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Original Article

Comorbidity of mental and musculoskeletal disorders in ageing women: A data linkage study using national registries

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ABSTRACT

Background: Mental disorders (MDs) and musculoskeletal disorders (MSDs) are the main causes of disability. Yet, their comorbidity has not received the deserved attention.
Objective: To investigate the extent of the comorbidity between MDs and MSDs in ageing women using national registries on prescription medications and work disability pensions (DPs).
Methods: The study included 7,809 Finnish women, born during 1932–41, from the population-based Kuopio Osteoporosis Risk Factor and Prevention Study (OSTPRE) cohort, established in 1989. Lifetime permanent DPs due to: 1) 'MDs only' ($n = 359$), 2) 'MSDs only' ($n = 954$), 3) 'MDs + MSDs' ($n = 227$), were recorded till 2003. The reference group was 'no DP' ($n = 6,269$). Data from the OSTPRE questionnaires was obtained in 1994. Use of medications was recorded in 1995 and 2003. The use of musculoskeletal or psychotropic medications by women having a DP or medication due to MD, or MSD diagnoses, respectively, was considered as an indicator of comorbidity.
Results: In 1995, all DP groups had used psychotropic and musculoskeletal medications more often than the referents. Use of musculoskeletal medications was associated with a higher use of psychotropic medications, and vice versa (OR=2.45; 95% CI 2.17–2.77), compared with non-use. The 'MSDs only' group was more likely to use psychotropic (OR=1.79; 95% CI 1.50–2.12), and the 'MDs only' group musculoskeletal medications (OR=1.38; 95% CI 1.09–1.74), compared with those without DPs. The proportions of medication users were similar in 1995 and 2003; however, the amounts used increased.
Conclusions: There was strong evidence for comorbidity between MDs and MSDs in ageing women. Further research concerning their longitudinal relationships is warranted.

1. Introduction

Multimorbidity – the presence of one or more co-existing long-term health conditions – increases with age [1]. It is not only linked with high functional disability [2], health care utilization and mortality [3], but also low life satisfaction [4] and poor quality of life [5]. Healthy ageing is a process of developing and maintaining functional ability that enables physical, mental and social wellbeing [6]. Thus, the rapid ageing of populations [7] emphasizes the need for a broader, rather than, a single-disease approach in research, medical education, health promotion, disease prevention and healthcare [8]. In our previous review, we have focused on the association between mental health (including subjective well-being) and common MSDs [8]. However, the extent of the comorbidity between mental disorders (MDs) and musculoskeletal disorders (MSDs) has been overlooked [8].

MDs (18.1%) and MSDs (15.9%) are the two leading causes of the global years lived with disability (YLDs), accounting for 34% of total YLDs in 2017 [9]. In Western countries, they are the leading causes of

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work disability, sick leave and unemployment [10]. In 2018, MDs and MSDs accounted for 51.4% and 19.5% of all permanent work disability pensions (DPs) amongst the Finnish population, respectively [11]. At working age, premature retirement due to permanent disability represents a severe form of disease, often preceded by a long sickness absence regardless of occupational class [12].

Reflecting the disease burden due to MDs, the use of psychotropic medications has been increasing [13,14], especially amongst older women [15]. Likewise, the overall use of prescribed medications for MSDs has been increasing [16]. Despite these increases, the extent to which people with MDs use musculoskeletal medications and people with MSDs use psychotropic medications (indicating comorbidity), have not been thoroughly explored.

In general, MDs could be either a precursor to, or a consequence of MSDs and other chronic conditions [17]. As the number of musculoskeletal and other physical morbidities increases, so does the prevalence of MDs, especially amongst women [1,18]. Furthermore, comorbid MDs are associated with decreased physical functioning, lower quality of life and other adversities such as mortality and high health care use [3,18,19]. Likewise, MSDs are also commonly comorbid with other chronic conditions and diseases [10] due to their high occurrence [20] and shared risk factors [21].

The World Health Organization (WHO) provides recommendations for treating patients with severe MDs suffering from major non-communicable diseases, but MSDs are yet to be considered [22]. Burgeoning evidence suggests that diagnosed MDs are linked with certain common MSDs, such as chronic back pain and low bone mineral density, but what is known regarding the overall comorbidity between MDs and MSDs is still emerging [8]. Thus, further research is needed to garner an appropriate public health response. The aim of the present study was to investigate the extent of the comorbidity between MDs and MSDs by using comprehensive registry-based data on DPs and prescribed medications in a large population-based sample of ageing women.

