



Aalborg Universitet

AALBORG UNIVERSITY  
DENMARK

## Cohort Profile: The Danish Occupational Medicine Cohort-a nationwide cohort of patients with work-related disease

Dalgaard, Vita Ligaya; Willert, Morten Vejs; Kyndi, Marianne; Vestergaard, Jesper Medom; Andersen, Johan Hviid; Christiansen, David Høyrup

*Published in:*  
International Journal of Epidemiology

*DOI (link to publication from Publisher):*  
[10.1093/ije/dyad013](https://doi.org/10.1093/ije/dyad013)

*Creative Commons License*  
CC BY-NC 4.0

*Publication date:*  
2023

*Document Version*  
Publisher's PDF, also known as Version of record

[Link to publication from Aalborg University](#)

*Citation for published version (APA):*  
Dalgaard, V. L., Willert, M. V., Kyndi, M., Vestergaard, J. M., Andersen, J. H., & Christiansen, D. H. (2023). Cohort Profile: The Danish Occupational Medicine Cohort-a nationwide cohort of patients with work-related disease. *International Journal of Epidemiology*, 52(4), e201-e210. Article dyad013. Advance online publication. <https://doi.org/10.1093/ije/dyad013>

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal -

### Take down policy

If you believe that this document breaches copyright please contact us at [vbn@aub.aau.dk](mailto:vbn@aub.aau.dk) providing details, and we will remove access to the work immediately and investigate your claim.

## Cohort Profile

# Cohort Profile: The Danish Occupational Medicine Cohort—a nationwide cohort of patients with work-related disease

Vita Ligaya Dalgaard <sup>1,2\*</sup> Morten Vejs Willert <sup>3</sup>  
Marianne Kyndi <sup>1,3,4</sup> Jesper Medom Vestergaard <sup>1,3</sup>  
Johan Hviid Andersen <sup>1,5</sup> and David Høyrup Christiansen <sup>1,5,6,7</sup>

<sup>1</sup>Department of Occupational Medicine, University Research Clinic, Danish Ramazzini Centre, Gødstrup Hospital, Herning, Denmark, <sup>2</sup>Department of Psychology and Behavioral Sciences, Aarhus University, Aarhus C, Denmark, <sup>3</sup>Department of Occupational Medicine, Danish Ramazzini Centre, Aarhus University Hospital, Aarhus N, Denmark, <sup>4</sup>Department of Occupational and Environmental Medicine, Danish Ramazzini Centre, Aalborg University Hospital, Aalborg, Denmark, <sup>5</sup>Department of Clinical Medicine, Aarhus University, Aarhus N, Denmark, <sup>6</sup>Elective Surgery Centre, Silkeborg Regional Hospital, Silkeborg, Denmark and <sup>7</sup>Centre for Research in Health and Nursing, Research, Regional Hospital Central Jutland, Viborg, Denmark

\*Corresponding author. Department of Psychology and Behavioral Sciences, Aarhus University, Bartholins Allé 11, Building 1350, Room 530 DK—8000 Aarhus C, Denmark. E-mail: Ligayadalgaard@psy.au.dk

Received 19 May 2022; Editorial decision 8 December 2022; Accepted 10 February 2023

## Why was the cohort set up?

Work is an essential part of modern life and a necessity for most people, but also a source of wellbeing and development. On the other hand, occupational exposures may contribute to ill health, sickness absence and expulsion from the work force.<sup>1,2</sup> As such, occupational and work-related health problems are a major public health concern which continues to cause suffering and economic impairment worldwide in spite of many preventive initiatives.<sup>3,4</sup> An occupational disease may be understood as any disease caused primarily by exposure to risk factors related to work activity.<sup>5</sup> In contrast, work-related diseases are multifactorial and work environmental factors may contribute in conjunction with other risk factors to the development of disease.<sup>5</sup>

Denmark and other Scandinavian countries have played a pivotal role in research related to occupational disease and related topics such as return to work, but the overall level of international publications concerning occupational

disease remains low compared with other medical fields.<sup>3,6</sup> Danish occupational health research has access to extraordinary administrative, occupational and health registers linked at an individual level through the Danish personal identification number<sup>7</sup> and therefore holds a unique opportunity to expand our knowledge about occupational and work-related disease, in particular with regard to long-term prognosis and time trends of prevalent occupational diseases.

Research trends within the area of occupational health have shifted during the past two decades from an emphasis on traditional types of occupational disease, such as respiratory and musculoskeletal disease, to the area of mental health, which in turn has led to a dramatic increase in the number of publications linking work, psychiatry and psychology.<sup>3</sup> This development coincides with reports by occupational health professionals in the International Occupational Medicine Society Collaborative Survey, that the need to handle mental

### Key Messages

- The Danish Occupational Medicine Cohort was established to conduct long-term follow-up for large groups of patients with work-related disease.
- The cohort comprises a national database of all patients assessed at Danish departments of occupational medicine from 2000 to 2018. Inclusion is determined by the first referral for assessment from 2000 on, comprising 145 390 patients (age range: 16–97 years) with a total of 169 197 assessments.
- Data were collected through Statistics Denmark where all patients were identified through the Danish National Patient Register (DNPR). The DNPR contains administrative and clinical data reported by hospital departments. The cohort is updated regularly and contains a broad range of register information such as work status, yearly job and industry types, health care service use, education, income, job exposure matrices, death and cause of death.
- Cohort data are found available by submitting a short project description to the head of the steering committee, Morten Vejs Willert [email: [morten.willert@aarhus.rm.dk](mailto:morten.willert@aarhus.rm.dk)].

