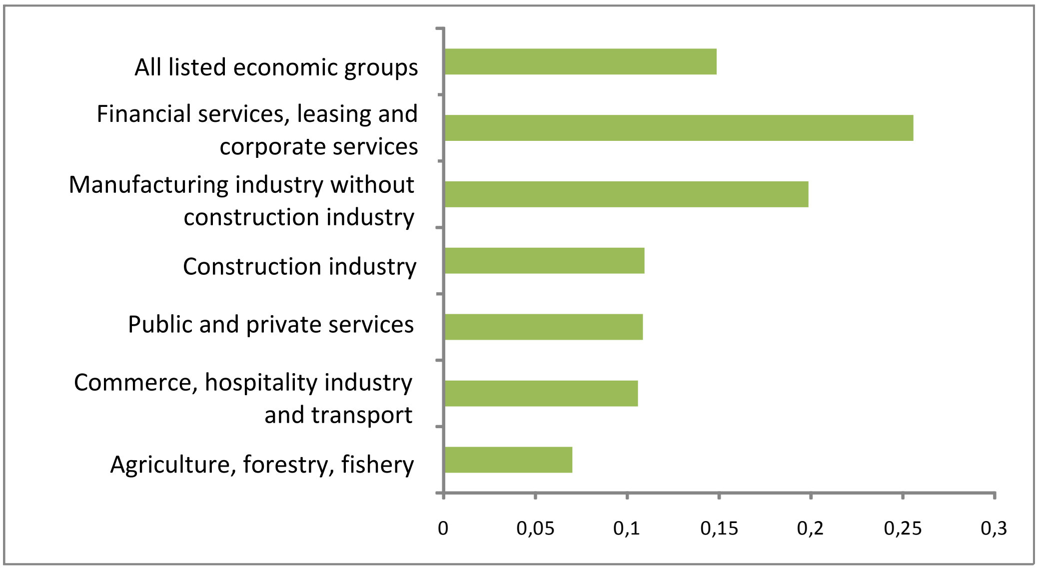
[3] Specifications refer to 31 million compulsorily and voluntarily insured by GKV in 2007.

[4] Barmer classifies MSD patients in 3 groups: 1. acute back pain (at most 6 weeks), 2. Subacute back pain (6-12 weeks), chronicle back pain (longer than 12 weeks).

Source: own composition based on different reports

The TK provided data that made it possible to generate statements for employees about inpatient costs due to MSD. As previously mentioned, the values presented for the total sum of MSDs and the individual diagnoses listed may be rather conservative due to the nature of the population insured by the TK. In 2008, 32,368 inpatient cases of unfitness for work due to MSDs were recorded for the approx. 2.75 million employed persons insured by the TK. The total cost came to approx. 95.6 million euros. Over three years - as is to be expected with an increase in the number of employed people - the total costs have increased by several million euros annually, due to higher case numbers, but the average cost per case has seen no noticeable increase. The medical expenses of the individual diagnoses listed are also relatively constant. Only diagnosis M53 (other dorsopathies) stands out, recording a reduction in the average cost per case of 400 euros from 2007 to 2008. An estimate of the indirect costs, recorded here for 2006 and 2007 is provided by the SUGA report [5, 6]. The costs of loss of production are calculated by multiplying the lost years of employment by the average annual employee salary. The estimate resulted in a loss of 9.5 billion euros for 2007. The loss of gross value added is calculated using the lost years of employment which are then multiplied by the average gross value added of an employee per year. In this case, the estimate for the MSD diagnostic category in 2007 was 17.3 billion euros. As an example, the Barmer 2008 health report contains the average sickness benefit payment per case caused by MSD [2]. As expected, costs increase with the duration of the case and come in at an average of 6,319 euros for absences of more than twelve weeks in duration. Across all three categories, costs per incident are higher for men than for women and show considerable differences starting at a duration of more than six weeks. Table 5 depicts an estimate of invalidity costs caused by MSD for various industries, compiled from information contained in the SUGA 2007 report [5, 6]. When it comes to classifying the values determined, the report maintains [5, 6]: “When estimating the economic production loss (labor costs) and the loss of labor productivity (loss of gross value added) based on the data of the overall economic calculation (Federal Office of Statistics), it is assumed that the labor costs of the employees and the gross value added of the persons employed are applicable to the data of the aforementioned individual insured by statutory health insurance. In some cases it may be necessary to extrapolate, as not all figures are available for all of the health insurance funds. Moreover, the estimates are done with roughly rounded values meaning that rounding errors and differences in the adding of the columns are sometimes unavoidable.“ Comparisons of individual loss values must take into account the different number of insured individuals in an industry as well as the different gross value added of a particular industry sector. For a comparison of the loss of gross value added, the loss of gross value added in billions of euros per 1 million days of sick leavers in the industry was calculated and an overview was then summarized in Figure 3. Here it is evident that manufacturing industry, with a value of 5.31 billion euros not including the construction industry, is relevant not only in terms of the absolute loss in gross value added due to MSDs, but also if the comparison value of 1 million days of sick leavers in the industry is consulted. In this case, manufacturing industry not including the construction industry is in second place with a loss in gross value added of approx. € 0.198 billion, whereas the commercial sector of financial services, leasing and corporate services occupies first place with a loss of approx. 0.255 billion euros per 1 million days of sick leavers.

Figure 3: Loss of gross value in billion € per 1 million days of sick leavers due to MSD



Source: Own calculations based on Data of SUGA 2007 [5, 6]

Table 5: Invalidity cost due to MSD in 2007, stratified by economic sector and sorted anticlimactic by loss of gross value

Economic Sector[1]	Days of sick leavers due to MSD in million	Days of sick leavers due to MSD in % of all patients of economic sector	Loss of production in bn. €	Loss of gross value in bn. €	Loss of gross value in bn. € per 1 m. days of sick leavers due to MSD
Manufacturing industry without construction industry	26.8	26.3	3.41	5.31	ca. 0.198
Public and private services	32.8	22.7	2.75	3.55	ca. 0.108
Financial services, leasing and corporate services	12.1	22.2	1.15	3.09	ca. 0.255
Commerce, hospitality industry and transport	23.8	24.1	1.74	2.50	ca. 0.105
Construction industry	6.9	29.3	0.57	0.75	ca. 0.109
Agriculture, forestry, fishery	1.0	24.7	0.05	0.07	ca. 0.070
All listed economic sectors	103.4	Not possible	9.67	15.27	ca. 0.148

[1]Classification of economic groups, issue1993 (WZ 93), NACE Rev. 1

Source: Own calculations and composition based on data of SUGA 2007 [5, 6]

2.1.3 Conclusion

The joint presentation in Table 3 must not be allowed to hide the fact that close comparison of the data is not possible for various reasons (cf. Chapter 7 Discussion). With due reservations it can however be said that many of the figures pertaining to unfitness for work as a result of an MSD point in the same direction. This includes the average length of invalidity as well as gender-specific observations. According to invalidity per 100 insured person years, men suffer from MSDs considerably more often than women but the duration of the unfitness for work is not as long. Between a quarter and a fifth of all days of sick leavers can be attributed to MSDs when it comes to days of sick leavers based on the relative percentage. The number of MSD-related days of sick leavers per 100 insured person years ranges in the sources for 2007 from 218 days for the TK to 374.6 as described in the SUGA 2007 report. These figures are based on a main diagnosis of MSD.

When it comes to MSD-related days of sick leavers per 100 insured members of the sector, the AOK data put the construction industry with 619.3 days and public administration with 600.6 days in the first two places in 2007. At the BKK, those employed in waste removal and recycling stand out (600 days of sick leavers), followed by employees in the ceramic industry (540 days of sick leavers), postal and courier workers (520 days) and employees in the glass industry (510 days) as compared to the national average of 330 days indicated by the BKK. The figures refer to the days of sick leavers caused by MSDs per 100 employed compulsory members of the BKK in 2007. The highest rates of absenteeism were recorded for diagnoses M40-M54 (dorsopathies) for employed persons insured by the TK in 2008 in the occupations of construction, construction sidelines and woodworking (254 days of sick leavers per 100 insured person years), transport and warehousing occupations (239 days of sick leavers per 100 insured person years) and metalworking occupations (232 days of sick leavers per 100 insured person years). Nevertheless, Liebers and Caffier's statement of "the danger that health risks are not sufficiently recognized through the summarized analysis for industries and occupational categories or for entire diagnosis groups and thus focal points for preventive measures cannot be adequately named“ must be pointed out [4]. For more specific information, the Work Packages 1 and 2 as well as the report for Project F 1996 “Job-specific unfitness for work as a result of musculoskeletal disorders in Germany“ may be consulted [4].

The present data regarding MSD-related direct and indirect costs is very straightforward. In 2006, the TK calculated a sum of 83.1 million euros (for 27,748 cases) for the cost of inpatient medical treatment for MSDs for their employed individuals. In 2007 it was 87.0 million euros (29,933 cases) and in 2008 it was 95.6 million euros (32,368 cases). The SUGA report estimates loss of production costs[1] caused by MSD at 8.5 billion euros for 2008 and 9.5 billion euros for 2009. The loss of gross value added[2] is estimated in the reports at 15.4 billion euros for 2008 and 17.3 billion euros for 2009. There is a lack of information available regarding the actual costs, especially as regards linking the diagnosis to an occupation.

[1] Because of the input data available, estimates by SUGA contain extrapolations and rounding errors.
[2] Because of the input data available, estimates by SUGA contain extrapolations and rounding errors.

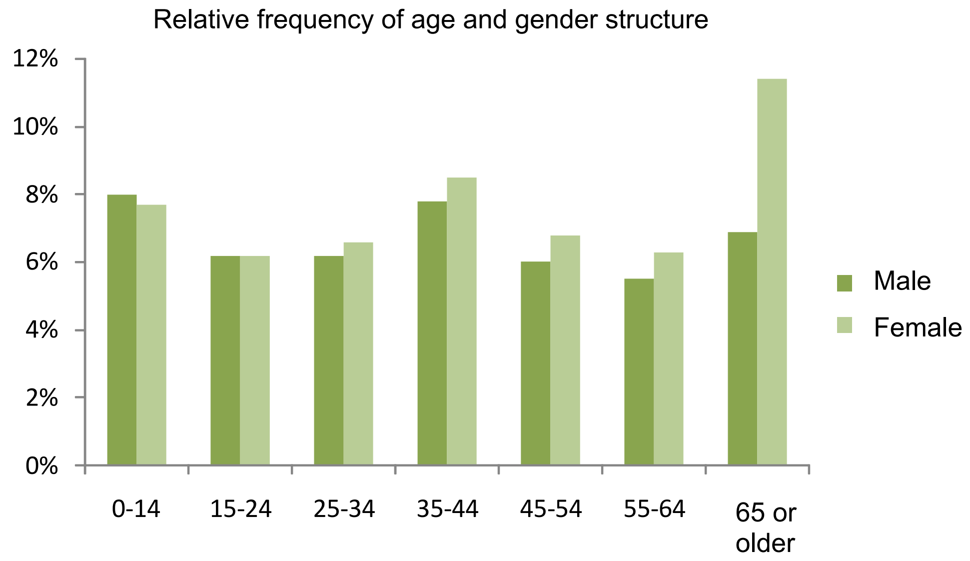
2.2 Evaluation of 2002 random sample data in accordance with Art. 268 of the Social Security Code V of those covered by statutory health insurance

2.2.1 Introduction and method

Using the remote data processing at the research data centre of the Federal Office of Statistics it was possible to analyze data concerning those covered by the statutory health insurance fund (GKV) in Germany in 2002 as regards MSD [15]. Some 90 percent of the German population falls under the statutory health insurance fund and they represent the basic population of the dataset, which comprises a 3% probability sample. In this way, it was possible to evaluate information from about 2.3 million people insured under the statutory health insurance plan in Germany as regards outpatient and inpatient medical costs as well as invalidity and sickness benefits related to MSD. Occupational information was not available. About 350 health insurance funds, the 23 associations for statutory health insurance physicians (KVen), the German Federal Insurance Authority (Bundesversicherungsamt – BVA), the Federal Pensions Office for Salaried Employees (Bundesversicherungsanstalt für Angestellte – BfA) as well as the German Institute of Medical Documentation and Information (Deutsche Institut für medizinische Dokumentation und Information – DIMDI) contributed to the gathering of this extensive data. Details of the dataset and its method can be seen in “Federal Office of Statistics and Länder Statistical Offices, Research Data Centers, Working Paper no. 22“. [15]

A total of 2,300,980 people were included in the evaluations, resulting in an insured period of 2,149,569 person years (= years insured). Figure 4 illustrates the age and gender structure of the collective.

Figure 4: Relative frequencies of persons insured by the statutory health insurance fund in Germany in 2002, stratified by sex and age-group



Source: 2002 random sample data in accordance with Art. 268 of the Social Security Code V; own calculations

To simplify the illustration, reference is always made to persons and not to the period insured. The age of the patients was restricted to 15-64 years of age (n_{Total}=1,520,127; n_{Men}=788,757; n_{Women}=731,370) so the focus could be on the work-capable population. The prevalent case was defined as a policyholder who, during the course of the reported insured period, had one of the following MSD diagnoses as an outpatient, inpatient or as a main diagnosis for invalidity or sickness benefits in the database[3] during 2002: (a list containing the relevant ICD-10 MSD diagnoses can be **found in Appendix 5).**

- G56 Mononeuropathies of upper limb
- M40 Kyphosis and lordosis
- M41 Scoliosis
- M42 Spinal osteochondrosis
- M43 Other deforming dorsopathies
- M45 Ankylosing spondylitis
- M46 Other inflammatory spondylopathies

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[3] The diagnoses “M10 Gout", “M15 Polyarthrosis", “M16 **arthrosis of hip**", “M17 **arthrosis of knee**", “M23 internal derangement of knee" were not included on account of a programming error and the short period of time available.

- M47 Spondylosis
- M48 Other spondylopathies
- M49 Spondylopathies in diseases classified elsewhere
- M50 Cervical disc disorders
- M51 Other intervertebral disc disorders
- M53 Other dorsopathies, not elsewhere classified
- M54 Dorsalgia
- M60 Myositis
- M61 Calcification and ossification of muscle
- M62 Other disorders of muscle
- M63 Disorders of muscle in diseases classified elsewhere
- M65 Synovitis and tenosynovitis
- M75 Shoulder lesions
- M77 Other enthesopathies
- M80 Osteoporosis with pathological fracture
- M81 Osteoporosis without pathological fracture
- M82 Osteoporosis in diseases classified elsewhere
- M83 Adult osteomalacia
- M84 Disorders of continuity of bone
- M85 Other disorders of bone density and structure
- S40-S49 Injuries to the shoulder and upper arm

Absolute and relative frequencies of the following indicators according to individual diagnoses were calculated as indicators:

- Prevalence of MSD in total collective
- Prevalence of persons reporting unfitness for work; number of days of sick leavers
- Amount of sickness benefit
- Amount of outpatient medical expenses
- Amount of inpatient medical expenses

Due to the anonymisation process of the Federal Office of Statistics in the event of too few case numbers, indicators for invalidity, sickness benefits and costs (“M49 Spondylopathies in diseases classified elsewhere“, “M61 Calcification and ossification of muscle“; “M63 Disorders of muscle in diseases classified elsewhere“, “M80 Osteoporosis with pathological fracture“, “M82 Osteoporosis in diseases classified elsewhere“, “M83 Adult osteomalacia“) either could not be shown or there is a slight underestimation of the indicators. A case of invalidity is defined if the insured was entitled to sickness benefits at the start of the invalidity and one of the investigated diagnoses was in the database as the main diagnosis when reporting the invalidity

2.2.2 Results

The appendix contains a complete list in table form of the individual results as well as overview tables with the ranking of the diagnoses within the specific indicator. The ranking is set out so that for each indicator the diagnoses are listed in descending order according to their significance. The text below contains examples of the three most important diagnoses for the individual indicators. They are presented in detail along with a summary of the findings. In the interests of clarity, this section only covers tables of relative frequencies, average costs as well as the first 10 positions in the ranking.

Prevalence of individual MSD diagnoses

“M54 Dorsalgia” was the diagnosis that occurred most frequently in the total collective made up of 15-64 year olds insured by the statutory health insurance fund during the 2002 insurance period (see Table 6 & Table 20) 367,885 individuals received this diagnosis, 66.3% of whom were women. This corresponds to a total period prevalence in the total collective of 24.2% (see Table 20**Fehler! Verweisquelle konnte nicht gefunden werden.**) and when projected comes to approximately 12,262,833 citizens of this age group in the Federal Republic of Germany.

With a period prevalence of 9.5% in the total collective in the 15-64 year age range, “M53 Other dorsopathies not elsewhere classified“ is the second most frequent diagnosis (n= 144,563; $n_{extrapolation}$=4,818,766). Of those affected, 63.5% are female.

The diagnosis “M51 Other intervertebral disc disorders“ takes third place in the total collective ranking. At total of 74,924 people were afflicted with it (see Table 6**Fehler! Verweisquelle konnte nicht gefunden werden.** & Table 20), which would be approximately 2,497,466 affected individuals if extrapolated to the entire population (15-64 years of age). 51.4% were women.

While the male collective is characterized by the ranking shown, the third most frequent diagnosis for women is not “M51 Other intervertebral disc disorders“, but rather “M47 Spondylosis“. With 39,548 women in the test collective affected ($n_{extrapolation}$= 1,318,266) and 28,402 men affected ($n_{nxtrapolation}$= 946,733), the gender-stratified period prevalence of this diagnosis is 5.01% for women and 3.88% for men (see Table 20).