2. Methods

2.1. Study design and participants

The Kuopio Osteoporosis Risk Factor and Prevention Study (OSTPRE) is a population-based cohort study, which was launched in 1989, capturing all (n = 14,220) women born during 1932–41, who were residing in Kuopio Province, Eastern Finland. Data has been collected by postal enquiries at 5-year intervals and through linkage with several national health registries.

Our study sample included a total of 7809 women (aged 52–61 years) from the OSTPRE cohort, who responded (response rate: 88%) to the postal enquiry in 1994, were alive until 2003 and had relevant linked national register data recorded (see Section 2.3). Specifically, the present study used questionnaire data from 1994 (T_Q) and registry data on prescriptions from 1995 (T_{R1}) (the first year of its complete data) and 2003 (T_{R2}), when even the youngest participants had reached the age entitling an old-age pension in Finland, which supersedes eligibility to receive a new DP. Over 80% of the participants, who had become recipients of a premature DP, had received it by the end of 1995 (T_{R1}) (Fig. 1).

All participants provided a written informed consent, and the study was approved by the Ethics Committee of Kuopio University Hospital.

2.2. Questionnaire data

In 1994 (T_Q), participants completed a self-reported questionnaire including information on the presence and number of lifetime chronic physician-diagnosed health disorders and currently used prescribed medications. Self-rated health was recorded as: 1) very good; 2) good; 3) fair; 4) rather poor; and 5) poor. Body mass index (BMI) was determined as kg/m^2. Current smoking status was used as a two categorical variable (yes/no), and total alcohol consumption (drinks/month, one drink corresponding to 12 gs of ethanol) was treated either as a continuous or a three categorical variable: 1) no alcohol use (i.e. 0 drinks per month); 2) moderate use (i.e. 1–27 drinks per month); and 3) high use (i.e. 28 or more drinks per month).

2.3. Register data

Using personal identification numbers, the OSTPRE questionnaire data was linked with data from two national registries: the National Register for Pensions [23] and the Finnish Prescription Register (FPR) [24].

2.3.1. National register for pensions

All pensions due to disability (DPs) administered since the 1950′s (i.e. since the early adulthood of the participants) have been classified according to the International Statistical Classification of Diseases (ICD) 8–10. ICD codes 290–319 (ICD 8–9) and F00–F99 (ICD–10) correspond

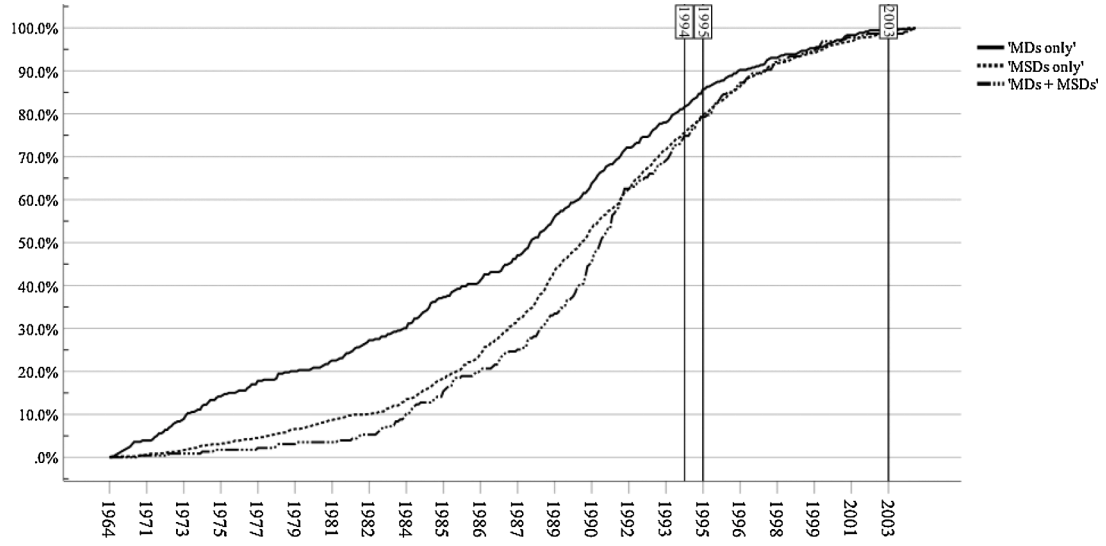

Fig. 1. Cumulative percent distribution of received lifetime disability pensions (DPs) by DP status in 1964–2003.
Abbreviations: MDs = mental disorders; MSDs = musculoskeletal diseases; DP = permanent work disability pension.
Questionnaire data in 1994 (T_Q); Registry data in 1995 (T_{R1}); Registry data in 2003 (T_{R2}).