health and other stress-related issues among workers has increased.<sup>8</sup> Whereas it is well known that occupational exposures may contribute to adverse health, the long-term prognosis of many work-related disorders is often unclear and there is a persistent need for long term follow-up studies of such conditions.<sup>9–12</sup>

Danish departments of occupational medicine currently receive around 9000 annual referrals due to suspected occupational or work-related disease. The departments operate as outpatient clinics in the welfare-based health care system in Denmark, with free admission without payment by the patient.<sup>13</sup> Patients are referred to the departments by general practitioners (GPs) or other health professionals. Additionally, unions and the safety organization at the workplace can also refer workers with suspected occupational diseases. There are currently seven active departments in Denmark located across the country. To comply with demands for knowledge and research, a large nationwide database that integrates prospective data on occupational exposures with data on health, diagnoses, work participation and labour market attachment has been developed. The purpose of the Danish Occupational Medicine Cohort is to facilitate long-term prognostic studies and identify potential modifiable predictors of negative health outcomes which may be addressed through future preventive measures.

### Who is in the cohort?

The Danish Occupational Medicine Cohort contains all patients registered in the Danish National Patient Register (DNPR) as seen in a Danish hospital department of occupational medicine from 1 January 2000 until 31 December 2018. Thus the cohort was created through the DNPR,<sup>14</sup> which is used extensively for research due to its high level of completeness.<sup>15</sup> The DNPR contains administrative and

clinical data reported to the DNPR by the hospital departments each time a patient is seen and registered with an entry date at a department. The administrative data comprise identification of the patient (the unique personal identification number—CPR-number), the municipality of the patient, identification (ID) of the hospital ward, date and time of activity. Information on all diagnoses was retrieved from the clinical data registered into the DNPR by the respective departments of occupational medicine, as well as other hospital departments.<sup>14</sup>

In total, 145 390 unique patients have been included in the Danish Occupational Medicine Cohort so far, with a total of 169 197 occupational health assessments. An occupational health assessment and counselling may include only one contact to the department or may comprise several contacts over a period of time before the assessment and counselling period is ended. A patient may be represented in the database with health assessments in relation to only one type of diagnosis or to several different types of diagnosis assessed at different time points (e.g. mental health problems and musculoskeletal disorder). Only occupational health assessments that were registered as finalized [represented with an outdate (date of discharge) registration in the DNPR connected to the particular assessment] prior to 2019 were included in the cohort. So if an assessment was initiated in, for example, December 2018 and not finalized during the end of 2018, the assessment was excluded from the cohort. The reason behind this is that the final diagnosis may be subject to change until the assessment period and all test results, examinations and potential counselling are finalized.

Each occupational health assessment was categorized into one of seven major diagnostic groups according to the International Classification of Diseases, 10th revision<sup>16</sup> (see Figure 1). This classification was based on the primary diagnosis of each assessment and/or, if relevant, the

**Total number of patients (N=145 390)**

Diagnostic groups	Mental	Respiratory	Skin	Musculoskeletal	Nervous system	Cancer	Other
Numbers and diagnostic group of first ever occupational health assessment	n=28 212	n=12 274	n=6544	n=51 056	n=5513	n=1566	n=40 225
Number of first assessments within a diagnostic group	n=29 646	n=12 978	n=6882	n=53 235	n=6063	n=1702	n=43 394
Number of patients with two or more assessments within a diagnostic group	n=2780	n=916	n=418	n=5266	n=444	n=35	n=3346
Number of patients with three or more assessments within a diagnostic group	n=490	n=126	n=49	n=789	n=63	n=4	n=614
Number of total assessments within a diagnostic group	n=32 916	n=14 020	n=7349	n=59 247	n=6570	n=1741	n=47 354

**Figure 1** Number of patients and diagnostic group of first occupational health assessment (time of inclusion), and number of patients with a first, second or third assessment within a diagnostic group (2000–18)

secondary or supplementary diagnostic codes related to the entry date. The primary diagnosis pertains to the main reason for the hospital contact as concluded by the occupational health professional. Secondary diagnoses supplement the primary diagnosis in terms of identifying other relevant diseases related to the current hospital contact, such as underlying chronic disease. Supplementary codes are also available to supplement the primary diagnosis, (e.g. cancer stage).<sup>14</sup>

Figure 1 illustrates the classification of all included patients into a diagnostic group at first entrance into the cohort from 2000–18, as well as the number of patients who have a first, second or third occupational health assessment within a diagnostic group independently of any previous assessments in other diagnostic groups. Thus, a patient may have a first-time occupational health assessment within both the mental and the musculoskeletal group (see third row in Figure 1). Across diagnostic groups, 145 390 had one or more occupational health assessments, 19 451 had two or more, 3321 had three or more and 709 had four or more occupational assessments. The cohort was assembled from 2019–21 with the aim of studying the long-term prognosis of large diagnostic groups in an occupational health setting.

Table 1 describes the demographics and characteristics of the patients included in the cohort. In total, 16 departments (that have been active during different time periods) across the five Danish regions contributed with patients into the cohort. Seven of these departments are currently active. Whether or not a department is currently active, has been closed or has merged with another department

during the follow-up period does not influence the possibility of long-term follow-up of patients, since the patient as identified through the DNPR is still available to individual follow-up in all registers.

