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ORIGINAL ARTICLE

Prevalence and consequences of spinal pain among people with type 1 and type 2 diabetes mellitus in Denmark

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Abstract

Purpose To describe 1-week and 1-year prevalence of spinal pain and its consequences in relation to leisure activity, work-life, and care-seeking in people with type 1 and 2 diabetes mellitus (DM).

Methods A cross-sectional survey including adults diagnosed with DM from two Danish secondary care centres. Using the Standardised Nordic Questionnaire, spinal pain prevalence (cervical, thoracic, lumbar) and its consequences were evaluated (proportions, 95% confidence intervals) and compared to the general population.

Results Among 3767 people, 1-week and 1-year spinal pain prevalence were 11.6–32.4 and 18.5–49.6%, respectively, highest for lumbar pain (24.6–49.6%). The prevalence was similar between DM types for cervical and thoracic pain, but higher in type 2 for lumbar spine. Women had higher pain prevalence across spinal regions and DM types, while cervical and thoracic pain estimates were higher for age < 60 vs. ≥ 60. Within the past year, > 50% reported pain > 30 days, high proportions had reduced their activities (leisure time, 43.7–63.9%; work, 20.7–33.3%), 13.3–28.1% reported sick-leave > 30 days, and 44.3–48.5% had sought care due to spinal pain.

Conclusion Spinal pain is common in people with type 1 and 2 DM, resulting in considerable consequences for work/leisure activities, sick-leave, and healthcare utilisation as compared to the general population.

Keywords Diabetes mellitus · Spinal pain · Spine · Work-life

Introduction

Diabetes mellitus (DM) is a chronic disease characterised by high blood glucose levels, affecting one in 10 adults worldwide [1]. In Denmark, one in 20 adults suffered from DM in 2018, while the prevalence is expected to almost double by 2030 [2, 3]. The two main types of DM include the autoimmune type 1 with absolute insulin insufficiency and type 2 with insulin resistance [4]. Type 2 DM accounts for the majority of cases (85–95%) in high-income countries [1], and physical inactivity and obesity are among commonly known risk factors [5, 6].

DM is associated with comorbidities and medical complications that increase the risks of morbidity and mortality [7], which in turn negatively impact the individual's quality of life [8]. Musculoskeletal (MSK) pain is more common in people with DM compared with the general population [9–11]. DM is associated with a range of common MSK conditions such as osteoarthritis, fragility fractures, neuropathy, and rheumatoid arthritis [12–15]. Even though there is an

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increased incidence of rare spine diseases such as epidural abscess and vertebral osteomyelitis in DM, more common disorders that cause chronic back pain such as lumbar disc degeneration, spinal stenosis and generally reduced joint mobility have also been linked to DM [16, 17]. Less known, however, is whether people with DM also suffer from more common non-specific spinal pain that are endemic in the general population [18].

In Denmark, more than half of the general population report MSK pain during the past 14 days, and cervical and lumbar pain contribute with the largest disease burden—e.g. being one of the main causes of long-term sick leave, early retirement as well as hospital admissions and visits to general practitioners [18, 19].

Previous studies indicate that people with DM report spinal pain more frequently than people without DM, but these studies do not consider DM types, or do not focus on specific pain sites [9, 12]. Physical activity and exercise is recommended for people with DM, but MSK pain is a known barrier to being physically active [20]. Furthermore, having chronic diseases and additional MSK pain can result in a higher healthcare load and treatment burden, but it is unknown [21].

The aim of the present study is to describe the prevalence and characteristics of pain in the spine (cervical, thoracic, lumbar) in people with type 1 and 2 DM from two large Danish secondary DM care centres. Secondly, to describe the consequences of this pain in relation to physical activity during leisure time and at work, and care-seeking behaviour. Finally, to compare the spinal pain prevalence and consequences to a population-based reference cohort from the Danish Twin Registry, because spinal pain is common in the general population [22, 23].

Subjects, materials and methods

Study design

This is a cross-sectional survey based on clinical cohorts recruited through two large secondary DM care centres in the Region of Southern Denmark, Denmark. The manuscript is in line with the Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals, and the reporting adheres to the Strengthening the Reporting of Observational Studies in Epidemiology guidelines for cross-sectional studies (STROBE).