to DPs relating to MDs and codes 710–739 and M00–M99 to MSDs, respectively. For this study, DPs from 1964 till the end of 2003 were used and categorized into: 1) 'MDs only'; 2) 'MSDs only'; 3) 'MDs + MSDs'; and 4) 'no DP' (the reference group). Women with DPs due to other health disorders ($n = 3529$) were excluded.

2.3.2. Finnish Prescription Register (FPR)

The FPR contains data from all reimbursed prescription medications purchased in any pharmacy in Finland since 1995. Medications were classified according to the Anatomical Therapeutic Chemical (ATC) codes. In the present study we used ATC codes N05/N06 ("psycholeptics/psychoanaleptics") and N05C ("hypnotics and sedatives") for psychotropic medications, and M ("musculoskeletal medicines") and M01 ("anti-inflammatory and anti-rheumatic medicines") for musculoskeletal medications [25]. Participants were considered as medication users if they made a purchase of and received reimbursement for the medications (as above) in 1995 (T_{R1}) or 2003 (T_{R2}). Medication use was treated both as a dichotomous (yes/no) and a continuous variable [i.e. as defined daily doses (DDDs)], with 1 DDD corresponding to an average of one-day use.

2.3.3. Comorbidity indicators

Register data was used to examine specific indicators of the extent of comorbidity between MDs and MSDs. The indicators were:

1) concurrent use of musculoskeletal and psychotropic medications;
2) belonging to 'MDs only' group and using musculoskeletal medications;
3) belonging to 'MSDs only' group and using psychotropic medications; and
4) belonging to 'MDs + MSDs' group, regardless of medication use

2.4. Statistical analyses

The SPSS statistical package 25.0 for Macintosh (SPSS Inc., Chicago, IL, USA) was used for all statistical analyses.

Descriptive statistics were used to calculate the proportion of participants by DP status and the cumulative percent distribution of received DPs by year (Fig. 1). Chi-squared test or Fisher's exact test for categorical, and Mann-Whitney U test for continuous variables were used to examine differences by DP status, according to study characteristics derived from the questionnaire data. (Table 1).

Chi-squared and Mann-Whitney U tests were used to examine medication use (Y/N) and DDDs by DP status, respectively (Table 2). In DDD analyses, those with no medication purchases were excluded.

Crude and adjusted risk estimates were computed with logistic regression models [odds ratios (ORs)] with 95% confidence intervals (95% CIs) to examine factors related to medication use (Tables 3 and 4). Logistic regression models (ORs; 95% CIs) were also performed to investigate specific indicators of comorbidity between MDs and MSDs (Tables 3 and 4). Adjusted models were used to control for possible confounding of age and BMI.

3. Results

3.1. Study population characteristics by disability pension status

A total of 80.3% (6269/7809) of the participants had no lifetime DP, while 12.2% (954/7809) had a permanent DP due to 'MSDs only', 4.6% (359/7809) due to 'MDs only' and 2.9% (227/7809) due to 'MDs + MSDs'.

Participants with DPs had higher BMI, poorer self-rated health and reported more physician-diagnosed diseases and currently used prescription medications than participants without DPs in 1994 (Table 1; all $p \leq 0.001$). Participants in the 'MDs only' group were more often current smokers and consumed more alcohol than those with no DPs, whereas the 'MSDs only' group consumed less alcohol (all $p \leq 0.001$) but had similar smoking status as the reference group (Table 1).

Table 1
Study characteristics according to the questionnaire data (T_Q) by lifetime disability pension (DP) status.