A simple validation of the number of patients included in the cohort was performed. All of the seven currently active departments of occupational medicine were contacted directly and asked to provide the researchers with internal department estimates of the number of patients seen each year during the time period 2000–18. The purpose was to assess to what extent the numbers of patients that were retrieved and included through the Danish National Patient Registry corresponded to the numbers reported by local department counts. However, in part due to large organizational merges that had taken place during 2000–18 and in part due to information back in time not always being available from the departments (due to, for example, closure of old patient IT systems), we only obtained information on 91 354 patients corresponding to 75% of the requested years (seven departments over 19 years). The information obtained from registers and the departments' own information differed by less than 20% for 70% of the validated years. For the years with the highest differences, a particularly high number of patients received unspecific diagnoses, not relating to any disease and ending in the 'Other' group in the cohort.

### How often have they been followed?

All patients aged at least 16 years at their first contact with a Danish department of occupational medicine from

**Table 1** Characteristics and demographics of patients at inclusion into the cohort during 2000–18

Characteristics	Total	Mental	Respiratory	Skin	Musculoskeletal	Nervous system	Cancer	Other
Number of patients in diagnostic groups <i>n</i> (%)	<i>N</i> = 145 390	<i>n</i> = 28 212	<i>n</i> = 12 274	<i>n</i> = 6544	<i>n</i> = 51 056	<i>n</i> = 5513	<i>n</i> = 1566	<i>n</i> = 40 225
Gender								
Male	65 295 (44.9)	7247 (25.7)	8049 (65.6)	3193 (48.8)	24 398 (47.8)	2922 (53.0)	1223 (78.1)	18 263 (45.4)
Female	80 095 (55.1)	20 965 (74.3)	4225 (34.4)	3351 (51.2)	26 658 (52.2)	2591 (47.0)	343 (21.9)	21 962 (54.6)
Age group during first visit to a clinic								
<35 years	30 707 (21.1)	4328 (15.3)	2197 (17.9)	2575 (39.3)	8233 (16.1)	1031 (18.7)	13 (0.8)	12 330 (30.7)
35–49 years	58 273 (40.1)	13 177 (46.7)	3423 (27.9)	2402 (36.7)	23 250 (45.5)	2424 (44.0)	147 (9.4)	13 450 (33.4)
50–66 years	51 114 (35.2)	10 655 (37.8)	4444 (36.2)	1518 (23.2)	19 365 (37.9)	1932 (35.0)	740 (47.3)	12 460 (31.0)
>66	5201 (3.6)	45 (0.2)	2200 (17.9)	43 (0.7)	182 (0.4)	122 (2.2)	666 (42.5)	1943 (4.8)
Missing	95 (0.1)	7 (0.0)	10 (0.1)	6 (0.1)	26 (0.1)	4 (0.1)	0 (0.0)	42 (0.1)
Level of further education <sup>a</sup>								
Long	5119 (3.5)	1890 (6.7)	374 (3.0)	136 (2.1)	663 (1.3)	82 (1.5)	22 (1.4)	1952 (4.9)
Medium	22 706 (15.6)	11 257 (39.9)	1372 (11.2)	808 (12.3)	3046 (6.0)	304 (5.5)	194 (12.4)	5725 (14.2)
Short	68 926 (47.4)	10 556 (37.4)	6345 (51.7)	3185 (48.7)	26 007 (50.9)	2854 (51.8)	809 (51.7)	19 170 (47.7)
None	45 630 (31.4)	4302 (15.2)	3933 (32.0)	2269 (34.7)	20 188 (39.5)	2145 (38.9)	500 (31.9)	12 293 (30.6)
Missing	3009 (2.1)	207 (0.7)	250 (2.0)	146 (2.2)	1152 (2.3)	128 (2.3)	41 (2.6)	1085 (2.7)
Marital status								
Married	82 055 (56.4)	16 181 (57.4)	7166 (58.4)	2996 (45.8)	30 160 (59.1)	3239 (58.8)	1107 (70.7)	21 206 (52.7)
Single	40 073 (27.6)	7129 (25.3)	2993 (24.4)	2794 (42.7)	12 489 (24.5)	1398 (25.4)	127 (8.1)	13 143 (32.7)
Divorced	20 179 (13.9)	4562 (16.2)	1601 (13.0)	661 (10.1)	7467 (14.6)	784 (14.2)	197 (12.6)	4907 (12.2)
Widowed	2591 (1.8)	292 (1.0)	479 (3.9)	63 (1.0)	798 (1.6)	77 (1.4)	129 (8.2)	753 (1.9)
Missing	492 (0.3)	48 (0.2)	35 (0.3)	30 (0.5)	142 (0.3)	15 (0.3)	6 (0.4)	216 (0.5)
Major occupational groups (DISCO-88)								
Armed forces	564 (0.4)	117 (0.4)	38 (0.3)	14 (0.2)	146 (0.3)	15 (0.3)	21 (1.3)	213 (0.5)
Managers	2063 (1.4)	924 (3.3)	210 (1.7)	53 (0.8)	269 (0.5)	50 (0.9)	37 (2.4)	520 (1.3)
Professionals	10 571 (7.3)	4874 (17.3)	877 (7.1)	221 (3.4)	1053 (2.1)	170 (3.1)	87 (5.6)	3289 (8.2)
Technicians and associate professionals	21 175 (14.6)	8613 (30.5)	1337 (10.9)	908 (13.9)	3980 (7.8)	445 (8.1)	173 (11.0)	5719 (14.2)
Clerical support workers	9375 (6.4)	2395 (8.5)	613 (5.0)	293 (4.5)	3117 (6.1)	347 (6.3)	51 (3.3)	2559 (6.4)
Services and sales workers	22 616 (15.6)	5099 (18.1)	1076 (8.8)	1080 (16.5)	9096 (17.8)	587 (10.6)	123 (7.9)	5555 (13.8)
Skilled agricultural, forestry and fishery workers	1678 (1.2)	118 (0.4)	254 (2.1)	85 (1.3)	612 (1.2)	67 (1.2)	21 (1.3)	521 (1.3)
Craft and related workers	22 091 (15.2)	941 (3.3)	2740 (22.3)	1227 (18.8)	8761 (17.2)	1283 (23.3)	353 (22.5)	6786 (16.9)
Plant and machine operators and assemblers	19 300 (13.3)	899 (3.2)	1617 (13.2)	1004 (15.3)	9954 (19.5)	1098 (19.9)	131 (8.4)	4597 (11.4)
Elementary occupations	22 416 (15.4)	1320 (4.7)	1711 (13.9)	1085 (16.6)	10 976 (21.5)	1057 (19.2)	190 (12.1)	6077 (15.1)
Missing <sup>b</sup>	13 541 (9.3)	2912 (10.3)	1801 (14.7)	574 (8.8)	3092 (6.1)	394 (7.1)	379 (24.2)	4389 (10.9)