Population

People ≥ 18 years diagnosed with type 1 and 2 DM and registered in two large Danish hospitals (Hospital South West Jutland and Odense University Hospital) were invited to participate. This cohort has been described in detail elsewhere [24], but below we present the data collection and procedures relevant for the current study. The Danish Twin Registry was founded in 1953 and holds data on more than 75,000 twin pairs born from 1870 to 2004. In 2002, all twins born between 1931 and 1982, who had previously consented to take part in research, were sent a 20-page questionnaire including questions from many different research groups [23]. The cohort is similar to the general population in many aspects and can be successfully used in epidemiologic studies [25].

Procedure/data collection

A survey was distributed through Odense Patient Exploratory Network (OPEN) via the official Danish electronic mail distribution system (e-Boks), used by 91.7% of Danish residents for their secured digital mail. Responses were captured using a REDCap database. The questionnaire consisted of the Standardised Nordic Questionnaire [26] and questions about education, occupation, physical job exposures, and physical activity at work and during leisure time. The first section of the Standardised Nordic Questionnaire [26] has 40 items identifying body regions causing MSK pain/trouble at nine symptom sites (including cervical, thoracic, and lumbar spine) during the past 12 months and the past 7 days interfering with normal daily activity [26]. The second covers functional impact at home and work, duration of the problem, and care-seeking behavior [26]. Additional information was collected from the diabetes registries, including DM type, gender, age, and body mass index.

The Danish Board of Health and the Danish Patient Safety Authority approved access to the two clinical cohorts (file 3-30132031/1). The study was conducted according to the Declaration of Helsinki, and all participants provided informed consent prior to participation.

Variables

Statistics Denmark generated the age and gender of everyone in the sample frame before scrambling the CPR number. Using the last discharge diagnosis recorded in the Danish National Patient Register, which records all hospital, emergency room, and ambulatory secondary care clinic encounters, the DM type was determined using the ICD10 codes: E10.XX for type 1 DM, E.11.XX for type 2, E13.XX for secondary DM and E14.XX for unspecified DM. The quality of the register is high, and the level of incorrect discharge diagnosis is below 3% [27].

Statistical analysis

Participant characteristics were presented using n (proportion). The prevalence of MSK pain was presented using n (proportion) with a 95% Confidence Interval (CI). The prevalence of pain in the three different body regions (cervical, thoracic, lumbar) was estimated separately for type 1 and 2 DM and presented by gender (men or women) and age (< 60 or ≥ 60 years). Using the ICD10 codes, type 1 DM and secondary DM were pooled, and unspecified DM was excluded from this analysis. The consequences of pain in the three body regions were estimated using n (proportion) with a 95% CI and presented separately for type 1 and 2 DM and combined. Between-group comparisons were made using the 95% CI, and comparison with the population reference from the Danish Twin Registry was made visually using bar charts with 95% CI, with level of statistical significance at 5% [22, 23]. Non-response for prevalence questions (i.e., empty cells) was considered a negative answer (i.e., not having pain), a common and accepted approach in other Danish register-based studies such as the Danish Twin Registry [22, 28, 29]. Consequences were presented for people reporting pain in the site of interest. Stata (StataCorp LLC, Texas, USA) version 17.0 was used for the statistical analyses.

Results

We distributed the questionnaire to 10,582 people with DM, and data from 3767 people were analysed (36.0% response rate) (Fig. 1). Men accounted for 59.8% of the sample, and most of the people were between 51 and 70 years (Table 1) [24]. Participants with type 1 DM accounted for 43.2% of the cohort, and participants with type 2 DM tended to have lower educational level and be less physically active than participants with type 1 DM.

Prevalence of spinal pain in the DM cohorts

Spinal pain was common in people with DM (Table 2). The 1-week prevalence across spinal regions ranged from 11.6% (thoracic) to 24.6% (lumbar) (type 1 DM) and from 13.5% (thoracic) to 32.4% (lumbar) (type 2 DM). The 1-year prevalence across spinal regions for all participants ranged from 18.5% (thoracic) to 49.6% (lumbar). Lumbar pain had the significantly highest 1-week (24.6%) and 1-year (49.6%) prevalence. The prevalence was similar between type 1 and 2 DM for cervical and thoracic pain, but significantly higher in type 2 for the lumbar spine (1-week 24.6 vs. 32.4%, 1-year 41.3 vs. 49.6%). Women had significantly higher pain prevalence for any spinal region for both DM types, while estimates were significantly higher for cervical and thoracic pain for participants < 60 years compared with ≥ 60 years. Of