Table 6: Indicators related to sick leavers

Gesamt		Männlich	Weiblich
M54	Rückenschmerzen	M54	M54
M53	Sonstige Krankheiten der Wirbelsäule und des Rückens	M53	M53
M51	Sonstige Bandscheibenschäden	M51	M47
M47	Spondylose	M47	M51
M77	Sonstige Enthesopathien	M77	M77
M75	Schulterläsionen	M75	M75
M41	Skoliose	M41	M41
M42	Osteochondrose der Wirbelsäule	M42	M62
M62	Sonstige Muskelkrankheiten	M62	M81[2]
M65	Synovitis und Tenosynovitis	M43[1]	M42

G56: Mononeuropathies of upper limb; **M40:** Kyphosis and lordosis; **M41:** Scoliosis; **M42:** Spinal osteochondrosis; **M43:** Other deforming dorsopathies; **M45:** Ankylosing spondylitis; **M46:** Other inflammatory spondylopathies; **M47:** Spondylosis; **M48:** Other spondylopathies; **M49:** Spondylopathies in diseases classified elsewhere; **M50: Cervical disc** disorders**, M51:** Other intervertebral disc disorders; **M53:** Other dorsopathies, not elsewhere classified; **M54:** Dorsalgia; **M60:** Myositis; **M61:** Calcification and ossification of muscle; **M62:** Other disorders of muscle; **M63:** Disorders of muscle in diseases classified elsewhere; **M65:** Synovitis and tenosynovitis; **M75:** Shoulder lesions; **M77:** Other enthesopathies; **M80:** Osteoporosis with pathological fracture; **M81:** Osteoporosis without pathological fracture; **M82:** Osteoporosis in diseases classified elsewhere; **M83:** Adult osteomalacia; **M84:** Disorders of continuity of bone; **M85:** Other disorders of bone density and structure; **S40-S49:** Injuries to the shoulder and upper arm

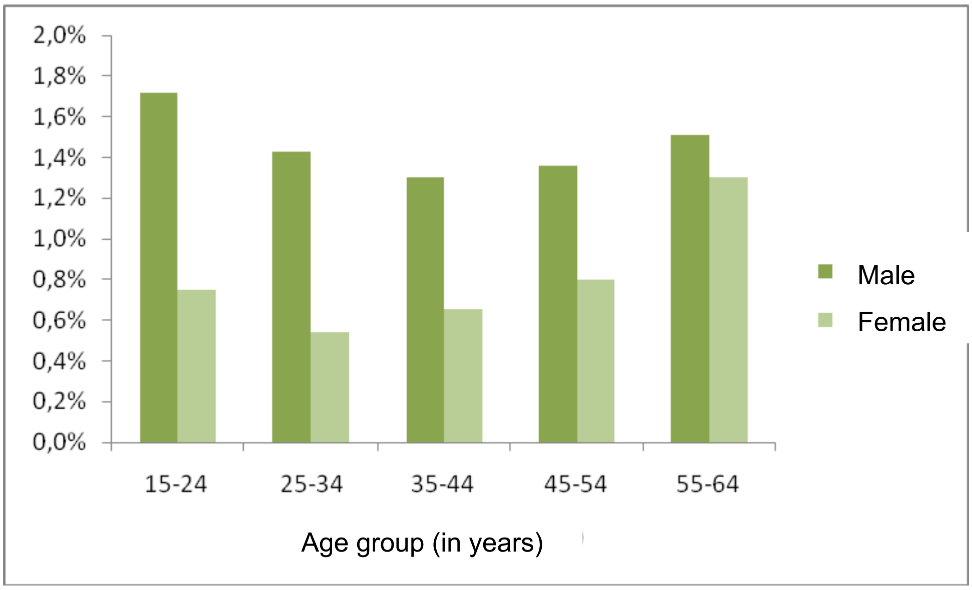
[1]Other deforming dorsopathies; [2] Osteoporosis without pathological fracture

Source: 2002 random sample data in accordance with Art. 268 of the Social Security Code V; own calculations

In addition to gender differences, it is equally important to take into account age group differences in the prevalences. While as a rule prevalence increases with age, this is not the case with the diagnoses “M40 Kyphosis and lordosis“, “M41 Scoliosis“, “M49 Spondylopathies in diseases classified elsewhere“, “M60 Myositis“ (men only), “M84 Disorders of continuity of bone“ (men only), “M85 Other disorders of bone density and structure“, or “S40-S49 Injuries to the shoulder and upper arm“. The example of “S40-S49 Injuries to the shoulder and upper arm“ illustrates this most impressively:

In the total collective, 1.01 % suffered “S40-S49 Injuries to the shoulder and upper arm“ (n=15,399; $n_{extrapolation}$=513,300), with men suffering from it with a period prevalence of 1.31% more often than women at 0.74% (see Table 20). The prevalence according to age group and gender is presented in Figure 5, illustrating that in this case the younger age groups show the higher prevalences.

Figure 5: Prevalence of „S40-49 Injuries to the shoulder and upper arm “, stratified by sex and age-group



Source: 2002 random sample data in accordance with Art. 268 of the Social Security Code V; own calculations

In summary, it can be said that the ranking of the diagnoses within the prevalence indicators varies depending on the gender. This is already evident in the third position and continues when the lower-ranking positions are observed. Age group specific observation of the indicators is necessary, as the indicators do not generally gain significance as the age increases. Instead, the peak of the prevalence varies depending on the diagnosis.

Indicators pertaining to unfitness for work

In addition to the sum of the absolute number days of sick leaversas well as the average number days of sick leaversper patient, Table 7 depicts invalidity period prevalence based on all of the insured individuals in the entire collective. The appendix contains the complete tables, also calculated separately according to gender (see Table 21).

Table 7: Indicators of incapacity of work stratified for single MSD diagnoses

	Diagnoses	Invalidity-prevalence in % corresponding to all insured persons	Total of all invalidity -days	Average length of invalidity-days per invalidity-patient
G56	Mononeuropathie der oberen Extremität	0.20	131,684	44.0
M40	Kyphose und Lordose	0.01	4,131	37.6
M41	Skoliose	0.03	12,908	28.5
M42	Osteochondrose der Wirbelsäule	0.06	26,617	28.6
M43	Sonstige Deformitäten der Wirbelsäule und des Rückens	0.11	31,633	19.7
M45	Spondylitis ankylosans	0.02	19,420	53.2
M46	Sonstige entzündliche Spondylopathien	0.01	6,568	40.8
M47	Spondylose	0.23	95,362	27.1
M48	Sonstige Spondylopathien	0.02	20,234	72.0
M49	Spondylopathien bei anderenorts klassifizierten Krankheiten	-	-	-
M50	Zervikale Bandscheibenschäden	0.09	67,180	50.9
M51	Sonstige Bandscheibenschäden	0.5	450,970	58.8
M53	Sonstige Krankheiten der Wirbelsäule und des Rückens	0.81	326,885	26.5
M54	Rückenschmerzen	5.19	2,152,544	27.3
M60	Myositis	0.01	2,405	21.3
M61	Kalzifikation und Ossifikation von Muskeln	-	-	-
M62	Sonstige Muskelkrankheiten	0.13	24,601	12.5
M63	Muskelkrankheiten bei anderenorts klassifizierten Krankheiten	-	-	-
M65	Synovitis und Tenosynovitis	0.36	111,242	20.2
M75	Schulterläsionen	0.46	257,386	37.0
M77	Sonstige Enthesopathien	0.57	240,804	27.9
M80	Osteoporose mit pathologischer Fraktur	-	-	-
M81	Osteoporose ohne pathologische Fraktur	0.01	6,670	81.4
M82	Osteoporose bei anderenorts klassifizierten Krankheiten	-	-	-
M83	Osteomalazie im Erwachsenenalter	-	-	-
M84	Veränderungen der Knochenkontinuität	0.01	8,878	77,2

	Diagnoses	Invalidity-prevalence in % corresponding to all insured persons	Total of all invalidity -days	Average length of invalidity-days per invalidity-patient
M85	Sonstige Veränderungen der Knochendichte und –struktur	-	1,309	31,9
S40-S49	Verletzungen der Schulter und des Oberarmes	0.21	105,159	33,6

G56: Mononeuropathies of upper limb; **M40:** Kyphosis and lordosis; **M41:** Scoliosis; **M42:** Spinal osteochondrosis; **M43:** Other deforming dorsopathies; **M45:** Ankylosing spondylitis; **M46:** Other inflammatory spondylopathies; **M47:** Spondylosis; **M48:** Other spondylopathies; **M49:** Spondylopathies in diseases classified elsewhere; **M50: Cervical disc** disorders**, M51:** Other intervertebral disc disorders; **M53:** Other dorsopathies, not elsewhere classified; **M54:** Dorsalgia; **M60:** Myositis; **M61:** Calcification and ossification of muscle; **M62:** Other disorders of muscle; **M63:** Disorders of muscle in diseases classified elsewhere; **M65:** Synovitis and tenosynovitis; **M75:** Shoulder lesions; **M77:** Other enthesopathies; **M80:** Osteoporosis with pathological fracture; **M81:** Osteoporosis without pathological fracture; **M82:** Osteoporosis in diseases classified elsewhere; **M83:** Adult osteomalacia; **M84:** Disorders of continuity of bone; **M85:** Other disorders of bone density and structure; **S40-S49:** Injuries to the shoulder and upper arm

Source: 2002 random sample data in accordance with Art. 268 of the Social Security Code V; own calculations

In the interests of obtaining a quick overview of the significance of the individual diagnoses, Table 8 ranks the 10 most frequent diagnoses within the respective indicator for unfitness for work according to significance. Table 22 in the Appendix provides a complete overview and is also separated according to gender.

Table 8: Indicators of incapacity of work - descending order of the 10 meaningful MSD diagnoses, stratified by sex

Invalidity-prevalence in % corresponding to all insured persons			Total of all invalidty-days	Total of all invalidity-days		Average lenth of invalidity-days per invalidity-patient		
Total	Male	Female	Total	Male	Female	Total	Male	Female
M54	M54	M54	M54	M54	M54	M81	M81	M81
M53	M53	M53	M51	M51	M51	M84	M84	M51
M77	M77	M77	M53	M53	M53	M48	M48	M48
M51	M51	M51	M75	M75	M77	M51	M51	M84
M75	M75	M75	M77	M77	M75	M45	M46	M45
M65	M65	M65	G56	S40-S49	G56	M50	M45	M50
M47	S40-S49	G56	M65	M47	M65	G56	M50	G56
S40-S49	M47	M48	S40-S49	G56	M47	M46	G56	S40-S49

Invalidity-prevalence in % corresponding to all insured persons			Total of all invalidty-days	Total of all invalidity-days		Average lenth of invalidity-days per invalidity-patient		
Total	Male	Female	Total	Male	Female	Total	Male	Female
G56	M62	S40-S49	M47	M65	M50	M40	M40	M75
M62	G56	M62	M50	M50	S40-S49	M75	M75	M40

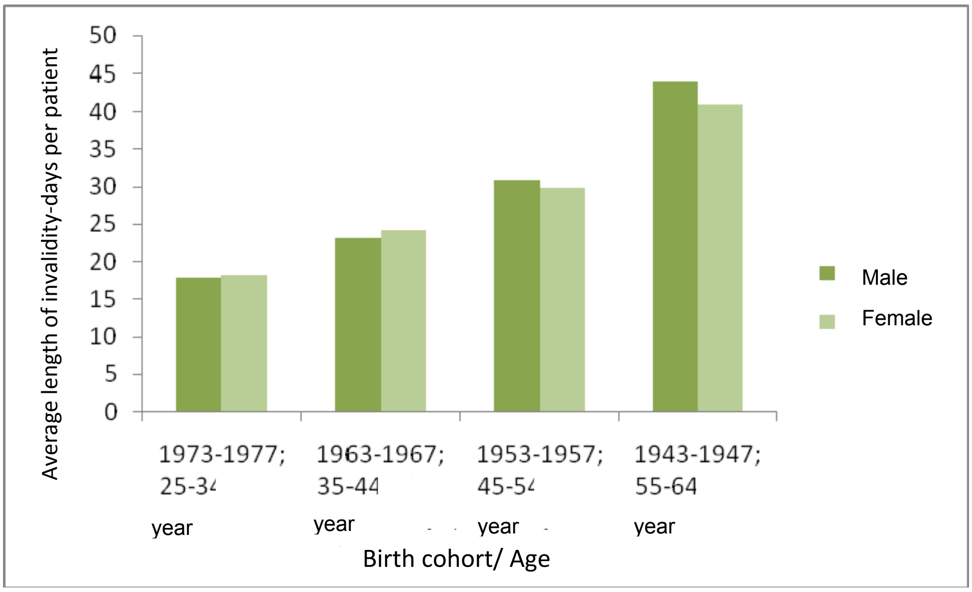
G56: Mononeuropathies of upper limb; **M40:** Kyphosis and lordosis; **M41:** Scoliosis; **M42:** Spinal osteochondrosis; **M43:** Other deforming dorsopathies; **M45:** Ankylosing spondylitis; **M46:** Other inflammatory spondylopathies; **M47:** Spondylosis; **M48:** Other spondylopathies; **M49:** Spondylopathies in diseases classified elsewhere; **M50: Cervical disc** disorders**, M51:** Other intervertebral disc disorders; **M53:** Other dorsopathies, not elsewhere classified; **M54:** Dorsalgia; **M60:** Myositis; **M61:** Calcification and ossification of muscle; **M62:** Other disorders of muscle; **M63:** Disorders of muscle in diseases classified elsewhere; **M65:** Synovitis and tenosynovitis; **M75:** Shoulder lesions; **M77:** Other enthesopathies; **M80:** Osteoporosis with pathological fracture; **M81:** Osteoporosis without pathological fracture; **M82:** Osteoporosis in diseases classified elsewhere; **M83:** Adult osteomalacia; **M84:** Disorders of continuity of bone; **M85:** Other disorders of bone density and structure; **S40-S49:** Injuries to the shoulder and upper arm*Source: 2002 random sample data in accordance with Art. 268 of the Social Security Code V; own calculations*

While in absolute terms the most people report unfitness for work due to “M54 Dorsalgia“, “M53 Other dorsopathies, not elsewhere classified“ and “M77 Other enthesopathies“, the most days of sick leavers in total and in absolute numbers are generated due to “M54“, “M51 Other intervertebral disc disorders“ and “M53 Other dorsopathies, not elsewhere classified“ These deviations are due to the average length of invalidity per diagnosis: whereas the diagnosis “M77“ has an average of 27.9 days of sick leavers, the figure for “M51“ is more than twice as high, at 58.8 days (see Table 7).

In addition to the different diagnosis order in the significance of the unfitness for work indicators, gender differences are observed once again (see Table 22). For example, primarily women suffer more often than men from “G56 Mononeuropathies of upper limb” as well as from “M54 Dorsalgia“ (prevalent cases as well as period prevalence are higher for women than men), even if the invalidity indices are different: In the absolute and relative number, based on all subjects of the respective gender group, more women (n=1,802) than men (n=1,189) are unfit for work due to a diagnosis of “G56 Mononeuropathies of upper limb”. The opposite is true when it comes to a diagnosis of “M54 Dorsalgia” (n_{Women}=29,352, n_{Men}= 49,605). If you compare the people unfit for work who became unfit for work due to the respective diagnosis, to the people who fell ill with the respective diagnosis, men have a higher risk of becoming unfit for work when it comes to “G56 Mononeuropathies of upper limb” and “M54 Dorsalgia“ as well as all other diagnoses. This corresponds to the tendency that men are more frequently in work than women. However, further research is necessary to clarify the range of the ratio differences as they cannot be attributed solely to the differences in the employment structures.

Using “M54 Dorsalgia“ as an example, Figure 6 illustrates the effects of age on the average duration of invalidity in addition to the differences in the gender groups: While women in the 25-34 and 35-44 year old age groups who were unfit for work due to “M54 Dorsalgia“ had longer inactive periods on average compared to men, this ratio is reversed in the age groups 45-54 and 55-64. In this case, men were reported unfit for work an average of 1-3 days longer than women.

Figure 6: Average number of invalidity-days per invalidity-patient for „M54 Dorsalgia“; stratified by sex and age-group



Source: 2002 random sample data in accordance with Art. 268 of the Social Security Code V; own calculations

In summary, it is important to point out the different kinds of invalidity indicators, so that the diagnoses are not the sole focus. If the aim is to minimize the number of people affected by an invalidity report, the decision is different than if the number days of sick leaversis to be minimized. In this case, gender and age-specific observations would seem to make sense.

Levels of sickness benefit

The total sickness benefit paid as well as the average values based on one patient unfit for work are presented in the Appendix in Table 23, along with the ranking in Table 24.

Whereas “M54 Dorsalgia”, “M51 Other intervertebral disc disorders” and “M75 Shoulder lesions” generate the highest cost for sickness benefits in the collective and for men, it is the diagnoses “M54 Dorsalgia”, “M51 Other intervertebral disc disorders” and “M53 Other dorsopathies, not elsewhere classified” for women (see Table 23 & Table 24).

The total of these three most frequent diagnoses according to gender alone generates 33,827,340 euros in costs for payment of sickness benefit (see Table 9). Extrapolated to apply to the entire population, this would come to 112,760,000 euros.