(Continued)

**Table 1 Continued**

Characteristics	Total N = 145 390	Mental n = 28 212	Respiratory n = 12 274	Skin n = 6544	Musculoskeletal n = 51 056	Nervous system n = 5513	Cancer n = 1566	Other n = 40 225
Major industries (NACE)								
Undisclosed/unknown activity	7459 (5.1)	543 (1.9)	1103 (9.0)	186 (2.8)	2752 (5.4)	399 (7.2)	234 (14.9)	2242 (5.6)
Agriculture, forestry and fishing	1300 (0.9)	29 (0.1)	219 (1.8)	61 (0.9)	487 (1.0)	56 (1.0)	7 (0.4)	441 (1.1)
Manufacturing	31 888 (21.9)	1889 (6.7)	3152 (25.7)	2249 (34.4)	13 786 (27.0)	1733 (31.4)	235 (15.0)	8844 (22.0)
Construction	11 046 (7.6)	376 (1.3)	949 (7.7)	425 (6.5)	5188 (10.2)	654 (11.9)	114 (7.3)	3340 (8.3)
Trade and transportation	19 210 (13.2)	2567 (9.1)	1408 (11.5)	903 (13.8)	8230 (16.1)	792 (14.4)	150 (9.6)	5160 (12.8)
Information and communication	1606 (1.1)	416 (1.5)	104 (0.8)	49 (0.7)	497 (1.0)	66 (1.2)	11 (0.7)	463 (1.2)
Finance and insurance	1208 (0.8)	398 (1.4)	91 (0.7)	32 (0.5)	341 (0.7)	40 (0.7)	15 (1.0)	291 (0.7)
Real estate	978 (0.7)	140 (0.5)	141 (1.1)	20 (0.3)	310 (0.6)	50 (0.9)	35 (2.2)	282 (0.7)
Business services	10 277 (7.1)	1853 (6.6)	749 (6.1)	368 (5.6)	3734 (7.3)	386 (7.0)	68 (4.3)	3119 (7.8)
Public service, education and health	43 529 (29.9)	16 311 (57.8)	2273 (18.5)	1518 (23.2)	11 411 (22.3)	858 (15.6)	290 (18.5)	10 868 (27.0)
Arts, entertainment and recreation	5228 (3.6)	888 (3.1)	544 (4.4)	285 (4.4)	1709 (3.3)	169 (3.1)	44 (2.8)	1589 (4.0)
Missing <sup>b</sup>	11 661 (8.0)	2802 (9.9)	1541 (12.6)	448 (6.8)	2611 (5.1)	310 (5.6)	363 (23.2)	3586 (8.9)
Number of patients, by region								
Capital	30 214 (20.8)	3254 (11.5)	2917 (23.8)	1075 (16.4)	11 641 (22.8)	904 (16.4)	312 (19.9)	10 111 (25.1)
Zealand	26 026 (17.9)	3362 (11.9)	1783 (14.5)	971 (14.8)	9450 (18.5)	776 (14.1)	320 (20.4)	9364 (23.3)
South	38 872 (26.7)	8921 (31.6)	2950 (24.0)	1614 (24.7)	11 560 (22.6)	2207 (40.0)	180 (11.5)	11 440 (28.4)
Central	33 531 (23.1)	8669 (30.7)	3194 (26.0)	2295 (35.1)	12 971 (25.4)	1168 (21.2)	249 (15.9)	4985 (12.4)
North	16 747 (11.5)	4006 (14.2)	1430 (11.7)	589 (9.0)	5434 (10.6)	458 (8.3)	505 (32.2)	4325 (10.8)
Prior work participation (3 years) <sup>c</sup>								
High	107 050 (73.6)	23 195 (82.2)	7882 (64.2)	5211 (79.6)	37 255 (73.0)	3775 (68.5)	645 (41.2)	29 087 (72.3)
Low	32 622 (22.4)	4878 (17.3)	2300 (18.7)	1248 (19.1)	13 418 (26.3)	1586 (28.8)	276 (17.6)	8916 (22.2)
Missing <sup>d</sup>	5718 (3.9)	139 (0.5)	2092 (17.0)	85 (1.3)	383 (0.8)	152 (2.8)	645 (41.2)	2222 (5.5)
Comorbidity								
Comorbidity (1 or more)	19 869 (13.7)	2455 (8.7)	4662 (38.0)	482 (7.4)	3948 (7.7)	526 (9.5)	1442 (92.1)	6354 (15.8)
No comorbidity	125 521 (86.3)	25 757 (91.3)	7612 (62.0)	6062 (92.6)	47 108 (92.3)	4987 (90.5)	124 (7.9)	33 871 (84.2)

DISCO, Danish International Standard Classification of Occupations; NACE, the classification of economic activities issued by the European Commission (from the French: Nomenclature Statistique des Activités Économiques dans la Communauté Européenne).