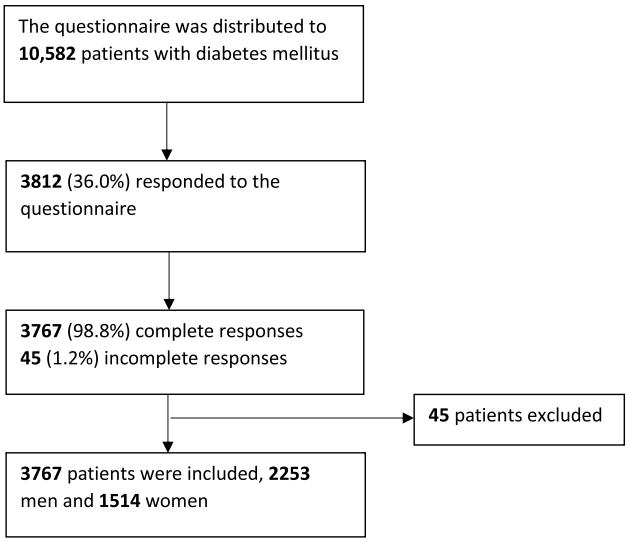

Fig. 1 Flow chart of the participant inclusion process

all participants, 51.5–53.4% reported having pain for more than 30 days within the past year, and significantly more participants with type 2 DM reported more than 30 days of spinal pain in all three regions compared to those with type 1 DM (Table 3).

Comparison to population reference

People with type 1 and 2 DM had significantly higher prevalence of cervical and thoracic pain than the population reference, while the prevalence was significantly higher for lumbar pain in people with type 2 DM but not type 1 DM (Fig. 2).

Consequences of spinal pain

Spinal pain considerably impacted leisure time, work, and care-seeking behavior in the DM cohorts (Table 3). A high proportion of participants reported that they reduced their activities at work (20.7–33.3%) or leisure time (43.7–63.9%), and the proportions at leisure time were significantly higher for type 2 DM compared with type 1 DM (Table 3). Change of work tasks was also significantly higher for type 2 DM for thoracic and lumbar pain. Generally, significantly more participants with type 2 DM than participants with type 1 DM reported that spinal pain across the 3 regions caused them to be unable to work at more than 30 occasions during the past year. Almost one-half of all participants had sought care due to spinal pain during the past year, most commonly thoracic pain (48.5%) and least commonly for cervical pain (44.3%). Consequences of pain in people with both DM types across all spine regions were significantly higher than the general

Tabel 1 Characteristics of study population (number (%))

Characteristic	Diabetes mellitus combined ($n=3767$)	Diabetes mellitus type 1 ($n=1626$)	Diabetes mellitus type 2 ($n=2141$)
Gender			
Men	2253 (59.81)	889 (54.67)	1364 (63.71)
Women	1514 (40.19)	737 (45.33)	777 (36.29)
Age group			
18–30	249 (6.61)	216 (13.28)	33 (1.54)
31–40	292 (7.75)	219 (13.47)	73 (3.41)
41–50	586 (15.56)	339 (20.85)	247 (11.54)
51–60	957 (25.40)	387 (23.80)	570 (26.62)
61–70	1065 (28.27)	325 (19.99)	740 (34.56)
70+	618 (16.41)	140 (8.61)	478 (22.33)
BMI			
Underweight (< 18.5)	29 (0.77)	20 (1.23)	9 (0.42)
Normal or healthy weight (18.5 to 24.99)	898 (23.84)	668 (41.08)	230 (10.74)
Overweight (25 to < 30)	1223 (32.47)	566 (34.81)	657 (30.69)
Obese (≥ 30)	1351 (35.86)	298 (18.33)	1053 (49.18)
Not reported	266 (7.06)	74 (4.55)	192 (8.97)
Smoking			
Never smoked	1530 (40.62)	770 (47.36)	760 (35.50)
Ex-smoker	1334 (35.41)	494 (30.38)	840 (39.23)
Smoker	523 (13.88)	242 (14.88)	281 (13.12)
Not reported	380 (10.09)	120 (7.38)	260 (12.14)
Education			
Primary and lower secondary	661 (17.55)	203 (12.48)	458 (21.39)
Secondary or vocational education	651 (17.28)	311 (19.13)	340 (15.88)
Short-term higher education	1,151 (30.55)	494 (30.38)	657 (30.69)
Medium-term higher education	691 (18.34)	358 (22.02)	333 (15.55)
Long-term higher education	225 (5.97)	134 (8.24)	91 (4.25)
Not reported	388 (10.30)	126 (7.75)	262 (12.24)
Physical activity min/week			
0 min/no activity	606 (16.09)	220 (13.53)	386 (18.03)
< 30	937 (24.87)	382 (23.49)	555 (25.92)
30–59	664 (17.63)	285 (17.53)	379 (17.70)
60–89	378 (10.03)	192 (11.81)	186 (8.69)
90–120	331 (8.79)	171 (10.52)	160 (7.47)
> 120	459 (12.18)	245 (15.07)	214 (10.00)
Not reported	392 (10.41)	131 (8.06)	261 (12.19)