Table 9: Total of sickness benefit (in euros) of the 3 meaningful MSD diagnoses

Male	Total sickness benefit	Female	Total sickness benefit
M54	16,211,733	**M54**	6,918,178
M51	4,701,386	**M51**	2,157,683
M75	2,548,524	**M53**	1,289,836
Total	23,461,643	**Total**	10,365,697

G56: Mononeuropathies of upper limb; **M40:** Kyphosis and lordosis; **M41:** Scoliosis; **M42:** Spinal osteochondrosis; **M43:** Other deforming dorsopathies; **M45:** Ankylosing spondylitis; **M46:** Other inflammatory spondylopathies; **M47:** Spondylosis; **M48:** Other spondylopathies; **M49:** Spondylopathies in diseases classified elsewhere; **M50: Cervical disc** disorders**, M51:** Other intervertebral disc disorders; **M53:** Other dorsopathies, not elsewhere classified; **M54:** Dorsalgia; **M60:** Myositis; **M61:** Calcification and ossification of muscle; **M62:** Other disorders of muscle; **M63:**

Disorders of muscle in diseases classified elsewhere; **M65:** Synovitis and tenosynovitis; **M75:** Shoulder lesions; **M77:** Other enthesopathies; **M80:** Osteoporosis with pathological fracture; **M81:** Osteoporosis without pathological fracture; **M82:** Osteoporosis in diseases classified elsewhere; **M83:** Adult osteomalacia; **M84:** Disorders of continuity of bone; **M85:** Other disorders of bone density and structure; **S40-S49:** Injuries to the shoulder and upper arm

Source: 2002 random sample data in accordance with Art. 268 of the Social Security Code V; own calculations

Outpatient treatment costs

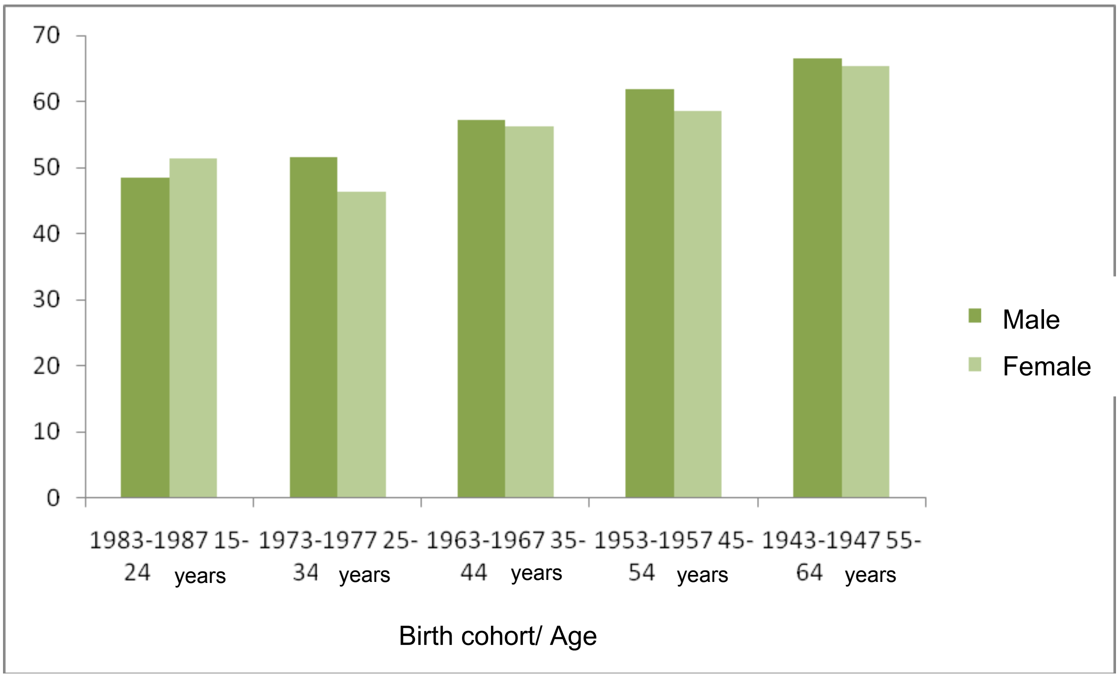
Note on methodology:

In the event of several diagnoses for one claim, the complex structure of the databases made it impossible to determine the basis on which a service was provided. Additional costs may have been generated by conditions other than musculoskeletal disorders. That is why claims based on a single MSD diagnosis were analyzed separately. In this case, it is a subgroup of people suffering from one MSD (Table 25). This does not represent the cost profile of all MSD patients and must be accordingly interpreted with caution. Our results can give only limited insight into the complexity of the cost structures; further research is necessary.

The highest absolute outpatient billing costs in the entire collective solely afflicted by MSD were caused by the diagnoses “M54 Dorsalgia” ($Costs_{Extrapolatioin}$= 4,601,668 euros), “M51 Other intervertebral disc disorders” ($Costs_{Extrapolation}$= 2,619,792 euros) and “G56 Mononeuroeuropathies of upper limb” ($Costs_{Extrapolatioin}$= 1,313,479 euros). As the absolute billing costs are calculated on the basis of the average costs and the number of claims, the ranking of these cost indicators must also be considered: In the entire collective analyzed, the ranking of the significance of the individual diagnosis varies according to the average cost per claim and the number of claims. In terms of average costs, the three most significant individual diagnoses are “M51 Other intervertebral disc disorders”, “M50 Cervical disc disorders”, “M46 Other inflammatory spondylopathies”, and in terms of the number of claims they are “M54 Dorsalgia”, “M51 Other intervertebral disc disorders”, and “M53 Other dorsopathies, not elsewhere classified" (Table 25 & Table 26). Gender differences were observed (Table 25 & Table 26).

The average cost per outpatient claim tends to increase with the age of the patient, however this does not apply to every individual diagnosis. This is presented in Figure 7Figure 7 using "M75 Shoulder lesions" as an example. If, however, the number of conditions per person increases with age and the percentage of patients with just one MSD drops, the illustration is not representative for all those afflicted.

Figure 7: M75 shoulder lesions, average costs (in euros) per outpatient claim, according to gender and age-group



Source: 2002 random sample data in accordance with Art. 268 of the Social Security Code V; own calculations

Inpatient costs

Just as with 2.2.2.4 Outpatient billing costs, there is a

Note on methodology:

If there were several diagnoses for one inpatient episode, the complex structure of the databases made it impossible to determine the diagnosis on the basis of which a service was provided. Additional costs may have been generated by conditions other than musculoskeletal disorders. That is why inpatient episodes based on a single MSD diagnosis were analyzed separately. In this case there is a subgroup of inpatient episodes that took place due to one MSD (see Table 7). This does not represent the cost profile of all MSD patients and must accordingly be interpreted with caution. Our results can give only a limited insight into the complexity of the inpatient cost structures; further research is necessary.

In the total collective, as well as divided according to gender, the absolute highest inpatient costs for 15-64 year old patients afflicted by an MSD are incurred for diagnoses “M51 Other intervertebral disc disorders”, “M54 Dorsalgia”; and “M75 Shoulder lesions”. The same three diagnoses are equally significant when it comes to the absolute number of inpatient episodes, where the ranking in the subgroup of the entire collective is characterized by “M51 Other intervertebral disc disorders“, “M75 Shoulder lesions“ and “M54 Dorsalgia“. When it comes to the gender-specific structure, the significances change between positions 2 and 3 (Men: M51, M75, M54; Women: M51, M54, M75) (see Table 27 & Table 28).

A look at the average cost per inpatient episode reveals that the three most significant diagnoses vary and are arranged differently according to gender (see Table 10).

Table 10: Inpatient costs, the three most meaningful diagnoses per indicator

Average costs per inpatient episode in euros (alone MSD)			Number of inpatient episodes (alone MSD)			Absolute costs of inpatient episodes (alone MSD)		
Total	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**
M45	M45	M41	M51	M51	M51	M51	M51	M51
M46	M43	M46	M75	M75	M54	M54	M54	M54
M41	M46	M47	M54	M54	M75	M75	M75	M75

G56: Mononeuropathies of upper limb; **M40:** Kyphosis and lordosis; **M41:** Scoliosis; **M42:** Spinal osteochondrosis; **M43:** Other deforming dorsopathies; **M45:** Ankylosing spondylitis; **M46:** Other inflammatory spondylopathies; **M47:** Spondylosis; **M48:** Other spondylopathies; **M49:** Spondylopathies in diseases classified elsewhere; **M50: Cervical disc** disorders**, M51:** Other intervertebral disc disorders; **M53:** Other dorsopathies, not elsewhere classified; **M54:** Dorsalgia; **M60:** Myositis; **M61:** Calcification and ossification of muscle; **M62:** Other disorders of muscle; **M63:** Disorders of muscle in diseases classified elsewhere; **M65:** Synovitis and tenosynovitis; **M75:** Shoulder lesions; **M77:** Other enthesopathies; **M80:** Osteoporosis with pathological fracture; **M81:** Osteoporosis without pathological fracture; **M82:** Osteoporosis in diseases classified elsewhere; **M83:** Adult osteomalacia; **M84:** Disorders of continuity of bone; **M85:** Other disorders of bone density and structure; **S40-S49: I**njuries to the shoulder and upper arm

Source: 2002 random sample data in accordance with Art. 268 of the Social Security Code V; own calculations

2.2.3 Conclusion

It should be kept in mind that the significance of the diagnoses varies according to the indicator and that no blanket statement may be made about the prioritization of prevention topics. Instead, various approaches must be discussed. What is important is to consider them according to individual diagnoses, as well as gender and age-specific distribution.

Approximately one in four 15-64 year olds covered by statutory health insurance underwent medical treatment for “M54 Dorsalgia” during the 2002 insurance year. Next in line according to significance within the period prevalence are the diagnoses “M53 Other dorsopathies, not elsewhere classified“ and “M51 Other intervertebral disc disorders“. A look at the indicators regarding unfitness for work shows that the ranking of the significance of the diagnoses changes: When considering all of the days of sick leavers, these three diagnoses continue to occupy the most important positions. However this is no longer the case when differentiated according to the number of people. In this case, the diagnoses “M54 Dorsalgia!, “M53 Other dorsopathies, not elsewhere classified”, and “M77 Other enthesopathies” are most relevant. If the average number days of sick leaversper patient unfit for work is assessed according to an individual diagnosis, the diagnoses “M81 Osteoporosis without pathological fracture”, “M84 Disorders of continuity of bone”, and “M48 Other spondylopathies” cause the highest number of absences from work on average per person. The highest sickness benefit costs are caused by the diagnoses “M54 Dorsalgia”, “M51 Other intervertebral disc disorders” and “M75 Shoulder lesions”. Whereas the highest outpatient medical expenses are generated by “M54 Dorsalgia”, “M51 Other intervertebral disc disorders” and “G56 Mononeuropathies of upper limb” for those given this diagnosis alone, the highest inpatient medical expenses are caused by “M51 Other intervertebral disc disorders”, “M54 Dorsalgia” and “M75 Shoulder lesions” for those solely afflicted by MSD.

The dataset cannot be used to make a distinction between those in employment and those unemployed.

3 Evaluating the statutory accident insurance data

3.1 Introduction and method

Under certain conditions and in keeping with the regulatory framework, some MSDs can be formally recognized as occupational diseases. The costs of occupational diseases (OD) are borne by the respective accident insurance providers or industrial accident insurance associations. Members of the German Statutory Accident Insurance (Deutsche Gesetzliche Unfallversicherung – DGUV) are the industrial accident insurance associations and the public accident insurance provider. In the 2008 reporting year, some 74 million people were insured in Germany. Of those, 17,058,553 were covered by pupil accident insurance, 10,599,153 by the general accident insurance of the public accident insurance provider and 46,581,789 by the industrial accident insurance associations; these included workers in the commercial sector, voluntarily as well as compulsorily insured employers, statutorily insured special groups, e.g. unpaid workers and non-commercial construction workers.[16]

Figures occupational diseases were provided for the project by the DGUV/ Department of OD Statistics. The assessments are based on the occupational disease documentation (OD-DOC) – a source of updated information on individual cases in which the relevant current status of a case is recorded. The following is a selection of assessments from the OD-DOC as at 24 June 2009.

3.2 Results

Table 11 contains the number of suspected OD cases confirmed for selected ODs, presented in the Appendix in Table 29, from 2003-2007. For OD 2101 and 2108-2110 there is a requirement to cease and desist the risky activities in order for the OD to be recognized. The group of ODs with confirmed suspicion presented here comprises the recognized ODs and those which have not been recognized due to the additional requirement.

Table 11: Absolute frequency of selected occupational diseases from 2003 to 2007 for the status „Confirmed suspected occupational disease cases"

Occupational disease documentation (OD-DOC) – Industrial economy and public service Confirmed suspected occupational disease									
Year	**2101 Tendon sheath**	**2102 Menis-cal lesions**	**2103 Vibra-tion (pneu-matic tools)**	**2105 Syno-vial bur-sae**	**2107 spi-nous pro-cesses**	**2108 Lumbar spine, lifting and carrying**	**2109 Cervical spine**	**2110 Lumbar spine, vibration of the entire body**	**total**
2003	33	360	131	201	0	299	8	14	1046
2004	26	302	108	187	0	324	15	6	968
2005	24	275	101	148	2	300	12	12	874
2006	22	253	98	143	1	336	10	6	869
2007	26	230	66	152	0	453	10	13	950
total	131	1.420	504	831	3	1.712	55	51	4.707

Source: © DGUV Department of OD Statistics /ZIGUV D-53757 Sankt Augustin; generated at 24 June 2009

If the OD is a recognized one and the reduction in earning capacity justifies a pension or the patient has died as a result of the OD, the sickness is declared a new occupational disease pension (OD-pension). This is a subset of the recognized occupational diseases (see Table 12).

Table 12: Absolute frequency of occupational diseases for 2003 to 2007 with the status „new occupational disease pension“

Occupational disease documentation (OD-DOC) – Industrial economy and public service

New OD-pension

Year	2101 Tendon sheath	2102 Menis-cal lesions	2103 Vibra-tion (pneu-matic tools)	2105 Syno-vial bur-sae	2108 Lumbar spine, lifting and carrying	2109 Cervical spine	2110 Lumbar spine, vibration of the entire body	total
2003	5	155	91	7	131	2	8	399
2004	3	132	72	3	137	4	3	354
2005	2	82	64	1	119	1	9	278
2006	2	75	64	2	115	1	6	265
2007	3	74	46	2	137	4	9	275
total	15	518	337	15	639	12	35	1.571

Source: © DGUV Department of OD Statistics /ZIGUV D-53757 Sankt Augustin; generated at 24 June 2009

In the last five years, suspicion was confirmed most frequently for OD 2108 (lumbar spine, lifting and carrying), based on the selected ODs, and a new OD-pension was recorded. OD 2102 (meniscus lesions) is both one of the confirmed suspected occupational diseases and in second place amongst the new occupational disease pensions. The following takes a closer look at the age when recognized (see Figure 8 and Figure 9) and the distribution according to gender for these two occupational diseases (OD 2108 and OD 2102). The year that OD 2108 or OD 2102 were recognized saw the majority of those affected between 45 and 54 years of age.

Figure 8: Number of OD 2102 „suspicion confirmed“ according to age when recognized

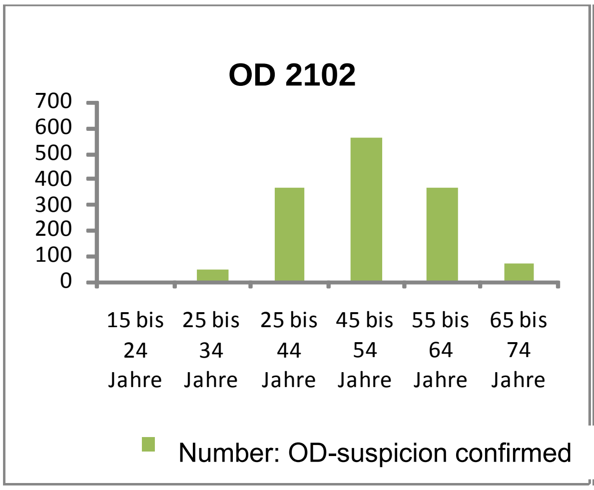
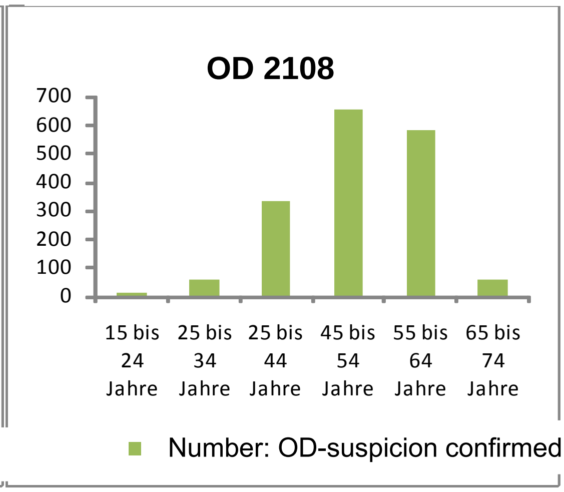


Figure 9: Number of OD 2108 „suspicion confirmed“ according to age when recognized



Source: © DGUV Department of OD Statistics /ZIGUV D-53757 Sankt Augustin; generated at 24 June 2009, own calculations

From a total of 1,712 confirmed cases of OD suspicion in the last five years for OD 2108 (lumbar spine, lifting and carrying), insured females were represented more strongly, with 1,050 cases (approx. 61.3%), than insured males at 662 (approx. 38.7%). Of the 1420 cases of OD 2102 (meniscus lesions), a total of 1,416 (approx. 99.7%) cases were men and 4 (approx. 0.3%) were women.