CHARACTERISTICS (T_Q)	DISABILITY PENSION STATUS 'no DP'(n = 6269)	'MDs only'(n = 359) $^{p1, p2}$	'MSDs only'(n = 954)^{p1}	'MDs + MSDs'(n = 227)^{p1}
Age, mean (SD)	57.0 (2.9)	57.1 (2.8)$^{ns, *}$	57.5 (2.9)***	56.6 (2.8)^{ns}
BMI, mean (SD)	26.6 (4.0)	28.5 (5.6)$^{***, ns}$	27.7 (4.3)***	28.1 (4.8)***
Current smoker, n (%)	551 (13.9%)	56 (23.3%)$^{***, ***}$	90 (14.2%)^{ns}	33 (21.0%)*
Alcohol consumption (drinks/month), mean (SD)	5.0 (9.6)	6.4 (16.1)$^{***, ns}$	3.9 (7.3)***	4.7 (7.7)^{ns}
Alcohol consumption (drinks/month), excluding non-users, mean (SD)	10.8 (13.7)	20.4 (29.5)$^{ns, ns}$	9.9 (10.3)^{ns}	11.7 (11.4)^{ns}
No. of diseases, mean (SD)	1.3 (0.9)	2.1 (1.5)$^{***, ns}$	2.1 (1.3)***	2.7 (1.6)***
No. of currently used prescribed medications, mean (SD)	0.9 (1.2)	2.2 (1.7)$^{***, ***}$	1.8 (1.6)***	2.2 (1.7)***
Self-rated health, mean (SD)	2.3a), (0.8)	3.1b) (0.9)$^{***, **}$	3.3b) (0.9)***	3.3b) (0.8)***

Abbreviations: DP = permanent work disability pension (lifetime since 1964 to 2003); T_Q = Questionnaire-based data in 1994; MDs = mental disorders, MSDs = musculoskeletal diseases.
BMI = body mass index (kg/m^2); IQR = interquartile range; no. = number.
p_1 = p-value with reference group 'no DP'; p_2 = p-value for the difference between the groups 'MSDs only' and 'MDs only'.
ns = non-significant i.e. p>0.05; * = $p \leq 0.05$; ** = $p \leq 0.01$; *** = $p \leq 0.001$.
[a)]corresponding 'good' self-rated health.
[b)]corresponding 'fair' self-rated health.
Tests: Mann-Whitney U test for continuous variables, chi-square for categorical variables.

3.2. Medication use

In 1995 (T_{R1}), 17.3% (1353/7809, c.f. Table 2) of all the participants had used psycholeptics/psychoanaleptics (ATC codes: N05/N06) and 8.7% hypnotics and sedatives (N05C), whereas 28.3% of all the participants had used musculoskeletal medications (M), and 26.4% anti-inflammatory and anti-rheumatic medications (M01).

The proportions of medication users differed significantly between the 'MDs only' (range: 25–66%) and 'MSDs only' (range: 12–48%) groups (all $p \leq 0.001$) (Table 2). These proportions were higher in all the DP groups than in the reference group (range: 7–25%) ($p \leq 0.001$, except for M01 in 'MDs only' $p \leq 0.01$) (Table 2).

The medication users in the 'MDs only' group had higher mean DDDs across all the examined medication classes than users with no DPs ($p \leq 0.001$, except for M01 in 'MDs only' $p \leq 0.05$). In the 'MSDs only' group, only the DDDs of musculoskeletal medication users were significantly higher ($p \leq 0.001$) than those of the users in the reference group (Table 2).

The number of medication users remained similar at T_{R1} and T_{R2}, but the mean DDDs increased, regardless of medications class or DP status (Fig. 2).

3.3. Comorbidity

In crude logistic regression analyses on medication use at T_{R1}, the use of musculoskeletal medications (M) was associated with a higher use of

Table 2.
Number of medication users (Y/N) and mean defined daily doses (DDDs) (T_{R1}) by lifetime disability pension (DP) status.