n Number; *BMI* body mass index

population reference both without and with spinal pain (Fig. 3a–c).

Discussion

In this questionnaire study covering 3767 people from two large secondary care centers in the Region of Southern Denmark, spinal pain was common in people with type 1 and 2 DM, with lumbar pain having the highest prevalence and more frequently reported in type 2 DM as compared to type 1 DM. Women had a higher pain prevalence for any spinal region for both DM types, while estimates were higher for cervical and thoracic pain for people < 60 years compared with ≥ 60 years. Spinal pain considerably impacted people´s leisure time, work life, and healthcare utilisation. A larger proportion of people with type 2 DM and spinal pain experienced pain-related consequences.

People with DM reported a significantly higher prevalence of spinal pain when compared to a Danish population-based cohort. In the Danish Twin registry study of 34,902 Danish adults aged 20–71 using the same questionnaire (i.e.

Table 2 Prevalence of spinal pain in people with type 1 and 2 diabetes mellitus by gender and age

Body region	Men *n* (%, 95% CI)	Women *n* (%, 95% CI)	< 60 years *n* (%, 95% CI)	60 years or above *n* (%, 95% CI)	Total *n* (%, 95% CI)
Type 1 diabetes mellitus	(*n* = 889)	(*n* = 737)	(*n* = 1125)	(*n* = 501)	(*n* = 1626)
Cervical					
Past 12 months	235 (26.4, 23.6; 29.4)	336 (45.6, 42.0; 29.2)	431 (38.3, 35.5; 41.2)	140 (27.9, 24.2; 32.0)	571 (35.1, 32.8; 37.5)
Past 7 days	135 (15.2, 13.0; 17.7)	209 (28.4, 25.2; 31.7)	258 (22.9, 20.6; 25.5)	86 (17.2, 14.1; 20.7)	344 (21.2, 19.2; 23.2)
Thoracic					
Past 12 months	121 (13.6, 11.5; 16.0)	179 (24.3, 21.3; 27.5)	230 (20.4, 18.2; 22.9)	70 (14.0, 11.2; 17.3)	300 (18.5, 16.6; 20.4)
Past 7 days	68 (7.6, 6.1; 9.6)	120 (16.3, 13.8; 19.1)	140 (12.4, 10.6, 14.5)	48 (9.6, 7.3; 12.5)	188 (11.6, 10.1; 13.2)
Lumbar					
Past 12 months	309 (34.8, 31.7; 38.0)	363 (49.3, 45.7; 52.9)	450 (40.0, 37.2; 42.9)	222 (44.3, 40.0; 48.7)	672 (41.3, 39.0; 43.7)
Past 7 days	177 (19.9, 17.4; 22.7)	223 (30.3, 27.0; 33.7)	263 (23.4, 21.0; 25.4)	137 (27.3, 23.6; 31.4)	400 (24.6, 22.6; 26.8)
Type 2 diabetes mellitus	(*n* = 1364)	(*n* = 777)	(*n* = 859)	(*n* = 1282)	(*n* = 2141)
Cervical					
Past 12 months	429 (31.5, 29.0; 34.0)	318 (40.9, 37.5; 44.4)	370 (43.1, 39.8; 46.4)	377 (29.4, 27.0; 32.0)	747 (34.9, 32.9; 36.9)
Past 7 days	256 (18.8, 16.8; 20.9)	207 (26.6, 23.6; 29.9)	221 (25.7, 22.9; 28.8)	242 (18.9, 16.8; 21.1)	463 (21.6, 19.9; 23.4)
Thoracic					
Past 12 months	235 (17.2, 15.3; 19.3)	203 (26.1, 23.2; 29.3)	220 (25.6, 22.8;28.6)	218 (17.0, 15.0;19.2)	438 (20.5, 18.8; 22.2)
Past 7 days	143 (10.5, 9.0; 12.2)	147 (18.9, 16.3; 21.8)	153 (17.8, 15.4; 20.5)	137 (10.7, 9.1; 12.5)	290 (13.5, 12.2; 15.1)
Lumbar					
Past 12 months	635 (46.6, 43.9; 49.2)	426 (54.8, 51.3;58.3)	430 (50.1, 46.7; 53.4)	631 (49.2, 46.5; 52.0)	1,061 (49.6, 47.4; 51.7)
Past 7 days	400 (29.3, 27.0; 31.8)	294 (37.8, 34.5; 41.3)	277 (32.2, 29.2; 35.5)	417 (32.5, 30.0; 35.1)	694 (32.4, 30.5; 34.4)