An OD cost survey for the industrial accident insurance associations according to benefit cases and their costs for outpatient and inpatient treatment of the OD listed in Table 11 were provided by the DGUV for 2003 through 2007. Of a total of 15,488,015 euros for the selected ODs in total for outpatient medical expenses from 2003 to 2007, 10,926,523 euros (70.55%) were allocated to OD 2108 (lumbar spine, lifting and carrying) and 3,220,372 euros (20.79%) to OD 2102 (meniscus lesions) (see Figure 11)

Figure 10: Percentage of the outpatient medical expenses from 2003 to 2007 for OD 2102, OD 2108 and others

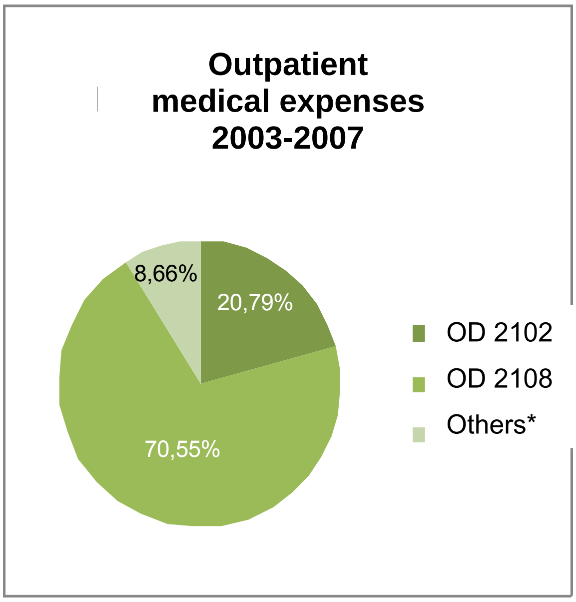
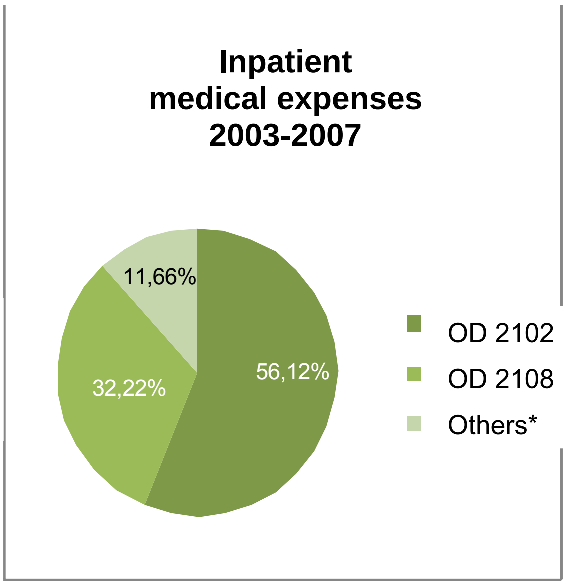


Figure 11: Percentage of the inpatient medical expenses from 2003 to 2007 for OD 2102, OD 2108 and others.



* OD 2101, OD 2103, OD 2105, OD 2107, OD 2109, OD 2110.

Source: © DGUV Department of OD Statistics /ZIGUV D-53757 Sankt Augustin; generated at 24 June 2009, own calculations

The highest inpatient medical expenses from 2003 to 2007 were caused by OD 2102 (meniscus lesions) at 10,117,498 euros (56.12%). With a total amount for all selected ODs of 18,029,484 euros, OD 2108 (lumbar spine, lifting and carrying) is in second place with 5,809,225 euros (32.22%).

If both inpatient and outpatient medical expenses are added together for the last five years, the total for OD 2108 comes to 16,735,748 euros.

Of note for OD 2108 is an increase in the average cost of outpatient care per claim in 2003, from 522.55 to 817.80 euros in 2007. The average inpatient cost per case also rose from 4,116.59 euros in 2003 to 5,159.22 euros in 2007.

The total costs for outpatient and inpatient medical expenses over the last five years come to 13,337,870 euros for OD 2102 (meniscus lesions), thus coming in under the total costs for OD 2108 (lumbar spine, lifting and carrying) for the same time period.

3.3 Conclusion

Data on occurrences from 2003 to 2007 reveals that occupational diseases (OD) 2108 (lumbar spine, lifting and carrying) and OD 2102 (meniscus lesions) have a high number of confirmed cases of suspected ODs and new OD pensions compared to other ODs associated with MSDs (see Table 29). The year that OD 2108 or OD 2102 were recognized, the majority of those insured were between 45 and 54 years of age. Of the confirmed suspected cases (2003 to 2007) for OD 2102 (meniscus lesions), men predominated, with 99.7% of the cases. If one looks at the cost of outpatient and inpatient medical treatment for the industrial accident insurance associations according to OD claims associated with MSD, some 90% of the outpatient and inpatient costs incurred from 2003 to 2007 are attributed to OD 2108 and OD 2102. These ODs take on huge significance when it comes to the issue of prevention of MSD.

4 Evaluation of data on pension claims based on invalidity

4.1 Introduction / method

The German social insurance system, within the statutory pension insurance fund (Section VI of the German Social Code) for employees, covers the insured risks of age, invalidity and death. In the 2007 reporting year, a total of 39,002,315 citizens were actively insured by the statutory pension insurance fund [17].

In the same reporting year, 844,425 men and 739,376 women received pensions as per Section VI of the German Social Code due to reduced earning capacity [18]. This is a provision that guarantees financial support for insured individuals to compensate for any reduction or loss of pay in the case of partial[4] or complete[5] reduction in earning capacity due to sickness or disability. In addition to the medical requirements, the following conditions pursuant to insurance law must be met: There is a waiting period of 5 years as well as a requirement that during the last 60 calendar months prior to the reduction in earning capacity, there have been 36 months of mandatory contributions (so-called 3/5 rule). A pension based on reduced earning capacity can be paid until the end of the 65th year of life.

MSDs can lead to a reduction in earning capacity and under certain conditions (see below under “Background”) to a pension entitlement.

In order to analyze influencing factors for a pension entitlement on grounds of reduced earning capacity related to an MSD, the Scientific Use File of the German Statutory Pension Insurance Fund (Deutsche Rentenversicherung) from 2007 was used. This takes the form of a 20% randomized sample (n ~ 32,000) of all cases of claims to pension insurance resulting from a reduction in earning capacity. The report deals exclusively with invalidity pensions. In addition, the Scientific Use Files from 2005 and 2006 were included in the assessment strategy in order to analyze the percentage of pension claims due (in part) to MSDs in relation to the whole of pension claims over time. The occupations were classified based on standardized data collection of the activities of the employees during the reporting process for social insurance.[6] The three digit occupation descriptions (occupation rankings) were included in the assessments. A detailed analysis of the occupations was not systematically possible due to the sometimes low numbers of cases.

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[4] If for health reasons an insured person is only able to work less than six hours a day (within a five-day week) for an unforeseeable period (i.e. more than six months) and measures to enable that person to participate are not likely to succeed.

[5] If for health reasons an insured person is only able to work less than three hours a day (within a five-day week).

[6] Structured acording to occupation categories for the statistics of the Federal Labor Office (Bundesanstalt für Arbeit). Ed. Bundesanstalt für Arbeit – version of September 1988

4.2 Results

All cases were considered for the assessments that were decided without the individual concerned having received a pension from a statutory pension insurance fund in the period directly preceding (identifiable in the dataset via report reason 10).

Table 13 illustrates new pensions based on reduced earning capacity for all diagnostic groups and for MSDs. As a criterion for MSD, at least one of the following diagnoses had to be present:

- M00-M25: Arthropathies
- M30-M36: Systemic connective tissue disorders
- M40-M54: Dorsopathies
- M60-M79: Soft tissue disorders
- M80-M94: Osteopathies and chondropathies
- M95-M99: Other disorders of the musculoskeletal system and connective tissue

The years 2005-2007 are presented, stratified according to gender. Whereas the absolute number of new pensions initially decreases from 2005 to 2006 and then increases again in 2007, the absolute number of new pensions based on MSDs decreases over the three years.

Table 13: New pensions based on reduced earning capacity for all diagnostic groups and the MSD diagnostic chapter in 2005-2007, stratified by gender

	New pensions based on reduced earning capacity								
	2005			2006			2007		
	Total	MSD diagnosis	%	Total	MSD diagnosis	%	Total	MSD diagnosis	%
Total	32,345	5,864	18.1	31,024	5,245	16.9	31,531	5,093	16.2
Male	17,904	3,308	18.5	17,206	2,936	17.1	17,377	2,806	16.1
Female	14,441	2,556	17.7	13,818	2,309	16.7	14,154	2,287	16.2

Source: FDZ-RV – SUFRTZN05XVSTEM, FDZ-RV – SUFRTZN06XVSTEM, FDZ-RV – SUFRTZN07XVSTEM – own calculations [19-21]

A closer examination of cases of reduced earning capacity over the time period and stratified according to occupation makes Table 14 possible. Here it can be noted that, over the given period from 2005 to 2007, with the exception of occupations in agriculture, animal husbandry and forestry or horticulture, the percentage of cases of reduced earning capacity caused (in part) by an MSD decreased. The causes for these changes may be developments in the socio-demographic profile of the occupation, changes in employment structures or other possible influencing factors. Two occupational areas can be singled out where the findings correspond to the information provided by the insurance funds. One is the high percentage of reduced earning capacities due to MSDs amongst miners and mineral extraction workers, where, for example, every fourth invalidity pension (25.0%) was linked to an MSD diagnosis in 2007. Manufacturing jobs occupy second place, with one in five individuals receiving a pension as the result of an MSD diagnosis.

Table 14: Absolute and relative frequencies of invalidity pensions by occupational category in 2005-2007

	Analysis by occupation ranking								
	2005			2006			2007		
	Total	**MSD diagnosis**	**%**	**Total**	**MSD diagnosis**	**%**	**Total**	**MSD diagnosis**	**%**
Occupations in agriculture, livestock farming, forestry and horticulture (01-06)	618	120	19.4	757	159	21.0	734	118	16.1
Miners, mineral workers (07-09)	98	31	31.6	146	44	30.1	124	31	25.0
Manufacturing occupations (10-55)	8,234	1,814	22.0	7,550	1,538	20.4	8,102	1,648	20.3
Technical Occupations (60-65)	796	116	14.6	770	100	13.0	712	76	10.7
Occupations in service sector (66-93)	14,762	2,511	17.0	14,566	2,337	16.0	15,029	2,337	15.5
Other workers (97-99)	266	53	19.9	485	45	9.3	558	45	8.1
Not specified	7,571	1,219	16.1	6,750	1,022	15.1	6,272	838	13.4
Total	32,345	5,864	18.1	31,024	5,245	16.9	31,531	5,093	16.2

Source: FDZ-RV – SUFRTZN05XVSTEM, FDZ-RV – SUFRTZN06XVSTEM, FDZ-RV – SUFRTZN07XVSTEM – own calculations [19-21]

Table 15 depicts the socioeconomic characteristics of those individuals who received an invalidity pension based on an MSD diagnosis for the first time in 2007. By way of comparison, individuals who received an invalidity pension not based on an MSD diagnosis are also listed. In the multivariate end model, statistically significant associations between gender, age, marital status, education and responsibility keys are demonstrated. For example, unmarried or widowed individuals have a lower risk (aOR 0.6; 95%-CI 0.6-0.7) of receiving an invalidity pension based on an MSD compared to all others who received such a pension in 2007. This effect is independent of variables in the model such as age and education. When looking at the risk estimator, it must be emphasized that these figures are based on a comparison with other individuals with invalidity pensions (but not due to an MSD).

Carefully formulated, it seems that when it comes to invalidity pensions based on MSDs, socio-economic influencing factors play an important role, and therefore stress or a lack of coping strategies outside the occupational sector are not to be underestimated. It is up to further research to generate solutions for this.

Table 15: Socio-economic characteristics of persons with invalidity pensions in 2007

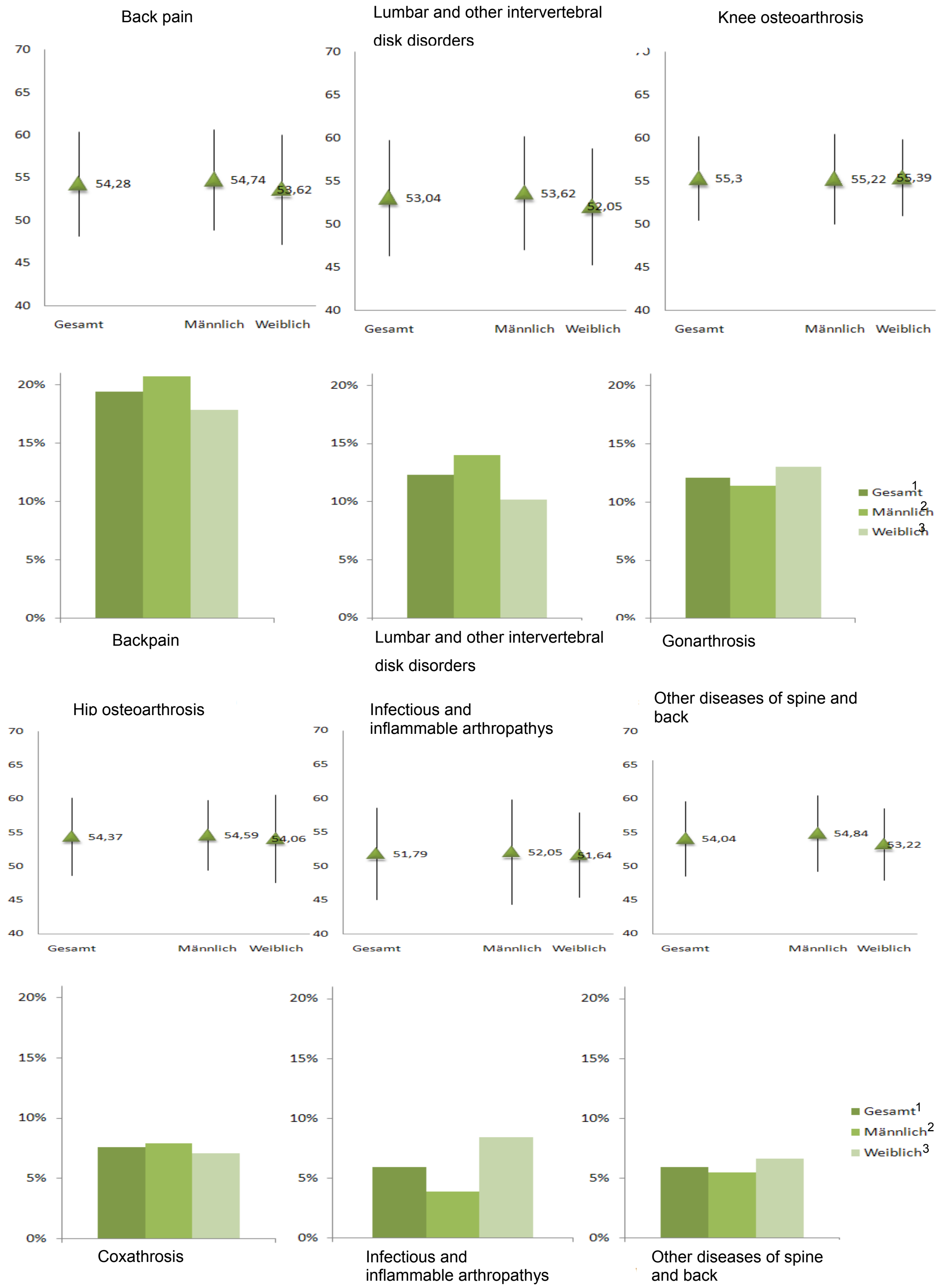
		Total	MSD diagnosis	MSD diagnosis	Not-MSD diagnosis		
		Frequency	Row percent[2]	Column percent[3]	Column percent[33]	aOR	95%-CI
Gender	Male	17,377	16.1	55.1	55.1	1.0	Ref.
	Female	14,154	16.2	44.9	44.9	1.2	1.1-1.2
Age at pesnion starting (in years)[1]	Younger than 30	840	3.7	0.6	3.1	0.1	0.1-0.2
	30-39	3,037	6.2	3.7	10.8	0.2	0.2-0.3
	40-49	8,548	11.3	18.9	28.7	0.4	0.3-0.4
	50-59	17,043	19.7	65.8	51.8	0.7	0.6-0.7
	60 and older	2,063	27.1	11.0	5.7	1.0	Ref.
Marital status[1]	married / again married	18,356	20.0	71.9	55.6	1.0	Ref.
	Not married / widowed	13,175	10.9	28.1	44.4	0.6	0.6-0.7
Education[1]	Lower secondary school/ intermediate school without apprenticeship	4,479	17.1	15.0	14.0	1.0	Ref.
	Lower secondary school/ intermediate school with apprenticeship	13,433	17.8	46.8	41.8	1.1	1.0-1.2
	Higher secondary school/ advance technical college / college/ university	2,576	4.2	2.1	9.3	0.4	0.3-0.5
	Not specified	11,043	16.6	36.0	34.8	1.1	1.0-1.2
Occupation ranking*[1]	Occupations in agriculture, livestock farming, forestry and horticulture (01-06)	734	16.1	2.3	2.3	1.1	0.9-1.3
	Miners, mineral workers (07-09)	124	25.0	0.6	0.4	1.8	1.2-2.7
	Manufacturing occupations(10-55)	8,102	20.3	32.4	24.4	1.4	1.3-1.5
	Technical occupations (60-65)	712	10.7	1.5	2.4	0.7	0.6-0.9
	Occupations in service sector (66-93)	15,029	15.5	45.9	48.0	1.0	Ref.
	Other workers (97-99)	558	8.1	0.9	1.9	0.5	0.3-0.6
	Not specified	6,272	13.4	16.5	20.6	1.0	0.9-1.1