<sup>a</sup>Levels of education: none = 9th grade or high school (12th grade), short = 3 years after high school, Medium = 4 years after high school, long = 5 or more years after high school.

<sup>b</sup>Missing values are present because the job register has only been updated up until 2017. Missing values are expected to be almost fully replaced during the next update of the cohort.

<sup>c</sup>Work participation level during year 3 prior to inclusion was dichotomized at </> 75%.

<sup>d</sup>Missing values relate to some participants being retired, emigrated etc. and thus not having any work participation during year 3 prior to baseline.

**Table 2** Registers and information included in the database

Name of register	Examples of available information	Years of availability in the cohort
The Population Register	Date of birth, region, sex, marital status, municipality, country of birth, family identification number, family type, identification number of mother, identification number of father	1995–2018
The Danish National Health Service Register	Providers, specialty, present general practice, provider number, date of entering present general practice, region, health insurance group, time of receiving health service	1995–2018
The Danish National Patient Registry	Municipality of the patient, hospital and department codes, admission type, patient contact type, referral information, contact reason, dates of admission and discharge and number of times seen during an assessment or counselling period, primary, secondary and supplementary diagnoses (based on the International Classification of Diseases, Tenth Revision) associated with each hospital contact, information on operations	1995–2018
The Danish Psychiatric Central Research Register	Diagnoses (primary, secondary and supplementary), date of visit and discharge, patient type, hospital, department, civil registration number	1995–2018
The Population Education Register	Highest completed level of education and date, education identifier	1995–2018
The Income Statistics Register	Main source of income, personal income, personal disposable income	1995–2018
The Family Income Register	Family income total, family disposable income	1995–2017
The Danish Register for Evaluation of Marginalization (the DREAM database)	Weekly information on public transfer payments in relation to sickness absence, disability pension, early retirement, regular retirement, emigration and death	1995–2018
The Job Register	Individual-level information on yearly employment and information on type of employment (job titles are based on DISCO-88 and industry on DB07)	1995–2016
Job exposure matrices (JEMs) from DOC*X	Psychosocial JEMs, mechanical JEMs, physical JEMs, lifestyle JEMs	1995–2016
IDAN database	Workplace registration number	1995–2018
The Causes of Death Register	Cause of death, date of death, age at the time of death	1995–2018

2000–18 have been followed continuously in relevant registers (see Table 2) from 5 years before entering the cohort until 2018, with the exception of a few registers that have only been updated until 2016 (see Table 2). Further yearly registrations will be added to the database for all registers regularly in the future. Moreover, ongoing registrations of emigration, date of death and cause of death

contribute to exact estimations of these types of events in the cohort from 1995 on.

### What has been measured?

The data connected to this cohort are based on information from several longitudinal Danish health and social

registers as well as the DOC\*X database.<sup>17</sup> All data sources are available through Statistics Denmark and the cohort also is available to Danish and international researchers through the Statistics Denmark platform.

In Denmark, all citizens have a unique personal identification number (CPR number) through which all data included in the database can be merged at the individual level.<sup>18</sup> Available data on demographic and social characteristics include age, gender, immigration and municipality of residence as well as family status (single, cohabitating, married and number of children), income and education. Information on job title (DISCO-88, the Danish version of the International Standard Classification of Occupations, ISCO, from 1988) and industry [DB07, a Danish version of the classification of economic activities issued by the European Commission, from the French: Nomenclature Statistique des Activités Économiques dans la Communauté Européenne (NACE)] was retrieved from the Occupation and Industry Register from the DOC\*X database.<sup>17</sup> Information on public transfer payments in relation to sickness absence, disability, pensioning and early retirement was retrieved from the Danish National Register on Public Transfer Payments (the DREAM database).<sup>19</sup> These data enable weekly categorization of work status type such as unemployment or sick leave.

Data on health-related issues include information on diagnosis, contact dates and treatment procedures of all inpatient and outpatient contacts in somatic and psychiatric hospitals available through the DNPR and the Danish Psychiatric Central Research Register.<sup>20</sup> Week-by-week information is retrieved from the Danish National Health Service Register (NHSR) and includes contacts and treatment received from health care providers in private primary care (i.e. general practitioners, practising medical specialists, physiotherapists, psychologists, chiropractors) but does not include information on diagnosis.<sup>21</sup> Furthermore, information on date and cause of death from the Causes of Death Register is also included.<sup>22</sup> Information from the Prescription Register (dispensing and prescriber of drugs)<sup>23</sup> may be included by request, but purposes of use must be specified pertaining to each retrieval of data.

From the DOC\*X database, a number of job exposure matrices (JEMs)<sup>24</sup> contain estimates of biomechanical, psychosocial, airborne, chemical and lifestyle occupational exposures aggregated by job and industry. The details of different JEMs have been provided elsewhere,<sup>17</sup> but in brief, a JEM is a cross-tabulation of occupational groups and corresponding exposure estimates based on a combination of national questionnaire surveys, expert assessments and exposure measurements.

Table 2 provides an overview of the included registers and data in the cohort. As shown in the right-hand column,

almost all registers are updated until 2018 with the exception of the Job Register and the Family Income Register. These registers will be updated during the next cohort update.

With regard to missing data, the Danish registers generally have low levels of missing data, as data are completely standardized similarly to other Scandinavian countries. Thus, data are collected automatically and without the involvement of the specific individual. However some events and situations are not recorded, such as treatments received at hospitals abroad.<sup>18</sup>

## What has it found?

Since the cohort was only recently established, previous findings are scarce but a number of studies on patients seen with musculoskeletal disorders are currently taking place. In addition, a paper on a 5-year follow-up of long-term use of health care facilities among mental health patients, and another paper on long-term follow-up of work status among mental health patients have been submitted.