n number of participants, *CI* Confidence Interval. In Table 2, non-response was considered as no pain

Standardised Nordic Questionnaire [26]), the overall pain prevalence within the past year was most frequently reported for the lumbar spine (43%), which is similar to the 43.9% reported for the Dutch population [23, 30]. This is comparable to the prevalence of lumbar pain in people with type 1 DM (41.3%) in our study, but lower than what we saw in people with type 2 DM in our study (49.6%) [23]. Cervical pain was reported by 30% in Danish adults and 31.4% in Dutch adults, which were lower than what was reported in our study for people with type 1 and type 2 DM (35.1 and 34.9% respectfully) [23, 30]. Thoracic pain was reported by 13% in Danish adults and 18.8% in Dutch adults, which were lower than both DM types (18.5 and 20.5%). When comparing our data with population-based samples of Danish adults using different definitions and methodologies, the prevalence in people with DM is considerably higher [31].

In our recent study, MSK pain in the upper and lower extremities on the same diabetes cohort was presented [29]. The 1-week prevalence in type 1 DM was highest for the shoulder (30.8%) and hand (23.0%), which were higher than lumbar pain (24.6%) and cervical pain (21.2%). For type 2, the highest 1-week prevalence estimates were reported for the shoulder (30.5%), ankle (29.8%), and knee (28.2%), comparable with lumbar pain (32.4%), but lower for the cervical pain (21.6%). The 1-year prevalence in type 1 DM was highest for the shoulder (41.8%), followed by the lumbar spine (41.3%), cervical spine (35.1%), hand and knee (both 32.2%), and ankle (29.6%). For type 2 DM, the highest prevalence was reported for the lumbar spine (49.6%), followed by the shoulder (40.5%), knee (40.3%), ankle (38.1%), and cervical spine (34.9%). Similar to our findings, a higher proportion of women reported MSK pain compared with men in populations with DM [9, 29, 31]. The higher prevalence of pain in women compared with men is in line with results from other studies of the general populations [32, 33]. Our findings add to the growing evidence—with caveats related to variations in the estimates across gender and age groups—that MSK pain is very common in people with DM.

Besides looking at the prevalence of pain, it is also important to compare symptom duration and chronicity. In our data, a substantially higher proportion reported having had lumbar pain for more than 30 days during the past 12 months than in the general population (58.6 vs. 12%) [22, 23]. The same pattern was observed for both cervical and thoracic pain regions (cervical 57.2 vs. 10%, thoracic 56.9 vs. 4%) [22, 23]. These data indicate that people with DM and concomitant spinal pain have more persistent pain than in the general population.

A relatively high proportion of people in our study reported that spinal pain influenced their ability to be physically active during leisure time (ranging from 43.7 to 63.9% across body regions for the total group) and at work

Table 3 Duration and consequences of spinal pain in participants with diabetes mellitus type 1, type 2 and combined