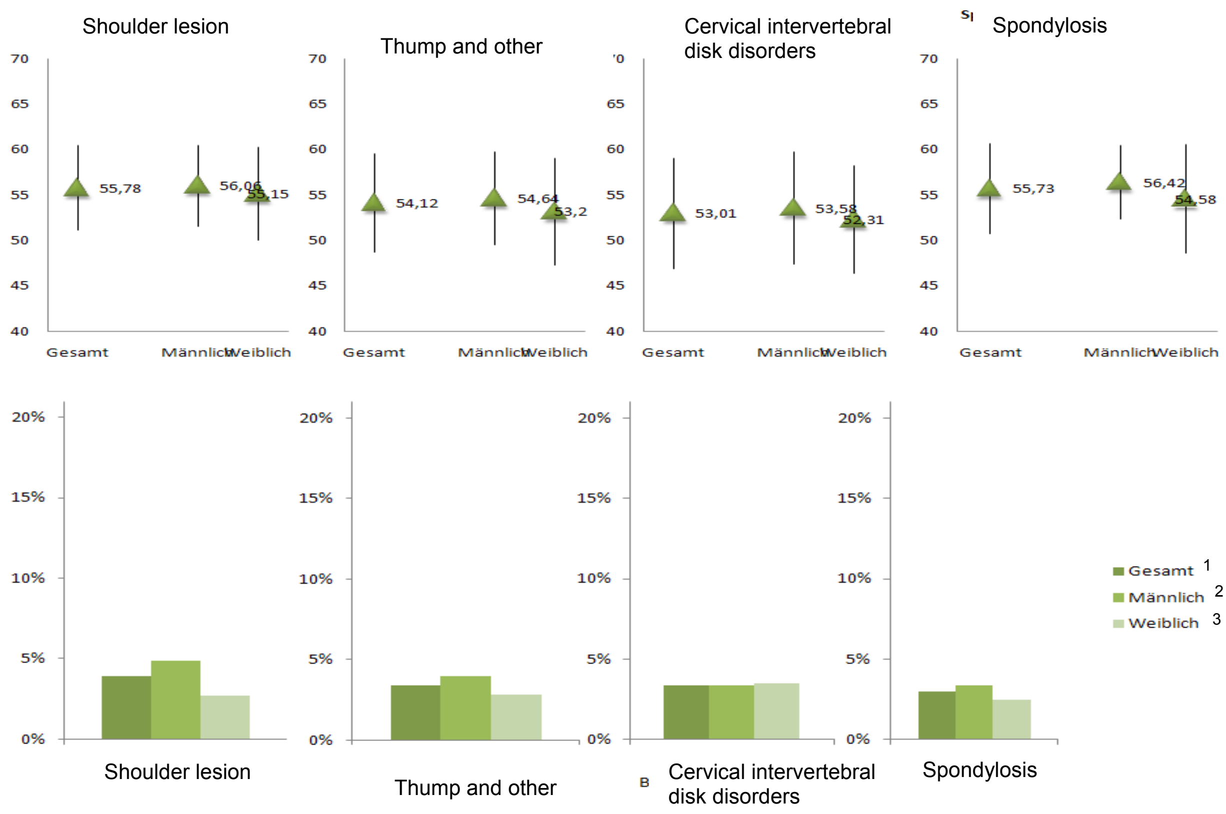
[1]p-value < 0,001 (Chi²-test); [2] Percentage of persons with MSD diagnosis per subcategory; [3] Frequency of subcategories within persons with MSD diagnosis (n = 5.093) respectively Not-MSD diagnosis (n=26.435);
* Available specifications on latest occupation were summarized with the aid of the occupational classification of the Federal Statistical Office and in adjustment with the key directory for occupational categories of the Federal Employment Office [22]

Source: SUFRTZN07XVSTEM – own calcaltions [21]

In order to understand the significance of the individual MSD diagnoses in relation to the invalidity pension, the following figures (see Figure 12; in the Appendix Table 30) present the ten most common MSD diagnoses that led to the approval of an invalidity pension in 2007, according to prevalence and age distribution. Almost one in five MSD invalidity pensions can be traced back to a diagnosis of back pain (19.4%). Gender specific differences are present: for example, men suffer more frequently from lumbar and other intervertebral disc disorders, shoulder lesions, thumb and other arthroses, whereas women suffer more often from infectious and inflammatory arthropathies. It is also noticeable that the average pension starting age for the 10 most common MSD diagnoses for women is younger than that for the male collective. Osteoarthritis of the knee and hip are exceptions, where the age distributions are approximately the same.

Figure 12: Prevalence and age distribution of the 10 most frequent MSD diagnoses coursing/contributing to invalidity pensions in 2007





[1] Gesamt means total; [2] Männlich means male; [3] Weiblich means female

Source: SUFRTZN07XVSTEM – own calculations

4.3 Conclusion

It should be noted that in 2007 approximately one pension claim in 6 (about 25,500 people) was in part due to reduced earning capacity as a result of MSD, and about one in five can be traced back to a diagnosis of “back pain”.

The number of invalidity pensions related to MSD has decreased slightly since 2005 and differs according to occupational category. An exclusive focus on the prevalence of invalidity pensions due (in part) to MSDs in 2007 shows a range of 8.1% (other workers) to 25.0% (miners, mineral extraction workers). If taken as an overall model, it becomes evident that age, gender, marital status and education are statistically significant in terms of the percentage of invalidity pensions based (in part) on MSDs and that, independent of these factors, miners (aOR 1.8 95%-CI 1.2-2.7) and those with manufacturing jobs (aOR 1.4 95%-CI 1.3-1.5) have a higher percentage of invalidity pensions based (in part) on MSDs compared to employees in the services sector, while people in technical occupations (aOR 0.7 95%-CI 0.6-0.9) and other workers (aOR 0.5 95%-CI 0.3-0.6) have a lower risk in comparison. Adequate calculation of the costs of invalidity pensions based (in part) on MSDs would call for close cooperation with the German statutory pension insurance fund and was not possible within the scope of this project due to time constraints.

5 Evaluation of 2003 telephone health survey

5.1 Introduction/method

Musculoskeletal disorders are usually accompanied by pain symptoms. The pain involves a perception that is codetermined, among other things, by cultural, social, and psychological personality factors and individually processed. This can lead to very different individual solutions for treatment of pain and likewise to medical assistance being sought on bio-psychosocial grounds. Because the previous analyses were based on data from the statutory health insurance system and other institutions for which contact with a physician is required for registration, this yields an incomplete picture of all people affected by MSDs. In order to gain a comprehensive view of MSD problems using the example of back pain and its effects on daily activities, the data from the 2003 telephone health survey (GSTel03) conducted by the Robert Koch Institute was analyzed. This is a representative survey of the adult population in Germany. In a computer-assisted telephone interview with a participation rate of 52.3% [23], a total of 8,318 people were asked questions on various aspects of conditions, including potential risk factors, quality of life, and socio-economic factors. Amongst other things, back pain was surveyed in detail, enabling subsequent analyses of the prevalence of back pain and potential influencing factors to be carried out.

In total, 61.7% of survey participants stated that they had suffered back pain in the previous 12 months. In bi- and multivariate analysis models it emerged that, apart from occupational status, other socio-economic factors such as gender and education level are associated with the occurrence of back pain. The potential influencing factors are shown in

Table 16 according to their relative frequencies and the adjusted risk in the form of odds ratios (including 95% confidence intervals).

Table 16: Socio-economic parameter in relation to back pain in general population

			Back pain during the last 12 months		
		Total	**Row-%**	**aOR**	**95%-CI**
Gender			0.000[a]		
	Female	4.301	658	Ref.	
	Male	4.017	57.4	0,7	0,6-0,8
Age groups			0.009[a]		
	<24 years	862	59.4	Ref.	
	25-34 years	1.267	60.4	1,0	0,8-1,2
	35-44 years	1.839	64.0	1,1	0,9-1,4
	45-54 years	1.383	62.7	1,0	0,8-1,3
	55-64 years	1.211	64.2	1,0	0,8-1,2
	65 years and older	1.756	59.3	0,7	0,5-0,9
Migration state			0.106[a]		
	Non-migrant	7.543	62.1	Ref.	
	Migrant	775	591	0,9	0,8-1,0
Life partner			0.058[a]		
	Yes	6.271	62.5	Ref.	
	No	2.035	59.6	0,9	0,8-1,0
	n.s.	11	63.6	1,0	0,3-3,3
Persons younger than 18 years in household			0.015[a]		

		Total	Back pain during the last 12 months Row-%	aOR	95%-CI
	None	6.012	61,0	Ref.	
	One or more	2.306	63,9	1,0	0,9-1,2
Employment state/ extend of employment			0,001[a]		
	Full time	3.525	60,2	Ref.	
	Part time	1.377	64,5	1,1	0,9-1,3
	Housewife	657	66,8	1,1	0,9-1,3
	Unemployed	322	62,4	1,0	0,8-1,3
	Retired or early retired	2.147	62,1	1,3	1,1-1,6
	Apprenticeship	282	53,9	1,0	0,7-1,4
	n.s.	7	57,1	1,3	0,3-6,4
Employment position			0,000[a]		
	Employee	4.336	63,2	Ref.	
	Clerk	558	57,7	0,9	0,8-1,1
	Selfemployed/ helping family member	797	52.6	0.7	0.6-0.8
	Worker	1,661	66.5	1.2	1.0-1.4
	Apprenticeship and vocational training	131	68.7	1.3	0.7-2.3
	Other	681	54.9	0.7	0.5-1.0
	n.s.	154	58.4	0.9	0.7-1.3
Smoker			0.005[a]		
	Never-smoker	3,379	59.6	Ref.	
	Ex-smoker	2,234	63.4	1.2	1.1-1.4
	Smoker	2,702	63.1	1.2	1.1-1.3
	n.s.	2	100	1.2	-
Highest school leaving certificate			0.000[a]		
	Higher secondary school, advanced technical college entrance qualification	2,604	57.6	Ref.	
	Intermediate school	2,705	62.2	1.0	0.9-1.2
	Lower secondary school	2,604	65.8	1.2	1.1-1.5
	No graduation	73	69.9	1.8	1.0-3.0
	Still in education	154	56.5	1.1	0.8-1.7
	n.s.	178	59.6	1.0	0.7-1.4

		Total	Back pain during the last 12 months Row-%	aOR	95%-CI
Highest professional certificate			0.000[a]		
	University, advanced technical college	1,575	57	Ref.	
	Vocational school	2,060	63.1	1.1	0.9-1.3
	Vocational training	2,931	64.2	1.0	0.9-1.2
	No vocational training	880	64.2	1.0	0.8-1.3
	Other	657	57.7	1.1	0.7-1.8
	n.s.	215	54	0.8	0.6-1.0

[a] p-Value of Chi²-test

Source: GSTel03, specifications rewighted, own calculations

The percentages of individuals experiencing back pain within the previous 12 months are shown in Table 16 for different socio-economic groups. According to this, the proportion of females, at 65.8%, is clearly greater than the proportion of males, which is just 57.4%. This finding is also confirmed in the multivariate analysis. Even considering (i.e., control) the possible influence of the remaining parameters listed in Table 16, it can be seen that men have a significantly lower risk than women (who represent the reference category here) of having suffered from back pain in the previous 12 months (aOR = 0.7; 95% confidence interval: 0.6–0.8). A value for the adjusted odds ratio (aOR) of greater than 1 indicates an increased risk in comparison with the respective reference category and a value of less than 1 a reduced risk. In contrast, a value of 1 indicates that no differences regarding risk exist between the category in question and the associated reference category. A confidence interval that does not include the value of 1 indicates a significant result (i.e., the observed difference in the back pain risk exists not only in the sample but also in the entire population; the probability of error is less than 5%).

From Table 17, it can be seen that people with reduced earning capacity suffer from back pain more frequently than people without reduced earning capacity, or that people with back pain more frequently exhibit reduced earning capacity. Apart from that, a clear relationship between declaration of back pain and the presence of a legally recognized disability likewise exists: People with legally recognized disabilities state back pain clearly more frequently (74.3%) than those without disabilities (60.5%). It is clear that back pain also has the potential to put a burden on the social security system in this respect. Further research is needed to determine the extent to which back pain is associated with other medical problems. It can likewise clearly be seen in Table 17 that difficulties in performing daily work often accompany back pain.

Table 17: Correlation between back pain and reduction in earning capacity, disability and difficulties performing work**

		Total	Back pain within the last 12 months	Row-%
Reduction of earning capacity**				
	No	7,554	4,564	60.4
	Yes	642	491	76.5
	n.s.	121	84	69.4
Legally recognized disability? **				
	No	7,518	4,545	60.5
	Yes	790	587	74.3
	n.s.	10	7	70.0
Difficulties performing daily work?**				
	Not at all	5,055	2,635	52.1
	Litte, moderate	2,704	2,043	75.6
	Fairly, not able to perform work	540	446	82.6
	n.s.	18	14	77.8

** p-Value of Chi²-tests in all three parameters <0.001

Source: GSTel03, specifications rewighted, own calulations

5.2 Conclusions

It can be concluded that the occurrence of back pain in the general population is very frequent, with a 12-month prevalence of 61.7%, and that it occurs more frequently in women than in men. Apart from the occupational status – in comparison with white-collar workers, self-employed people exhibit a lower and blue-collar workers a higher risk – additional socio-economic factors such as gender and level of education are found to influence the risk of back pain. Nearly half (48.5%) of the individuals with back pain in the previous 12 months have difficulties in performing their daily tasks.
It is clear that both the productivity of the individual and the social insurance system are impacted by back pain in ways that are not shown by the usual indicators such as invalidity or cost indicators. Not every person afflicted with back pain goes to a doctor or takes sick leave.

More than 40% of people with legally recognized disabilities or reduced earning capacity suffer from back pain.

6 Literature survey

6.1 Introduction and methodology

Supplementary to the analysis of data from the statutory health insurance system, the German statutory accident insurance system and the statutory pension insurance scheme, this section presents an analysis of scientific articles on the direct and indirect costs of MSDs published in English, Spanish, and German since 2004.

In the two databases MEDLINE and psycNET a systematic search using three linked phrases was performed (see Table 18). The first phrase contained search terms on the ten most frequently occurring MSDs (ICD-10, two-digit) – according to the latest statutory health insurance fund report from Barmer [24] – and the MSDs that are related to selected occupational complaints (ODs) [25]. Apart from keywords from this category, at least one keyword from the other two categories also had to be given. Articles published in languages other than English, Spanish, or German or published prior to 2004 were not considered in the search. The search in MEDLINE yielded 170 hits. The article abstracts were evaluated according to relevance. A total of 132 articles containing no information on costs of illness or not referring to groups for which an MSD was diagnosed were excluded. The full texts of the remaining 38 articles were checked for relevance according to the above-mentioned criteria, and another three articles were then excluded. Another four articles had to be excluded from the investigation because the full texts were not available during the project completion time. The search in psycNET yielded no hits for the linked phrases. A search using the keywords “MSD” and “back pain” without any other links yielded 14 hits, all of which were excluded after being evaluated for their relevance. The articles included were each evaluated and described by two people. Data extraction was performed according to defined information areas as detailed in Appendix 4. Costs related to studies performed after 1999 were converted to euros to allow comparison of the indices. The exchange rate on June 30 of the relevant year was taken to be the rate used for publication of the costs. The costs were also converted from USD to EUR. For twostudies the exchange rate from January 4, 1999, was used because there was no exchange rate for the euro available before that time.

Table 18: Search Strategy and hits of the literature survey

Diagnosis	AND	AND	Hits
Musculoskeletal disorders			61
Back pain			29
Dorsalgia M54		Sick Leave	38
Other dorsopathies, not elsewhere classified M53		[MESH]	7
Shoulder lesions M75, Other enthesopathies M77, Other soft tissue disorders, not elsewhere classified M79		OR	28
Internal derangement of knee M23			0
Other joint disorders, not elsewhere classified M25		Absenteeism [MESH]	1
Other intervertebral disc disorders M51			0
Biomechanical lesions, not elsewhere classified M99	Costs	OR	0
Synovitis and tenosynovitis M65			0
Seropositive rheumatoid arthritis M06, Gout M10, Other arthritis M13	AND	Disability pension	4
Gonarthrosis M17	Cost	OR	0
Other arthrosis M19	analysis [MESH]		0
Cervical disc disorders M50		Occupational	0
Disorders of continuity of bone M84		diseases [MESH]	0
Soft tissue disorders related to use, overuse and pressure M70			0
Other osteochondropathies M93		OR	0
Fracture of neck S12		Occupations	0
Fracture of rib(s), sternum and thoracic spine S22		[MESH]	0
Fracture of lumbar spine and pelvis S32			1
Fracture at wrist and hand level S62			1

In the scientific literature, direct costs, i.e., treatment costs are usually calculated per 100 patient years. Indirect costs of illness are estimated via the human capital approach (HCA) or the friction cost approach (FCA). The HCA is based on the assumption that the social costs due to loss of production over a certain period of time can be determined on the basis of the average earnings of the absentee for this time period. “Use of the friction cost approach requires that an assumption be made that the unemployment rate is not 0% and that the position is filled by someone who was previously unemployed. The time from initial absence from work of the patient to achievement of the previous level of productivity is the friction period” (translated from German) [26]. This friction period (FP) hence relates first and foremost to people receiving pensions for reduced earning capacity.