Furthermore, when analysing time trends with respect to diagnostic groups (Figure 2a), it is evident that the

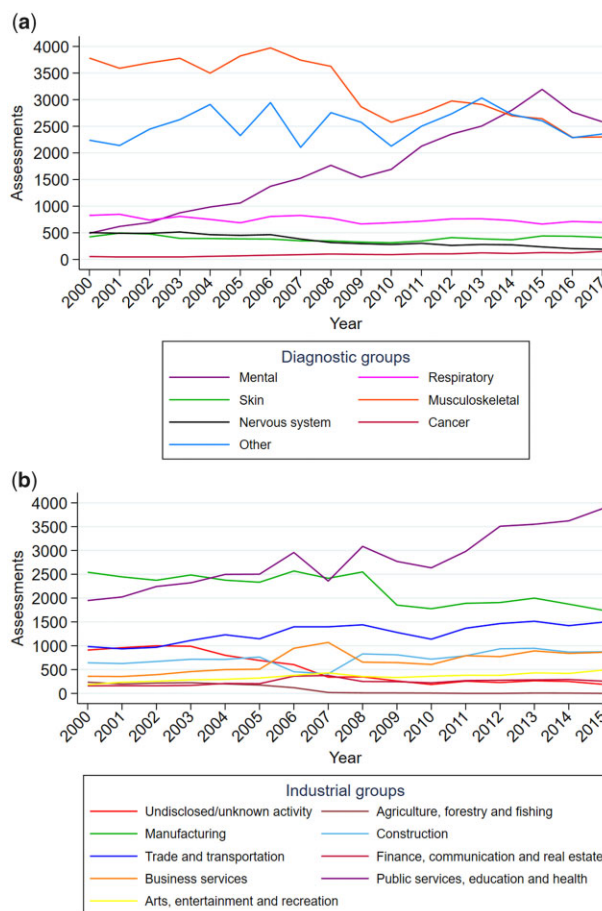
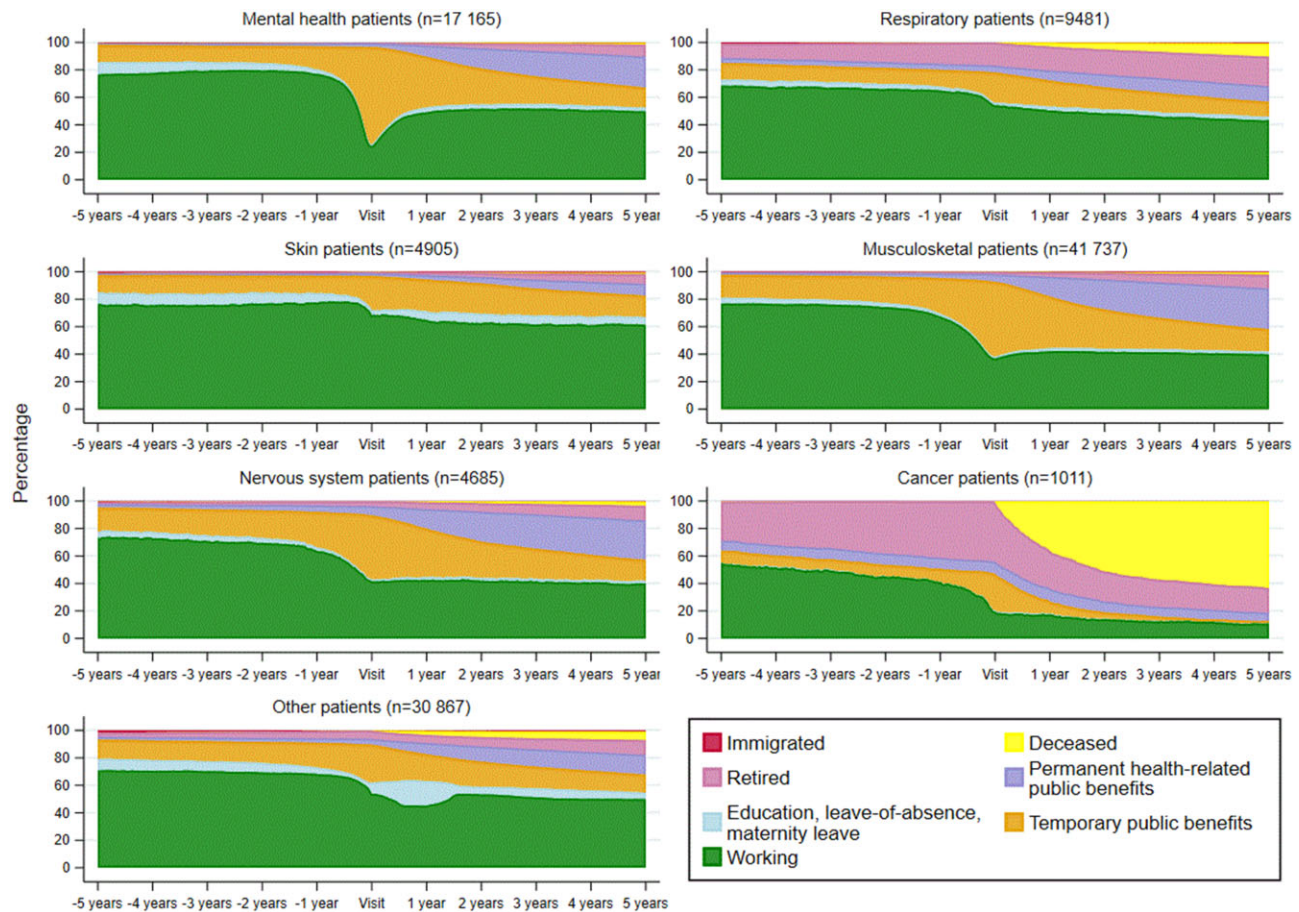