Outcome	Cervical *n* (%, 95% CI)	Thoracic *n* (%, 95% CI)	Lumbar *n* (%, 95% CI)
Type 1 diabetes mellitus			
Days with pain the past year			
0–7 days	117 (20.5, 17.4; 24.0)	73 (24.4, 19.9; 29.6)	137 (20.4, 17.5; 23.6)
8–30 days	149 (26.1, 22.6; 29.9)	72 (24.1, 19.6; 29.3)	181 (26.9, 23.7; 30.4)
> 30 days	305 (53.4, 49.3; 57.5)	154 (51.5, 45.8; 57.1)	354 (52.7, 48.9; 56.4)
Reduced activity in the past year			
Leisure time	232 (41.9, 37.8; 46.0)	144 (49.5, 43.7; 55.2)	389 (60.2, 56.4; 63.9)
At work	115 (21.8, 18.5; 25.6)	79 (29.3, 24.1; 35.0)	189 (32.4, 28.7; 36.3)
Care-seeking the past year	259 (45.7, 41.6; 49.8)	146 (49.0, 43.3; 54.7)	305 (45.8, 42.0; 49.6)
Change of work tasks	125 (16.3, 13.9; 19.0)	96 (23.9, 20.0; 28.4)	258 (28.9, 26.0; 32.0)
Sick leave			
0 days	351 (62.3, 58.3; 66.3)	136 (45.8, 40.2; 51.5)	284 (43.0, 39.3; 46.8)
1–7 days	103 (18.3, 15.3; 21.7)	53 (17.8, 13.9; 22.6)	126 (19.1, 16.3; 22.3)
8–30 days	46 (8.2, 6.2; 10.7)	51 (17.2, 13.3; 21.9)	111 (16.8, 14.1; 19.9)
> 30 days	63 (11.2, 8.8; 14.1)	57 (19.2, 15.1; 24.1)	139 (21.1, 18.1; 24.3)
Type 2 diabetes mellitus			
Days with pain the past year			
0–7 days	136 (18.3, 15.7; 21.2)	68 (15.6, 12.4; 19.3)	164 (15.5, 13.4; 17.8)
8–30 days	161 (21.6, 18.8; 24.7)	104 (23.8, 20.0; 28.0)	235 (22.2, 19.8; 24.8)
> 30 days	447 (60.1, 56.5; 63.5)	265 (60.6, 56.0; 65.1)	661 (62.4, 59.4; 65.2)
Reduced activity in the past year			
Leisure time	320 (45.2, 41.6; 48.9)	271 (65.5, 60.7; 69.9)	663 (66.2, 63.2; 69.1)
At work	130 (19.7, 16.9; 22.9)	130 (35.7, 30.9; 40.8)	298 (33.8, 30.8; 37.0)
Care-seeking the past year	319 (43.2, 39.6; 46.8)	209 (48.2, 43.5; 52.9)	458 (43.9, 40.9; 46.9)
Change of work tasks	158 (15.9, 13.7; 18.3)	179 (31.7, 28.0, 35.6)	439 (32.8, 30.4; 35.4)
Sick leave			
0 days	397 (54.9, 51.3; 58.5)	125 (29.5, 25.3; 34.0)	329 (32.1, 29.3; 35.0)
1–7 days	137 (18.9, 16.3; 22.0)	77 (18.2, 14.8; 22.1)	176 (17.2, 15.0; 19.6)
8–30 days	81 (11.2, 9.1; 13.7)	86 (20.3, 16.7; 24.4)	187 (18.2, 16.0; 20.7)
> 30 days	108 (14.9, 12.5; 17.7)	136 (32.1, 27.8; 36.7)	334 (32.6, 29.8; 35.5)
Diabetes mellitus combined			
Days with pain the past year			
0–7 days	253 (19.2, 16.5; 22.2)	141 (19.2, 16.5; 22.2)	301 (17.4, 15.7; 19.2)
8–30 days	310 (23.6, 21.4; 25.9)	176 (23.9, 21.0;27.1)	416 (24.0, 22.1; 26.1)
> 30 days	752 (57.2, 54.5; 59.8)	419 (56.9, 53.3; 60.5)	1,015 (58.6, 56.3; 60.9)
Reduced activity in the past year			
Leisure time	552 (43.7, 41.0; 46.5)	415 (58.9, 55.2; 62.4)	1,052 (63.9, 61.5; 66.2)
At work	245 (20.7, 18.4; 23.1)	209 (33.0, 29.4; 36.7)	487 (33.3, 30.9; 35.7)
Care-seeking the past year	578 (44.3, 41.6; 47.0)	355 (48.5, 44.9; 52.1)	763 (44.6, 42.3; 47.0)
Change of work tasks	283 (16.0, 14.4; 17.8)	275 (28.5, 25.7; 31.4)	697 (31.3, 29.4; 33.2)
Sick leave			
0 days	748 (58.2, 55.4; 60.8)	261 (36.2, 32.8; 39.8)	613 (36.4, 34.1; 38.7)
1–7 days	240 (18.7, 16.2; 20.9)	130 (18.0, 15.4; 21.0)	302 (17.9, 16.2; 19.8)
8–30 days	127 (9.9, 8.4; 11.6)	137 (19.0, 16.3; 22.0)	298 (17.7, 15.9; 19.6)
> 30 days	171 (13.3, 11.5; 15.3)	193 (26.8, 23.7; 30.1)	473 (28.1, 26.0; 30.2)