MEDICATION CLASS (ATC code) (T_{R1})	DISBILITY PENSION STATUS 'no DP'(n = 6269)	'MDs only'(n = 359)[p1, p2]	'MSDs only'(n = 954)[p1]	'MDs + MSDs'(n = 227)[p1]
Psycholeptics/ psychoanaleptics (N05/N06)				
no. (% within DP group) of medication users	811 (13.0%)	238 (66.3%)***,***	200 (21.0%)***	104 (45.8%)***
mean DDDs (SD)	126 (176.6)	428 (466.7)***,***	154 (225.0)[ns]	278 (368.2)***
Hypnotics and sedatives (N05C)				
no. (% within DP group) of medication users	424 (6.8%)	89 (24.8%)***,***	110 (11.5%)***	55 (24.2%)***
mean DDDs (SD)	114 (134.5)	244 (288.3)***,***	137 (172.4)[ns]	161 (225.3)*
Musculoskeletal medicines (M)				
no. (% within DP group) of medication users	1538 (24.6%)	111 (30.9%)***,***	456 (47.8%)***	102 (44.9%)***
mean DDDs (SD)	60 (80.2)	91 (122.2)***,***	137 (163.1)***	101 (125.5)***
Anti-inflammatory/ antirheumatic medicines (M01)				
no. (% within DP group) of medication users	1430 (22.8%)	104 (29.0%)***,***	436 (45.7%)***	93 (41.0%)***
mean DDDs (SD)	59 (78.6)	83 (111.8)*,***	135 (157.9)***	99 (124.6)***

Abbreviations: DP = permanent work disability pension (lifetime since 1964 to 2003); MDs = mental disorders, MSDs=musculoskeletal diseases; T_{R1} = Registry-based data in 1995; ATC = anatomical therapeutic chemical; BMI = body mass index (kg/m^2); no.=number; IQR = interquartile range.
p_1 = p-value with reference group 'no DP'; p_2 = p-value for the difference between the groups 'MSDs only' and 'MDs only'.ns = non-significant i.e. $p>0.05$; * = $p \leq 0.05$; ** = $p \leq 0.01$; *** = $p \leq 0.001$.
Tests: independent-samples Mann-Whitney U test for continuous variables, chi-square for categorical variables.

psychotropic medications, and vice versa (OR=2.45; 95%CI 2.17–2.77), when compared with non-use (Table 3).

Having a DP due to 'MDs only' was related to a higher use of any of the included medication classes. The ORs were 13.2 (95% CI 10.5–16.7) for using psychotropic medications (N05/N06) and 1.38 (1.09–1.74) for using musculoskeletal medications, compared to 'no DP'. In the 'MSDs only' group, the respective ORs were 1.79 (1.50–2.12) and 2.82 (2.45–3.45), and in the 'MDs + MSDs' group, 5.69 (4.34–7.46) and 2.51 (1.92–3.28), respectively (Table 3).

Higher age was marginally associated with higher use of hypnotics and sedatives (N05C) but lower use of musculoskeletal medications (M). Number of diseases, low self-rated health and higher BMI were related to the use of all the included medication classes (Table 3), except for BMI in respect of hypnotics and sedatives (N05C). High alcohol use and current smoking were strongly related to the use of psychotropic (N05/N06), but not musculoskeletal medications (M, M01) (Table 3). In multivariable analyses, adjusting for age and BMI did not substantially change the associations between DP status and use of medications (Table 4). These relationships with respect to the use of medications and other factors remained similar at T_{R2}.

4. Discussion

In the present study, the comorbidity between MDs and MSDs was studied in their severe forms using data from Finnish national registries on prescription medications and disability pensions. The comorbidity between the two leading causes of disability was evident. Compared to non-use, the use of either musculoskeletal or psychotropic medications substantially increased (+145%) the likelihood of the use of the other. Further, both the use of psychotropic medications in women granted a DP due to MSDs (+79%), and the use of musculoskeletal medications in women granted a DP due to MDs (+37%), were higher than expected. Even if in the 'MDs + MSDs' group neither of these causes of DP separately is usually severe enough for a disability pension, the co-occurrence of MDs and MSDs in the retirees *per se* indicates highly disabling comorbidity. During the 9-year interval (1995–2003), the observed pattern overall did not change greatly, but the mean amounts of purchased medications increased, regardless of medication class or DP status. All the DPs and prescription medications were related to an increased morbidity (e.g. diseases, use of medications, poor self-rated health and life style).

Previously, specific MDs, including mood and anxiety disorders, have been shown to be associated with MSDs such as chronic back pain, cervical or lumbar disc herniation and low bone mineral density [8]. However, more comprehensive and longitudinal studies are sparse [8]. The increased concurrent use of psychotropic and musculoskeletal medications in the studied group of ageing women emphasizes the significance of the overall comorbidity between MDs and MSDs. Thus, further research investigating the relationships between MDs and MSDs could hold major potential for supporting functional ability and overall well-being amongst the ageing.