Figure 2 Total number of annual assessments. (a) Per major diagnostic group (2000–17). (b) Per major industrial group (2000–15)





**Figure 3** Weekly work status distribution 5 years before and after first visit to a Danish department of occupational medicine (2000–13) ( $N = 109\,851$ )

number of patients diagnosed with musculoskeletal conditions has gradually declined from about 3800 in the year 2000 to less than 2500 in 2017. During the same time period, the number of referred patients with mental health conditions increased from about 500 in the year 2000 to more than 3000 in 2015. Referral numbers during recent years indicate that the rise in this patient group may have plateaued. Numbers of assessments with regard to the remaining diagnostic groups seem relatively stable except for the category Other, where the number of assessments varies over time.

Figure 2b illustrates the number of yearly assessments per major industrial group from 2000 to 2015 (groups of finance and insurance, information and communication, and real estate listed in Table 1 were pooled into one group in Figure 2b). The graphs show a clear rise in patients working within the public sector domain, whereas there seems to be a negative trend in numbers of patients employed in manufacturing. This shift may potentially be related to the shift in health conditions referred to the departments as mentioned above.

Based on the DREAM database, we have also examined cumulated weekly work status from 5 years before and

after entering the cohort for the first time from 2000 to 2013 (Figure 3). We found that the overall prognosis within major diagnostic groups seems to differ substantially. Five years prior to entering the cohort, about 80% of mental health patients are fully at work. During the time of assessment, this proportion drops to about 20% and subsequently reaches about 50% during the first year following assessment, but never returns to levels similar to those prior to inclusion. A somewhat similar pattern is observed in the musculoskeletal patient group, although the proportion of participants fully at work never returns to more than around 40% during the 5-year follow-up period. Skin patients differ least in pre-post levels of being fully at work. The mortality rate is highest among cancer patients, which is most likely related to the life-threatening nature of the disease and higher age in this patient group.

Finally, work participation levels over time have been analysed with descriptive statistics to examine the yearly development in work participation within diagnostic groups. The yearly work participation score (WPS) was estimated as the cumulative number of weeks fully working (or equivalent, such as education) divided by the total number of weeks where the patient was potentially eligible

for work (excluding weeks of retirement, living abroad or death). A person was censored from the year of retirement, living abroad or death. Several studies have categorized a work participation score of less than 0.75 (75%) as an indication of disability.<sup>25–27</sup>

In the analyses of the work participation score, a trend in accordance with [Figure 3](#) was observed (see [Supplementary Table S1](#), available as [Supplementary data](#) at *IJE* online).

### What are the main strengths and weaknesses?

Major strengths of this cohort are the large sample size and the nationwide and complete inclusion of all patients seen at all Danish departments of occupational medicine during a period of nearly 20 years. In addition, the availability of a wide range of data with a high degree of complete register follow-up covering the entire cohort and follow-up period enables detailed analyses of associations between occupational diseases, disability outcomes and working trajectories. Another strength is that all patients in the cohort have gone through a thorough diagnostic examination by an occupational health professional to establish the diagnosis.

The main weakness is that most of the patients are only assessed once, which may provide uncertainty as to what happens during the following years in terms of events that may influence work ability and health. However, information on new diagnoses, comorbidity and use of primary and secondary health care services is available, and data from the Prescription Register and other specialized registers may be added with future updates. Furthermore, as the cohort only includes register data, other important information from patient records such as data on clinical examination findings (aside from diagnosis), duration and severity of symptoms, functional limitations and whether or not the presented symptoms were assessed to be causally related to working conditions, are not available at the moment.

### Can I get hold of the data? Where can I find out more?

Access to data is obtained through the cohort executive committee at the Regional Hospital West Jutland, with a short project description. Further information on content and variables of the Danish Occupational Medicine Cohort and how to gain access is available through personal contact with the chairman of the steering committee

by e-mail [[Morten.Willert@aarhus.rm.dk](mailto:Morten.Willert@aarhus.rm.dk)], or from the corresponding author of this paper [[Ligayadalgaard@psy.au.dk](mailto:Ligayadalgaard@psy.au.dk)]. Individual-level data in the database are available only through online access at Statistics Denmark under standard conditions.

### Ethics approval

Since this study is entirely register based, approval from the Danish National Committee on Health Research Ethics was not required. The Danish Data Protection Agency approved the study (j. no.: 1–16-02–263-19).

### Data availability

See ‘Can I get hold of the data?’ above.

### Supplementary data

[Supplementary data](#) are available at *IJE* online.

### Author contributions

V.L.D. and D.H.C. initiated the cohort design. V.L.D. has been main responsible for data acquisition, contributed to all data management review, conducted the descriptive statistics of the current paper and wrote the first draft of the paper. M.V.W. and J.M.V. conducted the data management of the cohort. M.V.W., M.K., J.H.A. and D.H.C. contributed to the design of the cohort and coding of important variables. M.K. and V.L.D. performed the initial simple validation of the patients included in the cohort. All authors contributed to discussing results, writing the manuscript and approving the final draft.

### Funding

The work was supported by the Danish Working Environment Research fund (#20185100851) with ongoing updates funded through the two departments of occupational medicine in the Central Denmark Region.