CI Confidence Interval

(20.7–33.3%), and many sought care (44.3–48.5%). The consequences of spinal pain in the general population in Denmark has been scrutinised, allowing us to make direct comparisons [22]. In the general population, reduced daily activities was reported by 4–17%, and 6–17% had sought care because of spinal pain, which are considerably lower

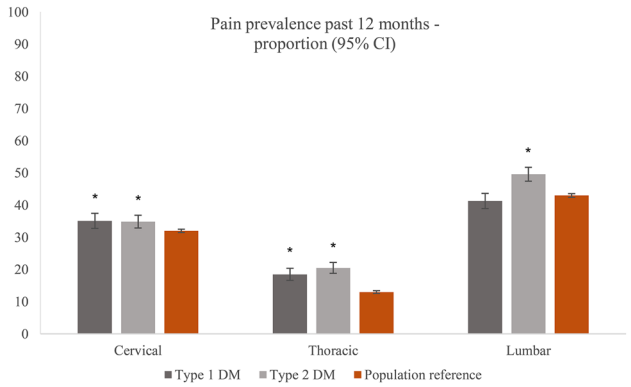

Fig. 2 Pain prevalence past 12 months in participants with type 1 and type 2 diabetes mellitus (DM) compared with population reference [23]. *Denotes statistically significant difference ($p < 0.05$) compared with population reference

estimates than in our cohort. Furthermore, 2–8% changed work or work duties in the general population compared with 16.0–31.3% in our study. Looking at people without DM with spinal pain [22], 38–40% reported care-seeking within the last 12 months, and the proportion was 42.2% in a large Dutch study, [30] compared with 44.3–48.5% in our study. However, 23% (any duration) [22] and 6.1% (duration > 4 weeks) [30] of the populations without DM with spinal pain reported sick leave during the last 12 months because of lumbar pain compared with our findings, where 28.1% were prevented from working > 30 days during the last 12 months, again highlighting that although pain prevalence might be similar in (a) the general population, (b) people without DM with spinal pain, and (c) people with DM and spinal pain, the consequences have greater impact on the individual's life and may last longer for the latter group. Besides being a potential obstacle to physical activity, MSK pain can negatively impact multiple aspects of patient health, including cognitive processes and brain function, mood/mental health, sleep, cardiovascular health, and quality of life [34]. An individual with both DM and MSK pain (i.e. multimorbidity) has a greater risk of poorer function, quality of life, increased healthcare utilisation, and premature death, and in people with back pain an increasing number of comorbidities is associated with poorer short-term and long-term pain and functional outcomes [21, 35].

Our data support that clinicians should focus on identifying MSK pain/limitations in people with DM, with particular