The increasing use of prescription medications (incl. psychotropics) over time has been previously reported [14,15]. The progressive increase in the use of antidepressants, in particular, has been argued to be partly driven by an increase in their long-term use, based on follow-up data from the UK for the period between 1995 and 2011 [13]. Indeed, in the present study, the number of psychotropic medication users did not change greatly across the time period (1995–2003), but the use in DDDs did increase, regardless of whether the disability was present or not. In addition to long-term use, the increased use of medications could also be due to reasons such as disease progression or intensified treatment needs.

Our results highlight that the burden of MDs and MSDs (both separate and comorbid) is not decreasing with increasing age, and a greater understanding about their mutual relationships – as well as preventive measures – is needed in order to decrease their subjective and objective disease burden. At present, patients with severe MDs have heavily decreased life expectancy [26]. They have cumulating health risk factors, as seen in the present study, poorer access to health care and receive poorer health care [27], and their somatic concerns are often overlooked [26]. Likewise, psychological distress of patients with MSDs should be assessed as a part of musculoskeletal rehabilitation [28]. Thus, optimizing functional ability and quality of life amongst older people needs a realistic and multidimensional view [29] – as well as collaboration between medical specialties. It could give new opportunities for personal fulfilment and contribution to the community.

The strengths of the present study include the large population-based sample of ageing women and the use of two comprehensive and internationally comparable national registries [23, 24], with DPs classified according to ICD and medications according to ATC. Even if the study participants were restricted by sex, age range and defined area of residence, the homogenous Finnish ageing population decrease confounding. Due to the original thematic scope of the OSTPRE (osteoporosis, falls, fractures etc.), the participants were likely to be active and interested in MSDs, but still, MSDs were also associated with higher than expected MD comorbidity. Our study does not allow causal conclusions, but it offers views for longitudinal research on the comorbidity between MDs and MSDs.

5. Conclusion

The comorbidity was evident between MDs and MSDs amongst ageing women, based on data from two comprehensive national

Table 3
Unadjusted Odds Ratios (ORs; 95% CI) for medication use (Y/N) (T_{R1}) by study characteristics and lifetime work disability pension (DP) status.

CHARACTERISTICS	USE OF MEDICATIONS (ATC code) (T_{R1})			
	Psycholeptics/-analeptics (N05/06) (n = 1353) OR (95% CI)$^{p\text{-value}}$	Hypnotics/sedatives (N05C) (n = 678) OR (95% CI)$^{p\text{-value}}$	Musculoskeletal (M) (n = 2207) OR (95% CI)$^{p\text{-value}}$	Anti-inflammatory/-rheumatic (M01) (n = 2.063) OR (95% CI)$^{p\text{-value}}$
Age (n = 7797), **(T_Q)**	1.02 (1.00–1.04)^{ns}	1.04 (1.01–1.07)**	0.97 (0.96–0.99)**	0.98 (0.96–0.99)**
BMI (n = 7367), **(T_Q)**	1.03 (1.01–1.04)***	1.01 (0.99–1.03)^{ns}	1.04 (1.03–1.05)***	1.04 (1.02–1.05)***
Current smoker (n = 4987), **(T_Q)**	reference	reference	reference	reference
no (4257)	1.59 (1.32–1.91)***	1.40 (1.09–1.80)**	1.13 (0.96–1.35)^{ns}	1.16 (0.98–1.38)^{ns}
yes (730)	reference	reference	reference	reference
Alcohol consumption (n = 5154), **(T_Q)**	0.90 (0.77–1.05)^{ns}	1.19 (0.97–1.45)^{ns}	0.97 (0.86–1.10)^{ns}	0.95 (0.83–1.07)^{ns}
no (2846)	1.67 (1.15–2.44)**	2.12 (1.34–3.38)***	0.98 (0.68–1.41)^{ns}	0.93 (0.64–1.36)^{ns}
moderate (2157)	1.46 (1.39–1.53)***	1.39 (1.31–1.48)***	1.29 (1.24–1.35)***	1.28 (1.22–1.33)***
high (151)	reference	reference	reference	reference
No. of diseases (n = 7809), **(T_Q)**	1.48 (1.15–1.89)**	1.44 (1.04 – 1.99)*	1.24 (1.03–1.49)*	1.21 (1.00–1.46)^{ns}
	2.40 (1.89–3.05)***	1.96 (1.43 – 2.68)***	1.87 (1.56–2.25)***	1.82 (1.51–2.19)***
Self-rated health (n = 7560), **(T_Q)**	3.65 (2.70–4.94)***	2.46 (1.64 – 3.70)***	3.46 (2.70–4.43)***	3.44 (2.68–4.41)***
very good (n = 894)	6.04 (4.21–8.66)***	4.34 (2.75 – 6.85)***	3.85 (2.79–5.32)***	3.67 (2.66–5.08)***
good (2870)	reference	reference	reference	reference
fair (3137)	13.24 (10.51–16.68)***	4.54 (3.51 – 5.89)***	1.38 (1.09–1.74)**	1.28 (1.09–1.75)**
rather poor (n = 458)	1.79 (1.50–2.12)***	1.80 (1.44 – 2.24)***	2.82 (2.45–3.45)***	2.85 (2.48–3.28)***
poor (n = 201)	5.69 (4.34–7.46)***	4.41 (3.20 – 6.07)***	2.51 (1.92–3.28)***	2.35 (1.79–3.08)***
Lifetime DP status (n = 7809)	reference	reference	-	-
'no DP' (6269)	2.45 (2.17–2.77)***	2.52 (2.15–2.95)***	-	-
'MDs only' (359)	-	-	reference	reference
'MSDs only' (954)	-	-	2.45 (2.17–2.77)***	2.27 (2.01–2.57)***
'MDs + MSDs' (227)				
Being a user of M (n = 7809), **(T_{R1})**				
no (5602)				
yes (2207)				
Being a user of N05/N06 (n = 7809), **(T_{R1})**				
no (6456)				
yes (1353)				