Most of the studies performed in the last five years were carried out in the industrial nations. The direct and indirect costs of specific conditions or diagnostic groups were investigated. In Section 6.2, details of these studies are summarized according to diagnostic group and the country in which the study was conducted. Classification according to the individual ICD-10 codes is not always possible due to the lack of information. A table at the end of the section provides an overview of the costs determined (see Table 19).

6.2 Results

6.2.1 General musculoskeletal disorders

An analysis of data of the US Bureau of Labor Statistics from 1993 estimates the costs of illness for 447,643 employed nurses over their life spans up to that point [27]. In the estimate, apart from the costs of treatment and loss of productivity, costs caused by accidents, employers' administrative costs, costs for induction of replacement employees, and reduction in quality of life were included. The three highest costs in the case of injuries were caused by MSDs (back sprains/strains: 1.15 billion euros, other sprains/strains: 806 million euros, fractures/dislocations: 233 million euros).[7] MSDs generated the two highest costs in the case of illness (musculoskeletal disorders, amounting to 62 million euros, and carpal tunnel syndrome, amounting to 36 million euros). The most frequently occurring MSDs together generated costs amounting to 2.29 billion euros.

6.2.2 Neck, Shoulder, and Back Pain

A retrospective cohort study investigates the costs of neck, shoulder and back pain for working people in **Sweden** who were on sick leave due to pain in the lower back or neck for at least 28 days between 1994 and 1995 [28]. The direct costs were 905

[7] For the calculation, the exchange rate as of January 4, 1999, was used, since no exchange rates prior to that time were available.

euros per patient-year. The indirect costs were calculated using the HCA and amounted to 12,578 euros per patient-year, 9,222 euros of which were caused by days of sick leavers. The total costs per patient-year were 13,483 euros. Of the survey participants, 36% returned to work within 3 months, 72% returned within a year, and 20% still did not return after two years.

In a case-control study of the effectiveness of preventive measures, the costs of back pain in the **Netherlands** was determined [29]. Treatment costs of 101 euros per patient-year (plus 231 euros for the intervention) were incurred for the intervention group (n = 258 afflicted workers performing physically demanding tasks in 9 major companies), whereas 165 euros resulted for the control group (n = 231 healthy workers). Indirect costs relate to days of sick leavers and reduced workplace productivity and were evaluated on the basis of average earnings of 244 euros. They amounted to 1,673 euros for the intervention group and 1,993 euros for the control group per patient-year. Total costs were 2,118 euros per patient-year for the intervention group (including the intervention) and 2,200 euros for the control group.

A retrospective cohort study from **Sweden** estimates the costs of lower back pain for 2001 [30]. For this, the total costs for all conditions were related to the frequency of the diagnoses investigated. The direct costs were related to both treatment costs and private expenditure. Direct costs of 105 euros per patient-year were calculated, with the comprehension of private costs remaining unclear. Indirect costs were calculated according to the classic human capital approach, using days of absence and early retirement. The indirect costs were 527 euros per patient-year, with 251 euros arising from days of absence and 276 euros from early retirement payments. If the cost of loss of production due to early retirement is included, costs of 11.82 billion euros result for all cases of early retirement in 2001 due to lower back pain. Otherwise, the total costs per person were 632 euros per patient-year.

In a **Belgian** cross-sectional study of 186 recipients of sickness benefit due to lower back pain, 20.4% (27.6% of women and 15.5% of men) were unable to work for at least 3 months after the first invalidity day [31].

A cross-sectional study performed within the scope of a cohort study with 969 working **New Zealanders** with lower back pain estimated the cost of loss of production for n = 448 afflicted people with an average age of 26 [32]. A total of 525 people stated that they had suffered back pain in the previous 12 months and, for this reason, had had 1.5 days of sick leavers in the patient-year. The average wage for this age group in New Zealand (118 euros per day) were taken as the earnings, resulting in costs caused by loss of production due to days off work of 178 euros per afflicted person in the year. No significant relationship between the medical complaint and the individual's occupation was found.

For **South Korea**, the costs of illness due to work-related lower back pain were calculated by means of data from the Korean Labor Welfare Corporation [33]. Apart from treatment costs, various forms of compensation (disability benefit, survivor benefit, funeral expense, etc.) were also included. The average costs of lower back pain in 1997 were approximately 270 euros per patient-year.[8]

In the **Netherlands**, a prospective cohort study was carried out to estimate the costs of shoulder pain [34]. In the calculation of direct costs, oblique costs such as expenditure on health promotion activities, home care, etc. were also incorporated. In total, the direct costs for six months were calculated at 365 euros per patient. The indirect costs comprised absence from work as well as leisure-time activity restrictions. A friction period of 123 days was used for the calculations. The earnings were calculated on the basis of the average income in the Netherlands according to age and gender. This yielded 6-month costs of 324 euros per patient. For working

[8] For the calculation, the exchange rate as of January 4, 1999, was used, since no exchange rates prior to that time were available.

individuals, the half-year costs were 523 euros per patient. According to this study, the total costs were 689 euros for a six-month period.

6.2.3 Osteoporosis

A cross-sectional study of 1,716 city council employees in **Belgium** determined the direct and indirect costs of osteoporosis [35]. Direct costs did not include any oblique costs such as transportation costs or costs of condition-related workplace accommodation and amounted to 535 euros per patient-year for 95 osteoporosis sufferers, with 376 euros of this being borne by the social security system. The 81 afflicted females in the study incurred treatment costs of 520 euros per patient-year, and the 14 men incurred costs of 640 euros. Indirect costs were related to days of sick leavers and days of absence to care for sufferers. Costs of loss of production ran to 414 euros per patient-year on the basis of an average of 4.8 days of absence per sufferer. Costs were 22 euros per patient-year for women and 2,826 euros for men (those major sex differences can arise from outlier). In addition, indirect costs of 22 euros per year and caregiver due to days of absence for care of afflicted family members and friends arose. Here, the costs were 24 euros for women and 19 euros for men. For the individuals concerned this resulted in total costs of 949 euros per patient-year plus 22 euros per year and carer.

6.2.4 Arthritis and other rheumatic conditions

An unsystematic review of data on the social impact of inflammatory rheumatic conditions in **Germany** between 1996 and 2006 includes data from results of studies, core documentation from the regional cooperative rheumatism centers, and statistics from the statutory health insurance system and pension insurance scheme [36]. It can be seen that according to statutory health insurance fund information on rheumatoid arthritis (RA), sufferers in the first year of illness were unable to work for an average of 9.1 (n = 134) days per month due to the condition. Women were unable to work for 8 (n = 85) days per month and men for 10.9 (n = 49). Another study identified, for illness durations of less than 2 years, loss of productivity of 135 days per patient-year, with 113 attributable to days of sick leavers , 13 to reduced earning capacity, and 9 to other reasons for giving up employment. With the HCA (without FP) used as a basis, this resulted in costs of 10,040 euros per patient-year, 8,400 euros due to days of sick leavers, 970 euros due to invalidity pensions, and 670 euros due to other reasons for giving up employment. In the case of the condition lasting 2–3 years, the number days of sick leaversdecreased to 106 days (27, 49, and 30 days) and the costs to 7,900 euros per patient-year (2,000 euros, 3,700 euros and 2,200 euros). According to the data in the core documentation from 2002, the number days of sick leavers for people afflicted with RA was 53.6 days per patient-year, for people afflicted with Bechterew syndrome (ankylosing spondylitis) 65.2 days per year, and for people afflicted with psoriatic arthritis 52.5 days. After 5 (or > 10) years 22 (or 40) patients with RA, 16 (or 29) with Bechterew syndrome, and 16 (or 29) with psoriatic arthritis received invalidity pensions. Indirect costs of the conditions can be determined from this information. For patients with RA, the costs were the highest, amounting to 6,052 euros per patient-year according to the HCA (or 2,620 euros according to the FCA) for an illness duration of less than 5 years, 8,954 euros (or 2,652 euros) between 5 and 10 years, and 15,659 euros (or 3,846 euros) after more than 10 years.

Within the scope of a case-control study investigating the relationship between days of illness and job loss (unemployment or inability to work) in the **Netherlands**, the days of sick leavers for people with chronic arthritis were determined [37]. For 112 working people who stated that they felt that their jobs were at risk due to the condition, an average absence from work of 18.7 weeks was determined, with 40% absent for more than 6 weeks and 28% for the entire year; 19% received an invalidity pension. A significant positive correlation ($p < 0.05$) was found between the duration of absence from work and job loss.

An **US** review of original articles on calculation of indirect costs of RA and osteoarthritis between 1966 and 2007 clearly shows that indirect costs make a significant contribution to the costs of illness [38].

A case-control study in 2003–2004 in the **US** took the form of a telephone interview conducted with 329 working people aged 40–65 [39] to determine the costs of arthritis. The sufferers reported 0.5 invalidity hours per patient-week and 3.5 hours of lost production caused by arthritis. This yielded costs of loss of production of 67 euros per afflicted person in one week for arthritis, corresponding to 3,508 euros per patient-year in relation to a 52-week period.

The data produced by the 2003 Medical Expenditure Panel Survey in the **US** enabled the costs of arthritis and other rheumatic conditions to be estimated [40]. Using a regression analysis, the proportion of treatment costs for the investigated conditions attributed to total treatment costs for the survey participants over 18 years of age was estimated to be 1,833 euros per patient-year. The indirect costs were estimated to be 1,664 euros per patient-year for working people.

For investigation of the influence of arthritis and other rheumatic conditions on employment, a prospective cohort study with 383 patients was carried out between 2000 and 2002 in **Canada** [41]. For calculating the indirect costs, inability to work, reduction of working time, and changes in employment status due to the condition were included, in addition to days of absence. The earnings per hour were calculated on the basis of patient statements regarding annual salary and working time. For invalidity, a friction phase of one year was assumed. 34 survey participants stopped working during the observation period, and 16 of them received invalidity pensions. In addition, 49% stated that their productivity was lowered, and 10% reduced the number of hours worked. This yielded indirect costs of 8,616 euros per patient-year, 3,337 euros of which were caused by reduced productivity at work, 987 euros by a reduction in the number of hours worked, 791 euros by days of sick leavers, and 3,044 euros by changing jobs or cessation of employment. RA generated 8,725 euros and osteoarthritis 7,690 euros of indirect costs per patient-year.

Osteoarthritis

A study of the costs of illness for osteoarthritis was carried out in **Germany** in which the data from public authorities, cost bearers, and pension funds for the report year 2002 was analyzed [42]. Direct costs of osteoarthritis ran to 7.2 billion euros, 70% of which went toward treatment of women. 67% of the costs arose in retirement age. Costs of outpatient treatment made up about one third of the treatment costs. The number of days of absence caused by gonarthrosis (osteoarthritis of the knee) amounted to 37 per patient; for coxarthrosis (osteoarthritis of the hip), the figure was 56. In total, about 90,000 years of employment are lost due to osteoarthritis. For an average employee remuneration of 32,700 euros, this results in costs caused by loss of production amounting to 2.95 billion euros. According to this estimate, the total costs of osteoarthritis are 10.15 billion euros. Osteoarthritis accounts for 3.2% of the direct costs of the German healthcare system. One in four retirements due to MSDs is caused by osteoarthritis.

For comparison of the costs of fibromyalgia and osteoarthritis, the insurance costs of 16 major companies in the **US** were analyzed [43]. The direct costs consisted of payments in 2005 to service providers and amounted to 7,285 euros per patient-year. For the calculation of indirect costs, payments for invalidity pensions and the costs resulting from days of absence from work were considered, resulting in 2,220 euros per patient-year. The total costs considered amounted to 9,504 euros per patient-year for osteoarthritis.

The indirect costs of knee osteoarthritis were calculated in 2005 by a study of 105 patients at the **Singapore** General Hospital [44]. For this purpose, the HCA was used, with the survey participants themselves estimating the reduction in productivity and the number days of sick leaversin the previous year. As a salary for the 21 working individuals, the average income was used; for people not working, the market price for housekeeping was assumed. This yielded average indirect costs of 834 euros per patient-year for the entire group; for working people, the figure was 1,035 euros.

Rheumatoid Arthritis

The indirect costs of rheumatoid arthritis (RA) in **Germany** were investigated by means of a group of 338 sufferers from the condition, patients insured by AOK Niedersachsen, who attended 14 rheumatology practices between 2000 and 2002 [45, 46]. Of these, 96 people were in work. The productivity costs were calculated using the FCA and a FP of 58 days. For evaluation of the loss of production due to days of sick leavers, reduced earning capacity, or constraints on housekeeping activities, the average gross income in Germany (74 euros per day in 2001) was used. For people in work at the start of the study, costs of 1,820 euros per patient-year were incurred; the figure was 635 euros per patient-year for people not in work. Of the overall average costs (970 euros per patient-year), 453 euros were due to days of sick leavers, 63 euros due to reduced earning capacity, and 454 euros due to constraints on housekeeping activities for people not in work. If the FCA was not used, the average costs were determined to be 1,276 euros per patient-year, with the costs of reduced earning capacity rising to 368 euros [45]. For the 234 patients between 18 and 65 years of age in the same study, patient statements regarding days of sick leavers (14 days per patient-year) were compared with information from the statutory health insurance fund (17 days) [46]. It was found that the information on number of days of absence varied on average by 2.2 days. According to information from AOK and with the FP taken into account, indirect costs of 1,500 euros were incurred per patient-year, with 1,260 euros of this being based on invalidity and 240 euros on reduced earning capacity. According to information provided by the patients, costs of 1,240 euros per patient-year were calculated, with 1,040 euros being attributed to absence from work and 200 euros to invalidity. If the friction period is not taken into account, the costs are estimated to be 2,470 euros and 2,430 euros per patient-year [46].

Another study of the costs of illness for RA in **Germany** was conducted in Lower Saxony in 2000–2001 [47]. Direct costs of 2,312 euros per patient-year, consisting of both outpatient and inpatient treatment costs (1,703 euros and 556 euros per patient-year, respectively) and oblique costs (53 euros) such as transportation costs and home care, were calculated. The indirect costs were 11,193 euros per patient-year, with 2,835 euros arising from days of sick leavers and 8,358 euros from reduced earning capacity. In total, costs of illness von 13.505 euros per patient-year were incurred.

The costs of illness for RA in **France** in 2000 were determined in a retrospective cohort study of 1,109 patients [48]. The direct costs were 4,003 euros per patient-year. The indirect costs were made up of the costs days of sick leaversand the costs arising from reduced earning capacity and amounted to 2,742 euros per patient-year for the entire group. For 415 of the patients, for whom at least one of the two characteristic features applied, the costs were 7,328 euros. The total costs were determined to be 6,745 euros per patient-year.

In the **Netherlands**, the indirect costs over the previous 2 weeks were determined in a cross-sectional survey performed between 1999 and 2000 [49]. An FP of 123 days was used. A total of 142 working people exhibited an average of 22 days of absence from work per year. The 64 women were absent from work for 19 days and the 78 men for 28 days per year. For assessment of the production time lost, the national production level of 1998, with differentiation according to age and gender, was used. Two different values were calculated for the entire group of 576 individuals. If the days of absence and the FP were taken into consideration, the costs were 278 euros per patient-year, 203 euros for women (n = 417) and 473 euros for men (n = 159). If, apart from absence from work without an FP, an estimated reduction in working time was included, the costs were 4,434 euros per patient-year (3,170 euros for women and 7,750 euros for men). Arising from the service of formal or informal domestic helpers, costs of 2,045 euros per patient-year (based on the entire cohort) were incurred; the average wage for domestic helpers was used as the basis for assessment. The total indirect costs were between 2,323 euros and 6,479 euros per patient-year: 2,492 euros to 5,459 euros for women and 1,876 euros to 9,153 euros for men.

The costs of illness for the first year were determined by means of a prospective cohort study of 211 patients from 10 rheumatology departments in southeastern

Sweden [50]. Treatment costs in the first year of illness were 3,859 euros per patient-year for the entire group. For women, the costs were 4,192 euros per patient-year; for men, they were 3,251 euros. The indirect costs were calculated on the basis of average monthly salary (108 euros per day). This yielded indirect costs of 8,726 euros per patient-year (8,625 euros for women and 8,957 euros for men). Total costs were hence 12,586 euros per patient-year (12,754 euros for women and 12,208 euros for men).

A clinical study of the cost effectiveness of rheumatism treatment calculated the direct and indirect costs of the condition for 2,426 people in **Sweden** [51]. The direct costs of 3,423 euros per patient-year were made up of the treatment costs paid by the social security system (2,731 euros) and the associated costs paid by the patient (692 euros). The average indirect costs were 6,662 euros per patient-year and included the cost of absence from work (1,734 euros) as well as costs arising due to early retirement (4,928 euros). Details on data collection and the calculation method used were not provided.

A prospective cohort study performed in **Sweden** as part of a review of factors influencing the indirect costs of the illness determined the average number days of sick leaversof 162 patients in the working population to be 23 days per year [52]. In the 5-year observation phase, 40 people took early retirement due to the condition.