### Conflict of interest

None declared.

### References

1. Andersen LL, Thorsen SV, Flyvholm MA, Holtermann A. Long-term sickness absence from combined factors related to physical work demands: prospective cohort study. *Eur J Public Health* 2018; 28:824–29. <https://www.ncbi.nlm.nih.gov/pubmed/29741617> (21 January 2023, date last accessed).
2. Labriola M, Holte KA, Christensen KB, Feveile H, Alexanderson K, Lund T. The attribution of work environment in explaining gender differences in long-term sickness absence: results from the prospective DREAM study. *Occup Environ Med* 2011;68: 703–5.

3. Gehanno JF, Postel A, Schuers M, Rollin L. Trends and topics in occupational diseases over the last 60 years from PubMed. *Scand J Work Environ Health* 2018;44:670–77. <https://www.ncbi.nlm.nih.gov/pubmed/29982842> (10 December 2020, date last accessed).
4. Dembe AE. The social consequences of occupational injuries and illnesses. *Am J Ind Med* 2001;40:403–17.
5. European Agency for Safety and Health at Work. *Work-Related Diseases* 2021. <https://osha.europa.eu/en/themes/work-related-diseases> (11 August 2021, date last accessed).
6. Rollin L, Gehanno JF. Research on return to work in European Union countries. *Occup Med (Lond)* 2012;62:210–15.
7. Pedersen CB. The Danish Civil Registration System. *Scand J Public Health* 2011;39:22–25.
8. Loeppke R, Heron R, Bazas T *et al.* Global trends in occupational medicine: results of the International Occupational Medicine Society Collaborative Survey. *J Occup Environ Med* 2017;59:e13–16.
9. Dalgaard VL, Aschbacher K, Andersen JH *et al.* Return to work after work-related stress: a randomized controlled trial of a work-focused cognitive behavioral intervention. *Scand J Work Environ Health* 2017;43:436–46. <https://www.ncbi.nlm.nih.gov/pubmed/28650513> (15 December 2020, date last accessed).
10. Dalgaard VL, Hviid Andersen J, Pedersen AD, Andersen LP, Eskildsen A. Cognitive impairments and recovery in patients with work-related stress complaints: four years later. *Stress* 2020;1–9. <https://www.ncbi.nlm.nih.gov/pubmed/32812459> (15 December 2020, date last accessed).
11. Steyerberg EW, Moons KG, van der Windt DA *et al.*; PROGRESS Group. Prognosis Research Strategy (PROGRESS) 3: prognostic model research. *PLoS Med* 2013;10:e1001381.
12. Riley RD, van der Windt D, Croft P, Moons KGM, *Prognosis Research in Healthcare Concepts, Methods, and Impact: Concepts, Methods, and Impact*. Oxford, UK: Oxford University Press, 2019.
13. Netterstrøm B, Grandjean P. Occupational and environmental medicine in Denmark. *Int Arch Occup Environ Health* 1998;71:3–6.
14. Lyng E, Sandegaard JL, Rebolj M. The Danish National Patient Register. *Scand J Public Health* 2011;39(Suppl 7):30–33.
15. Schmidt M, Schmidt SA, Sandegaard JL, Ehrenstein V, Pedersen L, Sørensen HT. The Danish National Patient Registry: a review of content, data quality, and research potential. *Clin Epidemiol* 2015;7:449–90.
16. World Health Organization. *ICD-10: International Statistical Classification of Diseases and Related Health Problems: Tenth Revision*. Geneva: World Health Organization. 2004. Report No.: 9241546492 (v.1)
17. Flachs EM, Petersen SEB, Kolstad HA *et al.* Cohort Profile: DOCX: a nationwide Danish occupational cohort with eXposure data an open research resource. *Int J Epidemiol* 2019;48:1413–13.
18. Schmidt M, Pedersen L, Sørensen HT. The Danish Civil Registration System as a tool in epidemiology. *Eur J Epidemiol* 2014;29:541–49.
19. Hjollund NH, Larsen FB, Andersen JH. Register-based follow-up of social benefits and other transfer payments: accuracy and degree of completeness in a Danish interdepartmental administrative database compared with a population-based survey. *Scand J Public Health* 2007;35:497–502.
20. Mors O, Perto GP, Mortensen PB. The Danish psychiatric central research register. *Scand J Public Health* 2011;39:54–57.
21. Andersen JS, Olivarius NDF, Krasnik A. The Danish National Health Service Register. *Scand J Public Health* 2011;39:34–7.
22. Helweg-Larsen K. The Danish register of causes of death. *Scand J Public Health* 2011;39:26–29.
23. Kildemoes HW, Sørensen HT, Hallas J. The Danish National Prescription Registry. *Scand J Public Health* 2011;39:38–41.
24. Bonde JPE, Flachs EM, Madsen IE *et al.* Acute myocardial infarction in relation to physical activities at work: a nationwide follow-up study based on job-exposure matrices. *Scand J Work Environ Health* 2020;46:268–77.
25. Biering K, Hjollund NH, Lund T. Methods in measuring return to work: a comparison of measures of return to work following treatment of coronary heart disease. *J Occup Rehabil* 2013;23:400–05.
26. Jakobsen ELT, Biering K, Kærgaard A, Andersen JH. Neck-shoulder pain and work status among former sewing machine operators: a 14-year follow-up study. *J Occup Rehabil* 2018;28:80–88.
27. Kolstad HA, Christensen MV, Jensen LD, Schlünssen V, Thulstrup AM, Bonde JP. Notification of occupational disease and the risk of work disability: a two-year follow-up study. *Scand J Work Environ Health* 2013;39:411–19.