Abbreviations: DP = permanent work disability pension (lifetime since 1964 to 2003); MDs = mental disorders, MSDs = musculoskeletal diseases. T_{R1} = registry-based data in 1995;.
ATC = anatomical therapeutic chemical; BMI = body mass index (kg/m^2);.
OR (95% CI) = odds ratio with 95% confidence interval; ns = non-significant i.e. $p>0.05$; * = $p \leq 0.05$; ** = $p \leq 0.01$; *** = $p \leq 0.001$.

Table 4
Adjusted Odd Ratios (ORs; 95% CI) for medication use (Y/N) (T_{R1}) by study characteristics and lifetime disability pension (DP) status.

CHARACTERISTICS	USE OF MEDICATIONS (ATC code) (T_{R1})			
	Psycholeptics/psychoanaleptics (N05/N06)OR (95%CI)$^{p\text{-value}}$	Hypnotics and sedatives (N05C)OR (95%CI)$^{p\text{-value}}$	Musculoskeletal medicines(M) OR (95%CI)$^{p\text{-value}}$	Anti-inflammatory and antirheumatic medicines(M01)OR (95%CI)$^{p\text{-value}}$
Age (n = 7358), **(T_Q)**	1.01 (0.99–1.04)^{ns}	1.04 (1.01–1.07)**	0.96 (0.95–0.98)***	0.97 (0.95–0.99)***
BMI (n = 7358), **(T_Q)**	1.00 (0.99–1.02)^{ns}	0.99 (0.97–1.01)^{ns}	1.03 (1.02–1.04)***	1.03 (1.02–1.04)***
Lifetime DP status (n = 7358)	reference	reference	reference	reference
'no DP' (n = 5933)	13.06 (10.25–16.65)***	4.53 (3.44–5.95)***	1.36 (1.06–1.73)*	1.38 (1.08–1.77)**
'MDs only' (n = 329)	1.71 (1.43–2.05)***	1.80 (1.43–2.26)***	2.81 (2.43–3.25)***	2.82 (2.44–3.27)***
'MSDs only' (n = 886)	5.56 (4.19–7.37)***	4.67 (3.35–6.50)***	2.41 (1.82–3.18)***	2.28 (1.72–3.03)***
'MDs + MSDs' (n = 210)				

Abbreviations: DP = permanent work disability pension (lifetime since 1964 to 2003); MDs = mental disorders, MSDs = musculoskeletal diseases.
T_Q = Questionnaire-based data in 1994; T_{R1} = registry-based data in 1995; ATC = anatomical therapeutic chemical; BMI = body mass index (kg/m^2); OR = odds ratio; 95%CI = 95% confidence interval; ns = non-significant i.e. $p>0.05$; * = $p \leq 0.05$; ** = $p \leq 0.01$; *** = $p \leq 0.001$.

registries, i.e. on disability pensions and on the use of medications. To disentangle the reciprocal causal relationships and to govern the disease burden due to these medical conditions, further research on their longitudinal relationships is needed.