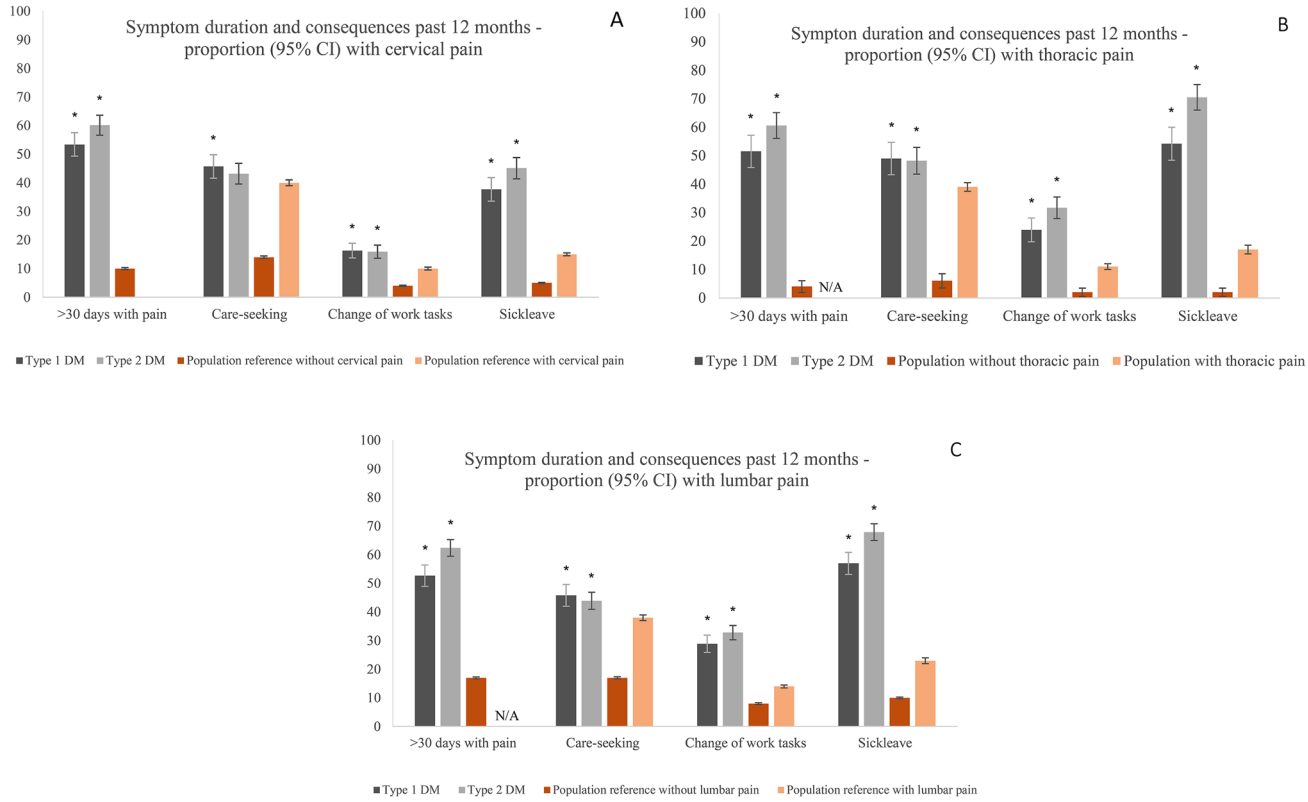

Fig. 3 Duration and consequences of cervical (**A**), thoracic (**B**) and lumbar (**C**) pain in the past 12 months in participants with type 1 and type 2 diabetes mellitus (DM) compared with a population reference with and without spinal pain [22]. *Denotes statistically significant difference ($p<0.05$) compared with population reference with and without spinal pain. *N/A = no available data*

focus on the different spine regions, DM types, gender, and age, due to the considerable prevalence and consequences for the individual. Person-centred care is recommended to manage multimorbidity, but there is still limited evidence to support any specific approach [21]. However, the complications may be reduced by identifying MSK problems early to promote physical activity—a cornerstone in the treatment of DM—[11, 12, 36, 37] and recent promising initiatives for the global treatment of multimorbidity have the potential to benefit people with DM and MSK pain in order to improve their self-care behaviors [21].

Limitations

This study has some limitations. The response rate was 36.0%, which is low but comparable with participation rates in surveys that have solely used e-Boks as their means of recruitment [38, 39]. As expected, the proportion of type 1 and type 2 DM did not represent the proportion of each type of DM in the general population (i.e., 85–95% with type 2 DM and 5–15% with type 1 DM), since all people were included from existing DM cohorts and not from the general population. Furthermore, our findings should be generalised to Danish people with DM with caution because (a) a recent analysis on the same cohort [24] found some non-responder bias (i.e., related to age, DM type, comorbidity burden, and socioeconomic status), (b) the people were included from two of many Danish secondary DM care centres, and (c) MSK pain is multifactorial meaning that other aspects than the combined DM and MSK pain could explain the differences in consequences. Another important caveat is that using non-response as a negative answer could result in an underestimation of spinal pain in the current study. However, our findings are important to determine the prevalence and consequences of MSK conditions in a secondary care DM population.

Conclusion

Spinal pain is common in people with type 1 and 2 DM from Denmark, leading to considerable consequences for leisure/work physical activity, sick-leave, and healthcare utilisation. A larger proportion of people with type 2 DM than type 1 DM is affected by the consequences of spinal pain. The prevalence of spinal pain in populations with DM is higher than in the general population, and people with both spinal pain and DM report more consequences of their pain, particularly in relation to work.

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Declarations

Conflict of interest The authors declare no conflict of interest.

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