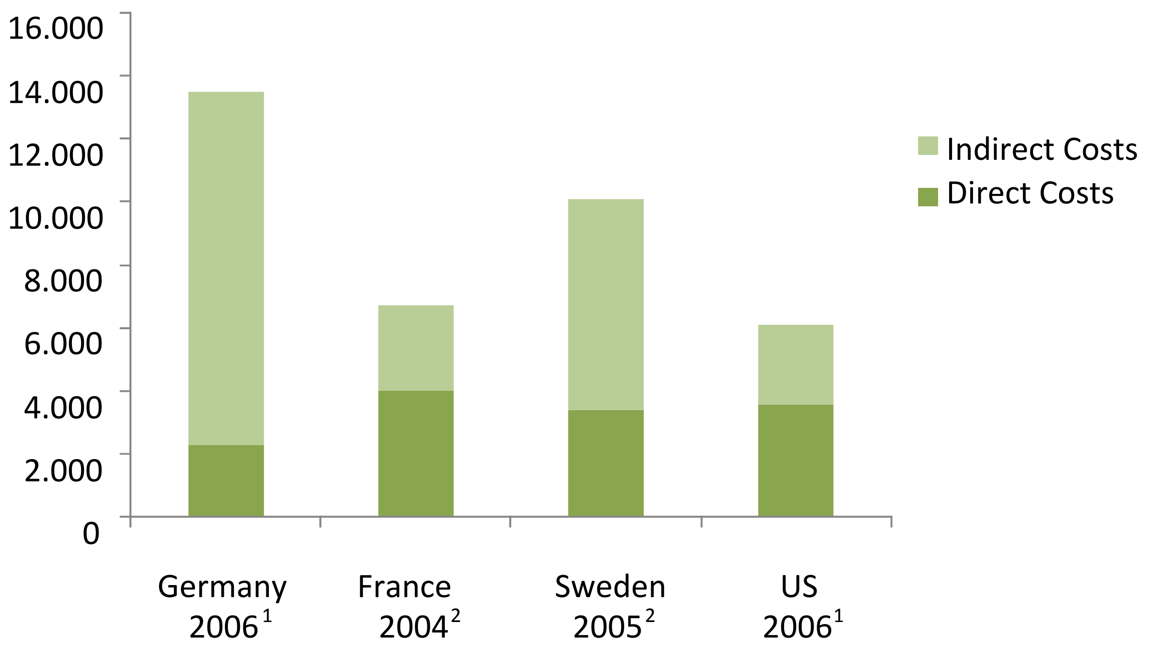
A **Finnish** study of 162 working rheumatoid arthritis sufferers estimated the indirect costs of RA [53]. The HCA and the FCA with a friction period of 230 days were used. For calculating the costs of absence from work, the respective salary was extrapolated from the sickness benefits paid. According to the HCA, the average costs were 8,344 euros per patient-year; use of FCA resulted in costs of 1,928 euros.

A 2006 case-control study of the impact of rheumatoid arthritis on employment in the **US** found that treatment costs of 4,379 euros per patient-year arose for afflicted employees with employer-financed health insurance [54]. In addition, the condition was found to have a negative, but unquantifiable, effect on employment. Regarding the number of days of absence from work and productivity, the case group did not show any significant differences in comparison with the control group.

A case-control study in the **US** investigated the costs of rheumatoid arthritis for employees in 9 major American companies between 1997 and 2001 [55]. The costs of the condition were determined by means of a regression analysis. Treatment costs were estimated to be 3,577 euros per patient-year. The indirect costs were 2,532 euros per patient-year. This yielded total costs of 6,109 euros per patient-year.

Figure 13 provides examples of the available data on the indirect and direct costs of RA from the studies. Because different calculation methods were used, the numbers are not directly comparable, but the graph indicates higher costs in Germany and Sweden as well as a generally higher proportion of indirect costs in relation to total costs.

Figure 13: Direct and indirect costs of rheumatoid arthritis in Germany (2006), France (2004), Sweden (2005) and the US (2006)



1 Method used for calculating indirect costs: HCA; 2 Method used for calculating indirect costs not stated

Juvenile Rheumatoid Arthritis

Within the framework of a 17-year follow-up study in **Germany**, a retrospective cohort study was carried out between 1998 and 2000 to determine the costs of illness for 215 juvenile rheumatoid arthritis (JRA) patients treated between 1978 and 1988 at the pediatric clinic in Berlin-Buch [56]. Patient costs were also included in the calculation of treatment costs, which amounted to 1,899 euros per patient-year, 78 euros of which were patient expenditure. Indirect costs were calculated by means of the HCA, with average earnings of 89 euros per day being taken as the basis for evaluation. The costs amounted to 1,571 euros per patient-year. This yielded average total costs of 3,471 euros per patient-year.

6.2.5 Gout

A case-control study with data from 2001 to 2004 from the Human Capital Management Services Research Database in the **US** was used to estimate the costs caused by gout [57]. For calculation of the direct costs arising due to the diagnostic category of the musculoskeletal system and connective tissue, 1,171 working people with gout and a control group of 247,867 people were used. The direct costs were 3,455 euros per patient-year and indirect costs 2,510 euros per patient-year, resulting in total costs of 5,965 euros. Costs for people suffering from gout were significantly higher ($p < 0.05$) than those for the control group.

Table 19 provides a summary of all indirect and direct costs of MSDs determined from the literature survey.

Table 19: Direct and indirect costs due to MSD – Literature Survey Direct and indirect costs due to MSD – Literature Survey

Author	Year	Country	Method	Direct costs	Indirect Costs			Other costs	Total Costs
				Treatment costs	Days of sick leavers	Reduced earning capacity	Total		
					General musculoskeletal disorders				
Waehrer G, Leigh JP, Miller TR	2005	US							Total costs of the most frequently occurring MSD 2,291 m. €
					Neck, shoulder and back pain				
Du Bois M, Donceel P	2008	Belgium			20,4% were absent at least 3 months				
Ekman M, Johnell O, Lidgren L	2005	Sweden	HCA	105 € per patient-year	251 € per patient-year	Ca. 4,600 cases, 276 € per patient-year	527 € per patient-year		632 € per patient-year
Hansson EK, Hansson TH	2005	Sweden	HCA	905 € per patient-year	≤ 3 months: 36%, ≤ 1 year: 72%, > 2 years: 20%, 9,222 € per patient-year	88 persons, 3,356 € per patient-year	12,578 € per patient-year		13,483 € per patient-year
Ijzelenberg H, Meerding WJ, Burdorf A	2007	Netherlands	HCA	Control group165 €, Intervention group 101 € + Intervention 231 € per patient-year	Control group 1,993 €, Intervention group 1,673 € per patient-year				Control group 2,158 €, Intervention group 2,005 € per patient-year
Kim HS, Choi JW, Chang SH, et al.	2005	South Korea							Ca. 27,000 € per patient-year
Kujpers T, van Tulder MW, van der Heijden GJMG, et al.	2006	Netherlands	FCA (123 days)	730 € per patient-year	5.6 days per patient-year		648 € per patient-year		1,378 € per patient-year
McBride D, Begg, D, Herbison P, et al.	2004	New Zealand	HCA		1,5 days of sick leavers per patient-year, 178 € per patient-year				

Author	Year	Country	Method	Direct costs	Indirect Costs			Other costs	Total Costs
				Treatment costs	Days of sick leavers	Reduced earning capacity	Total		
Osteoporosis									
Rabenda V, Manette C, Lemmens R, et al.	2006		HCA*	535 € per patient-year	4,8 days per patient-year, 414 € per patient-year		436 € per patient-year (incl. others)	Productivity loss due to care for patients 22 € per patient-year	971 € per patient-year
Arthritis and other rheumatic conditions									
Centers for Disease Control and Prevention (CDC)	2007	US		1,833 € per patient-year			1,664 € per patient-year		3,497 € per patient-year
de Buck PDM, de Bock GH, van Dijk F, et al.	2006	Netherlands			93.5 days per patient-year				
Li X, Gignac MAM, Anis, AH	2006	Canada	FCA** (1 year)			16 Persons	8,161 € per patient-year		
Ricci JA, Stewart WF, Chee E, et al.	2005	US	HCA*		0.5 hours per patient-week	3.5 hours	67 € per patient-week		
Arthrosis									
Merx H., Dreinhцfer K.E., Günther K.-P.	2007	Germany		7.2 billion € per year	56 € per patient-year (coxarthrosis), 37 per patient-year (gonarthrosis), total 2.4 M.	8,617 cases of early retirement due to arthrosis, out of which 2.3% due to gonarthrosis, 1.7% due to coxarthrosis	90,000 years of employment missed due to arthrosis, 2.95 billion € costs of production loss, 4.64 billion € loss of gross value	113,000 rehabilitation measures for coxarthrosis and 100,000 for gonarthrosis	
White LA, Birnbaum HG, Kaltenboeck A, et al.	2008	US	HCA*	7,285 € per patient-year	25.7 days per patient-year		2,220 € per patient-year		9.04 € per patient-year

Author	Year	Country	Method	Direct costs Treatment costs	Indirect Costs Days of sick leavers	Reduced earning capacity	Total	Other costs	Total Costs
Xie F, Thumboo J, Fong KY, et al.	2008	Singapore	HCA*			834 € per patient-year			
					Rheumatoid Arthritis				
Guillemin F, Durieux S, Dauгиs JP, et Al	2004	France		4,003 € per patient-year	178 days per patient-year		2,742 € per patient-year		6,745 € per patient-year
Hallert E, Husberg M, Jonsson D et al.	2004	Sweden	HCA*	3,859 € per patient-year	8,726 € per patient-year for 141 full time working persons				
Hülsemann JL, Ruof J, Zeidler H, et al.	2006	Germany	HCA*	2,312 € per patient-year	2,835 € per patient-year	8,358 € per patient-year	11,193 € per patient-year		13,505 € per patient-year
Kessler RC, Maclean JR, Petukhova M, et al.	2008	US		4,379 € per patient-year					
Kobelt G, Lindgren P, Singh A, et al.	2005	Sweden		3,423 € per patient-year, 692 € of which to bear by the patient	1,734 € per patient-year	4,928 € per patient-year	6,662 € per patient-year		
Merkesdal S, Huelsemann JL, Mittendorf T et al.	2006	Germany	FCA **(58 days)		6 days per patient-year, 453 € per patient-year	63 € per patient-year HCA, 368 € per patient-year FCA	970 € (incl. others) per patient-year FPA, 1,276 € per patient-year HCA	constraints on housekeeping activities 454 € per patient-year	
Merksedal S, Ruof J, Huelsemann JL, et Al	2005	Germany	FCA **(58 day)		17 days per patient-year, 1,260 € per patient-year according to AOK, 14 days according to patients	240 € per patient-year according to AOK	1,500 € per patient-year according to AOK by FCA, 2,470 € by HCA		
Ozminkowski RJ, Burton WN, Goetzel RZ, et al.	2006	US	HCA*	3,577 € per patient-year			2,532 € per patient-year		6,109 € per patient-year
Puolakka K, Kautiainen H,	2005	Sweden			23 days per patient-year	40 patients within 5 years			

Author	Year	Country	Method	Direct costs	Indirect Costs			Other costs	Total Costs
				Treatment costs	Days of sick leavers	Reduced earning capacity	Total		
Mцttцnen T, et al									
Puolakka K, Kautiainen H, Mцttцnen T, et al.	2009	Finland	FCA** (230 days)				8,344 € per patient-year HCA, 1,928 € per patient-year FCA		
Verstappem SMM, Boonen A, Verkleij H, et al.	2005	Netherlands	FCA** (123 days)		22 days per year for 142 working people		278 € per patient-year FCA, 4.434 € HCA	constraints on housekeeping activities 2,045 € per patient-year	
Juvenile Rheumatoid Arthritis									
Minden K, Niewerth M, Listing J, et al.	2004	Germany	HCA*	1,899 € per patient-year			1,571 € per patient-year		3,470 € per patient-year
Gout									
Brook RA, Kleinman NL, Pankaj AP, et al.	2006	US			3,455 € per patient-year	634 € per patient-year	1,876 € per patient-year	2,510 € per patient-year	5,965 € per patient-year

*HCA= Humankapitalansatz; **FCA= Friktionskostenansatz

6.3 Conclusions

In industrialized countries, musculoskeletal disorders result in enormous costs to the healthcare and social insurance system as well as the entire economy. Given this, the number of studies published on this topic in the last five years is very low. Rheumatoid arthritis and osteoarthritis are the most frequently investigated conditions. There are only a few studies of the conditions, including intervertebral disk disorders and back pain (see Table 19), for which the highest costs per patient-year are incurred.

Comparison of different countries is somewhat difficult and does not provide very meaningful results. Comparability of the direct costs of illness is limited by two factors. Firstly, different prices are calculated for treatments and different services are paid for by the social security systems in different countries. And secondly, there are differences in the methods used for calculating the costs. Some surveys only include direct treatment costs that are usually paid for through health insurance [28, 29, 33, 35, 40, 43, 48, 54, 55], whereas others include the costs that patients have to pay as well as other costs [27, 34, 47, 50, 56]. Comparability of indirect costs cannot be guaranteed due to the different calculation methods used [38]. The results obtained using the FCA are recognized as being more realistic. However, up to now there have been no uniform procedures or criteria for definition of the FPs. Many of the available studies continue to be based on the HCA [27-30, 35, 39, 40, 43, 44, 50, 55, 56], which overestimates the indirect costs. Only a few studies use the FCA [34, 41, 45, 46, 53], employing greatly varying FPs in the process. Limitations in comparability always exist, especially due to differences in the social security and employment systems of the different countries. However, methodical standardization of the calculation of costs would enable a better overall picture of the real social costs of the conditions to be obtained.

7 Discussion

Within Work Package 3, “Documentation of indices and indicators concerning the effects of particular MSDs when determining prioritization of relevant prevention topics,” of the DGUV IPP-aMSD project, numerous findings from various sources of information could be compiled. In the following sections these findings are grouped according the indicators and methodologically discussed.

7.1 Number of affected jobs

No authoritative, scientifically reliable statement about the number of jobs affected by MSDs can be formulated. Two indicators that enable a rough estimate to be obtained are the MSD prevalence in the general population (Section 5) and in the database from the statutory health insurance system (Section 2.1) and the indicator of the prevalence of individuals with a documented inability to work (Section 2.2).

In a representative survey of the German population was carried out by the Robert Koch Institute in 2003, 61.7% of the 8,318 individuals surveyed stated that they had experienced back pain in the previous 12 months (women: 65.8%, men: 57.4%). Stratification according to working status indicated that approx. 60% of all working people suffered from back pain and hence had jobs affected by their reduction or loss of performance. Because only back pain was surveyed explicitly, the MSD period prevalence in the general population must actually be higher.

Prevalences of individual MSD diagnoses were calculated separately via remote processing by the German Federal Statistics Office of a 3% sample of all people with statutory health insurance in 2002 (Section 2.2). The diagnosis “M54 Dorsalgia” was the most frequent MSD diagnosis and was made for 24.2% (66.3% of which were women) of the 15- to 64-year-olds with statutory health insurance (followed in terms of significance within the period prevalence by the diagnoses “M53 Other dorsopathies, not elsewhere classified” and “M51 Other intervertebral disc disorders”). This prevalence does not reflect the jobs affected, since employment status was not considered. In 2002, 65.4% of people in this age group were working [58]; hence, under the assumption that the back pain problems were distributed uniformly, around 15% of the jobs could be assumed to be affected. However, this procedure leads to an underestimation of the problem, because not every MSD necessarily causes the affected person to consult a doctor and is registered in the databases of the health insurers. The same applies to the inclusion of invalidity indicators, which are treated in a separate section (Section 7.3, “Number of days of sick leavers”).

7.2 Treatment costs

In Germany, several indicators of treatment costs are available. Differentiation can be made between inpatient and outpatient treatment costs as well as according to the level of sickness benefits paid. The scientific literature has provided only limited information for Germany up to now. Thus, findings for individual conditions such as rheumatoid arthritis (2,312 euros per patient-year) are available (see Table 19), but they are not very meaningful due to the inadequacy of the analysis methods used. Results from the international literature cannot be applied to Germany due to the different healthcare systems and cost structures. Because of dissimilar calculation methods, even comparison within a country is hardly possible. Thus, for example, for the diagnostic group “Neck/shoulder/back pain,” various studies in Sweden reported costs ranging from 105 euros to 905 euros per patient-year. A uniform international – or at least European – system for data entry and calculation of indices is urgently needed.

7.2.1 Inpatient treatment costs

Techniker Krankenkasse calculated, e.g. for inpatient treatment costs for MSD for employees, a sum of 83.1 million euros (for 27,748 cases) in 2006, 87.0 million euros (for 29,933 cases) in 2007, and 95.6 million euros (for 32,368 cases) in 2008. The number of MSD cases has risen over the years – this can be traced back to the rising insurance figures, among other things – and has resulted in higher costs, despite decreasing average inpatient treatment costs. Assessment of why the average costs have declined is not possible.