Contributors

J Heikkinen contributed to conceptualization, data curation, formal analysis, methodology, validation, visualization, writing the original draft, and review and editing of the draft article.

H Koivumaa-Honkanen contributed to conceptualization, methodology, project administration, supervision, validation, visualization, writing the original draft, and review and editing of the draft article.

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LJ Williams contributed to review and editing of the draft article.

SE Quirk contributed to review and editing of the draft article.

J Leung contributed to review and editing of the draft article.

RJ Honkanen contributed to conceptualization, data curation, methodology, supervision, validation, and review and editing of the draft article.

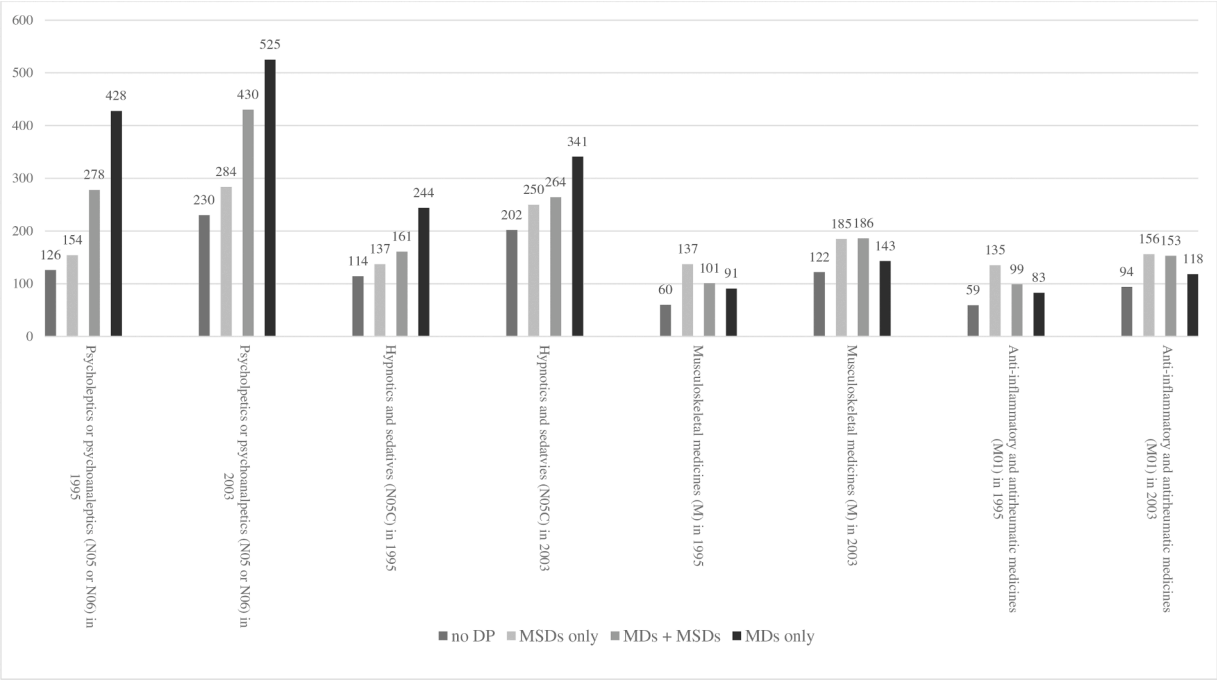

Fig. 2. Mean defined daily doses (DDDs) of psychotropic and musculoskeletal medications in 1995 (T_{R1}) and in 2003 (T_{R2}) by lifetime disability pension (DP) status. Abbreviations: DP = permanent work disability pension (lifetime since 1964 to 2003); MDs = mental disorders; MSDs = musculoskeletal diseases.

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All participants provided a written informed consent, and the study was approved by the Ethics Committee of Kuopio University Hospital.

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Research data (data sharing and collaboration)

There are no linked research data sets for this paper. Data will be made available on request.

Declaration of competing interest

The authors declare that they have no competing interests.

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