On the basis of in-house analyses of a subgroup of people who were receiving inpatient treatment due solely to an MSD, it was shown that the diagnoses “M51

Other intervertebral disc disorders," "M54 Dorsalgia," and "M75 Shoulder lesions" resulted in the highest absolute inpatient treatment costs (source: sample data for 2002 in accordance with §268 of Section V of the German Social Code [15]). They were determined by the number of inpatient episodes and the average treatment costs per inpatient episode, and hence both indicators must be assessed. Whereas the diagnoses presented also occurred the most frequently in terms of absolute number of inpatient episodes, they did not result in the highest average costs per inpatient episode. These were represented by the diagnoses "M45 Ankylosing spondylitis," "M46 Other inflammatory spondylopathies," and "M41 Scoliosis."

7.2.2 Outpatient Treatment Costs

Based on analysis of the 3% statutory health insurance system sample, the highest outpatient treatment costs were incurred by people suffering solely from MSDs through "M54 Dorsalgia," "M51 Other intervertebral disc disorders," and "G56 Mononeuropathies of upper limb" (source: sample data for 2002 in accordance with §268 of Section V of the German Social Code [15]). Here, too, both indicators – the number and the average costs – have to be analyzed in order for a complete view of possible actions to be obtained. Accordingly, the three most significant individual diagnoses were "M51 Other intervertebral disc disorders," "M50 Cervical disc disorders," and "M46 Other inflammatory spondylopathies" for average costs and "M54 Dorsalgia," "M51 Other intervertebral disc disorders," and "M53 Other dorsapathies" for the number of claims. The fact that these calculations are based on analysis of a subgroup of patients with musculoskeletal disorders but no other diagnoses for the respective treatments must be discussed methodologically. These cost indicators may deviate from the overall population of patients with primary or secondary diagnoses from the MSD range.

7.2.3 Sickness Benefits

Based on the 3% statutory health insurance system sample, the highest sickness benefits costs were associated with the diagnoses "M54 Dorsalgia," "M51 Other intervertebral disc disorders," and "M75 Shoulder lesions" (source: sample data from 2002 in accordance with §268 of Section V of the German Social Code [15]).

For all cost indicators, gender- and age-specific differences must be taken into consideration. The costs are influenced by the number of patients, the frequency, duration, and type of medical contact, the billing system for the medical services, and, for sickness benefits, the income of the patient. The extent to which the medical documentation and billing system possibly leads to an incorrect assessment of actual absenteeism due to sickness is unknown. From an ethical point of view, prevention approaches should not be aligned solely to cost indicators because the primary goal must be to minimize suffering and help people. Isolated consideration of costs, e.g., by means of the sickness benefits, would lead to inequality in medical care and ultimately to intervention for individuals with higher incomes, and this would go against the principles of the social security system in the Federal Republic of Germany.

In general, there is a great need for research into the costs of MSDs, especially in consideration of the fact that the analysis strategies of the health insurers, among others, are not standardized and hence no direct comparisons can be made or an overall picture obtained. The costs of primary and secondary diagnoses are analyzed in part separately and in part together, and there is ample scope for over- and underestimates.

7.3 Number of days of sick leavers

Invalidity indicators from the health reports (Section 2.1) and the 3% statutory health insurance system sample (Section 2.2) are available.

Given as relative percentages, one-quarter to one-fifth of all days of sick leavers are due to MSDs. The number days of sick leaversdue to MSDs per 100 insured person years for 2007 for the sources using the primary diagnosis in the counting method range from 218 days (TK) to 374.6 days (AOK), based on the evaluation of the main-diagnosis [6]. With the necessary caution due to methodological deficits in the analysis and representation of the health reports, it can be concluded that many indices for invalidity due to MSDs in the reports considered point in the same direction, for example, regarding the average invalidity duration, which ranges from 16.0 days to 19.7 days. The indices are also consistent regarding gender-specific trends. In terms of invalidity cases per 100 insured person years, men are considerably more frequently affected by MSDs than women, but, in terms of invalidity duration, they are not affected as for long as women are. This is in harmony with the findings from an in-house analysis, although it does not apply in general to every individual diagnosis. For the diagnoses “M40 Kyphosis and Lordosis,” “M46 Other inflammatory spondylopathies,” “M48 Other spondylopathies,” “M53 Other dorsopathies, not elsewhere classified,” “M60 Myositis,” “M81 Osteoporosis without pathological fracture,” “M84 Disorders of continuity of bone,” and “M85 Other disorders of bone density and structure,” men exhibit a longer invalidity duration than women.

The significance of the three most important diagnoses in the period prevalence can also be seen in the consideration of the sum of all days of sick leavers but not in the indicator of the number of sufferers. Here, the diagnoses “M54 Dorsalgia,” “M53 Other dorsopathies, not elsewhere classified,” and “M77 Other enthesopathies” are the most relevant. If the average number days of sick leaversper patient is evaluated for individual diagnoses, the diagnoses “M81 Osteoporosis without pathological fracture,” “M84 Disorders of continuity of bone,” and “M48 Other spondylopathies,” result in the highest amount of working time lost per person (Section 2.2.2).

Findings regarding industries and occupation-specific invalidity indicators can be taken from the reports as follows (Section 2.1):

AOK reports the most significant MSD-affected industries in 2007 to be the construction industry, with 619.3 days of sick leavers caused by MSDs, and public administration, with 600.6 days of sick leavers caused by MSDs per 100 insured members in the sector. These numbers clearly indicate that MSD is not caused alone by heavy physical labor but that sedentary jobs also generate high numbers of MSD-related disabilities. Causal relationships cannot be supported by the numbers presented; thus, especially in publication administration, the reason for the days of sick leavers due to MSDs could lie in the fact that more unhealthy people choose administrative occupations because they cannot perform physically demanding jobs. Furthermore, the fact that these numbers are distorted as a result of the analytical method used, namely the inclusion of secondary MSD diagnoses, also calls for methodological consideration.

At BKK, in terms of the number days of sick leavers caused by MSDs per 100 working compulsory subscribers to BKK in 2007, workers in waste disposal or recycling (600 days of sick leavers) were the most prevalent, followed by those in the ceramic industry (540 days of sick leavers), postal workers and couriers (520 days), and employees in the glass industry (510 days), whereas the national average was given by BKK to be 330 days. For members of the wor ng population insured by TK in 2008, the occupational fields construction, construction-related, and woodworking jobs (254 days of sick leavers per 100 insured person years), transport and warehousing (239 days of sick leavers per 100 insured person years), and metalworking occupations (232 days of sick leavers per 100 insured person years) recorded the highest amount of time lost due to diagnoses M40–M54 (Dorsopathies).

The invalidity is certified and the expected duration specified by a physician in accordance with the invalidity guidelines formulated by the Federal Joint Committee according to Section V of the German Social Code. As a rule, this certification of invalidity is submitted to the employer at the latest on the third day of absence in order for continued remuneration and entitlement to sickness benefits to be guaranteed. Invalidity is not defined in the case of a) the need to look after, supervise, or care for a sick child, b) performance of inpatient or outpatient checkup or rehabilitation services, or c) restrictions on working under the German Maternity Protection Act. Point b) in combination with the (usually) three-day grace period do not allow the invalidity indicators to be viewed as suitable measures of the number of affected jobs (see Section 1).

The criticism already formulated by Liebers and Caffier – that with the consideration of industries and occupational groups, the danger exists "that through the summary analysis for industries and occupational groups or for entire diagnostic groups, health risks cannot be adequately detected and hence the focus of prevention is not adequately specified" - must be mentioned [4]. Analyses of the socio-economic influencing factors in Section 5 make it clear that these factors must not be ignored in risk analyses. Occupational groups have special socio-economic and demographic characteristics which can independently affect the MSD risk. If no adjustments are made for these socio-economic and demographic influencing factors, including gender, age, and education, in the analysis of occupational risks, the calculated occupational risks may be under- or overestimated.

Finally, the analytical method for invalidity indicators must be discussed: The method used is not standardized in the health reports of the statutory health insurers, and hence the numbers cannot be directly compared. The invalidity indicators are based in part only on the primary diagnoses and in part on both the primary and the secondary diagnoses. Also, in invalidity reporting, different procedures are used in the selection of the base population, i.e., only working people or both working people and recipients of unemployment benefits, and conclusions cannot always be drawn for the groups actually included with the published indications. Thus overall comparability is reduced.

It is recommended that standardization of the definitions and analytical strategies as well as the methods of presentation be aimed at, in order to gain an overall impression for health reporting in Germany.

7.4 Costs of loss of production/loss of gross value added

The costs of loss of production – caused by MSDs – are estimated to be 8.5 billion euros for 2008 and 9.5 billion euros for 2009. The loss of gross value added is estimated to be 15.4 billion euros for 2008 and 17.3 million euros for 2009 in the reports (Section 2.1).

The scientific literature (Section 6) allows only very unreliable statements to be made as to the costs of loss of production and loss of gross value added, because no uniform definition is used for these costs, which are usually designated as indirect costs. Added to this is the fact that some studies exhibit inadequacies in the explanation of the methodology used [27-29, 34, 40, 45, 47, 48, 51, 54, 56] or the description of the sample [27-29, 32, 33, 45, 51, 52] or do not reproduce important determined indices [27, 28, 30, 33, 54]. In some studies, distortions due to sample selection are probable because patients receiving intensive medical care were selected [44-48, 50-52], patients with comorbidities were excluded [41], or a very young group [32] was investigated.

A number of studies use patient's own statements regarding diagnosis [29, 34, 37, 39, 41, 54] and absence from work [29, 31, 34, 35, 39, 41, 44, 48, 50, 54, 56] in the investigation of costs. Especially in the case of the number of days of absence, which patients tend to underestimate, this may lead to underestimation of the costs [46]. Three studies estimate the percentage of total costs made up by specific costs of illness solely via a regression analysis, and do not use any condition-related data [40, 55, 57]. In addition, differences in the determination of inclusion criteria for the diagnosis exist, and the employment situations of the investigated groups differ greatly.

Calculation of indirect costs urgently requires standardization in order for comparability to be ensured [38]. Limitations in comparability are always present, especially due to differences in the social security and employment systems in different countries. However, the cost calculation methods vary strongly even within a single country [38]. The results obtained using the friction cost method are recognized as being more realistic, but hitherto there have been no uniform procedures or criteria for defining the friction period. Many of the available studies continue to be based on the human capital method [27-30, 35, 39, 40, 43, 44, 50, 55, 56], in which the indirect costs are overestimated. Only a few studies use the FCA [34, 41, 45, 46, 53], laying down greatly differing FPs in the process.

Even within the individual methods, different factors are included in the calculation of indirect costs. Some studies that only include days of sick leavers [32, 35, 43, 50] or days of sick leavers and loss of productivity [29, 39, 44] for the indirect costs of probably underestimate the costs. Other studies include a large number of factors [30, 34, 41, 44, 45] whose contribution to the real social costs of the conditions is not clear. Other differences lie in the inclusion of taxes and other deductions in the calculation of the salary used to evaluate loss of production. In several studies, this salary was estimated, not directly determined [27, 29, 32, 44-46, 50, 55, 56].

There is insufficient information available on the actual indirect costs, especially for the linking of diagnosis and occupational activity, and an urgent need for research at the international, European, and German levels is indicated.

7.5 Number and costs of invalidity pension claims due wholly or in part to MSDs

Information on invalidity pensions was compiled for the years 2005 to 2007 from the Scientific Use Files (Pension Access by Insured Persons – topic file "Reduced Earning Capacity and Diagnoses") of Deutsche Rentenversicherung (German Statutory Pension Fund) [19-21]; see Section 4. In the years 2005 to 2007 the proportion of invalidity pensions due wholly or in part to MSDs decreased slightly, exhibiting different manifestations for different occupational fields. Approximately one pension claim in six (corresponding to approx. 25,500 people in total) in 2007 was due wholly or in part to an MSD, with about 5,000 alone being due to the diagnosis of "back pain." Separate consideration of the prevalence of invalidity pensions due wholly or in part to MSDs among all new invalidity pensions in 2007 shows a range from 8.1% (other laborers) to 25.0% (miners, mineral extraction workers). The overall model clearly shows that there is a statistically significant relationship between the factors of age, gender, marital status, and level of education and the percentage of invalidity pensions due wholly or in part to MSDs and that, irrespective of these factors, miners (aOR: 1.8, 95% confidence interval: 1.2–2.7) and people working in manufacturing jobs (aOR: 1.4, 95% confidence interval: 1.3–1.5) have a higher percentage of invalidity pensions due wholly or in part to MSDs in comparison with people working in service jobs, whereas people in technical jobs (aOR: 0.7, 95% confidence interval: 0.6–0.9) and other laborers (aOR: 0.5, 95% confidence interval: 0.3–0.6) exhibit a lower risk. Adequate calculation of the costs of invalidity pensions due wholly or in part to MSDs requires intensive cooperation with Deutsche Rentenversicherung and could not be performed due to time restrictions.

7.6 Number and costs of occupational diseases

Occupational disease indicators are available from the German statutory accident insurance (DGUV) system (Section 3). Differentiation can be made between the number of confirmed suspected occupational disease cases, new occupational disease pensions, and outpatient and inpatient claims and their costs.

7.6.1 Occurrence of occupational diseases

Information on the occurrence of occupational diseases from industry and the public sector indicates that (OD) 2108 (Lumbar spine, lifting and carrying) and OD 2102 (Meniscus lesions) show a high number of confirmed suspected OD cases and new OD pensions for the years 2003 to 2007 in comparison with other ODs connected with musculoskeletal disorders (see Table 29). In the year in which an OD 2108 or 2102 was diagnosed, most of the insured parties were between 45 and 54 years of age. Gender-based differences were especially clear for OD 2102 (Meniscus lesions), with the proportion of males among the confirmed suspected cases (2003–2007), at 99.7%, being clearly predominant.

7.6.2 Claims and their costs

Analyses of the occupational disease cost survey relate to the industrial injuries insurance associations in the years 2003 to 2007 for MSD-related occupational diseases. Most inpatient and outpatient claims are recorded for OD 2108 (Lumbar spine, lifting and carrying) and OD 2102 (Meniscus lesions) and together account for about 90% of the inpatient and outpatient costs (OD 2108 = 16,735,748 euros; OD 2102 = 13,337,879 euros).

OD 2108 and OD 2102 are particularly important for providing answers to questions on prevention of MSD-related ODs. Gender- and age-specific differences must be considered. Where occupational diseases are concerned, it must be remembered that a complex procedure leads to a case definition within a specific legal framework. Hence, data on MSDs in the general population cannot be used to derive data on occupational diseases. In addition, different classification systems (German regulation on occupational diseases versus ICD-10) are used.

7.7 Suitability of indices for German statutory accident prevention system preventative measures

Musculoskeletal disorders (MSDs) must be rated as having a high socio-medical and economic relevance due to their widespread occurrence as well as their impact on social insurance costs. Apart from physical suffering, psycho-social factors influencing the pathogenesis and management of the condition as well as the development of preventive measures must be considered in order for the multicausality of sufferers to be accommodated. Targeted, evidence-based prevention is urgently needed.

MSD indicators are available in a wide variety of forms, but their suitability for effective preventive measures must be critically scrutinized. The prevalences calculated from the 2003 telephone health survey on back pain and the sample data provided by the statutory health insurers from 2002 can enable an estimate to be made of the extent of occurrence of MSD in the population and hence form the basis for public health measures. However the available data does not permit allow extensive analysis of the potential occupational influencing factors, particularly because this is secondary data, which brings with it not only the advantage of real-time analysis but also the following disadvantages:

- It does not contain the items of interest (e.g., work-related strain) because it was obtained with other objectives in mind.
- It is no longer current (e.g., health survey from 2003, sample data from statutory health insurers from 2002).
- It makes subgroup analyses more difficult due to the small number of cases.
- The quality of data collection varies.
- Longitudinal findings cannot be determined because there is no appropriate design.

Of several relevant indices, the invalidity indicators are the ones that are documented the best and the most extensively. Despite this, these indicators do not appear to be suitable for targeted preventive measures because they are influenced by several factors. The invalidity diagnoses are dependent on the physician and the current patient’s activities and do not produce a complete picture of the extent of the conditions.

Evidence- and occupation-based MSD prevention in Germany requires the generation of comprehensive, valid data on the occupational influencing factors of MSDs, but these are difficult to determine because of multifactoral problems and cannot be adequately elicited through secondary data analyses. Another package of measures, which could take the form shown below, is required for obtaining findings:

- Analysis of data from occupational physicians derived from checkups, including the corresponding information on stress in and outside the workplace at companies such as AUDI, at which thousands of employees are regularly examined

- Conduction of a cross-sectional survey in major companies with the possibility of performing a prospective survey in the form of an intervention study based on it

- Implementation of an occupation-specific MSD module within the framework of the Helmholtz cohorts

The advantages and disadvantages of the various possible approaches must be discussed within the DGUV on the basis of existing resources. Independently of the methodology used, consideration of individual diagnoses as well as gender- and age-specific distributions must be taken into account. There is only limited scope for prioritization of the possible approaches and preventive measures according to the costs of the individual conditions, because of the data available. Nevertheless, it can be seen that back conditions have the highest relevance for healthcare policy. Consideration should be given to whether or not occupation-specific prevention approaches should be replaced or supplemented by public health measures.

The stated limitations on interpretation of the prevalence and cost indicators mean that scientific, evidence-based prioritization of preventive measures for MSDs solely based on the findings of Work Package 3 is not possible. The ten most important

MSD conditions for specific indicators are listed in Table 6 and Table 8 (pages 26 and 29) in Section 2.2 and must be supplemented by the findings of the other sections. Thus, for example, the occupational diseases 2108 (Lumbar spine, lifting and carrying) and 2102 (Meniscus lesions) must be considered especially in the development of preventive measures.

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