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A longitudinal cohort study on dispensed analgesic and psychotropic medications in older adults before, during, and after the COVID-19 pandemic: the HUNT study

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Abstract

Background There is a growing concern and debate over the inappropriate use of analgesics and psychotropic medications by older adults, especially those with dementia. The long-term effects of the COVID-19 pandemic and lockdown measures on these prescriptions remain uncertain.

Aim The primary aim was to examine changes in the prescription of analgesics (opioids and other analgesics) and psychotropics (anxiolytics/sedatives, antidepressants, and antipsychotics) in Norwegian home-dwelling older adults before, during, and up to 2 years after the COVID-19 lockdown, with a particular focus on dementia status. Secondarily, we explored individual characteristics associated with changes in medication prescriptions.

Methods A prospective cohort study using baseline data from 10,464 participants (54% females, mean age 76 years [SD 5.8]) from the Norwegian Trøndelag Health Study (HUNT4 70+) linked with the Norwegian Prescription Database. Age- and education-adjusted Poisson regression was applied to examine changes in prescription fills, and multilevel mixed-effects linear regression was used to estimate the mean sum of defined daily dose (DDD) per person per period during the lockdown (March–September 2020) compared to that during the corresponding months (March–September) in 2019, 2021, and 2022.

Results Overall, prescriptions of opioids, other analgesics, and anxiolytics/sedatives were higher in 2022 than during the lockdown. People without dementia had increased prescriptions of opioids, other analgesics, and antidepressants after lockdown, whereas no changes were observed among those with dementia. Increases in prescriptions of opioids, other analgesics, anxiolytics/sedatives, and antidepressants between the lockdown and 2022 occurred mainly among those aged < 80 years, without comorbidities or mental distress, with good physical function, low fear of COVID-19, and no social isolation during COVID-19.

Conclusion An increase in analgesics and psychotropics after the lockdown was predominantly observed among younger-old and healthier participants. This indicates that in high-income countries, such as Norway, home-dwelling vulnerable individuals seem to have received adequate care. However, the pandemic may have increased

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the number of vulnerable individuals. These findings should be considered when identifying future nationwide stressors that may impair social interactions and threaten mental health. They also highlight the need to evaluate medication prescriptions for older adults after the pandemic.

Trial registration The study is registered in ClinicalTrials.gov 02.02.2021, with the identification number NCT 04792086.

Keywords Analgesics, Psychotropic medication, COVID-19, Dementia, Older adults, Longitudinal cohort-study, HUNT

Introduction

The COVID-19 pandemic and lockdown measures offer unique opportunities to study the impact of nationwide stressors on potentially inappropriate medication prescriptions in older adults. Social restrictions following the control measures introduced during the pandemic led to social isolation and reduced mental and physical health in older populations [22, 29, 40–42], and an increase in neuropsychiatric symptoms among people with dementia [13, 32, 39, 45]. Analgesics and psychotropic medications are often prescribed to older adults based on symptoms rather than a diagnosis, and frequently for durations that exceed guideline recommendations [4, 35, 51]. Therefore, long-term studies examining how a nationwide stressor, such as the COVID-19 pandemic and lockdown measures, affects the prescription of these medications in older adults are highly relevant.

Previous studies have shown that the pandemic has had an impact on medication prescriptions among older adults. Regarding analgesics, individuals aged 65 years and older with chronic pain used fewer opioids after the onset of the pandemic in 2020, despite the fact that the prevalence of high-impact chronic pain remained unchanged [27]. Older adults commonly take other analgesics such as paracetamol or non-steroidal anti-inflammatory medications [28] which are also frequently used to manage symptoms and treat COVID-19 [12]. A comprehensive review has shown that the prescription of such medications increased significantly from 2020 to 2022 [11]. Older adults (≥65 years) had an increase in prescriptions of psychotropic medication; such as benzodiazepines [7, 36], other anxiolytics and hypnotics [48], antidepressants [10], and antipsychotics [24] during the first year of the pandemic. It has been suggested that fear of COVID-19 infection and social isolation may have been the main reasons for the increased use of benzodiazepines [36].

For people with dementia, a significant increase in psychotropic medication prescriptions during the pandemic was observed in Europe [26, 32, 45], South Korea, the USA, the UK [26], and Latin America [45]. A Norwegian study of home-dwelling people with dementia reported an increase in neuropsychiatric symptoms after the COVID-19 lockdown. However, there has been no corresponding increase in the use of psychotropic medications [13]. This contrasts with earlier findings that an increase in behavioural and psychological symptoms in people with dementia led to an increase in antipsychotic and benzodiazepine prescriptions [45].

Prior studies on changes in medication prescriptions in older adults during the COVID-19 pandemic were predominantly based on aggregated data at the population level for the first year after the pandemic, highlighting the need to provide individual-level data over a longer period. Our aim was to deepen our insight into the initial and continuing 2-year impact of major events, such as a pandemic, on the prescription of analgesics and psychotropic medications in older adults, with a particular focus on people with dementia. Our secondary aim was to explore the sociodemographic and clinical characteristics associated with changes in prescriptions.

Method

Study design

We used a longitudinal population-based cohort of participants aged ≥70 years from the Norwegian Trøndelag Health Study (HUNT4 70+) linked to the Norwegian Prescription Database (NorPD). The HUNT study began in 1984 in North Trøndelag County, Norway, and in the fourth wave (2017–2019) the study expanded to include a city district in Trondheim, as North Trøndelag lacks large urban areas. Participant data from HUNT4 70+included sex, year of birth, dementia status, education, living alone, and mental and physical health statuses [3]. Data was collected either at a field station (84%), in the participants own home (8%) or at the nursing home (8%). Data on social isolation and fear of COVID-19 were collected from the same population in January 2021, using a postal questionnaire. Individual data were linked with registry data on medication prescriptions from 12 March 2019 to 11 September 2022 using Norwegian personal identification numbers. This period covers 1 year before and 2 years after the COVID-19 lockdown in Norway. The lockdown period (12 March to 11 September 2020) was compared with the same months in 2019 (pre-lockdown), 2021, and 2022 (both post-lockdown) (Fig. 1). We extended the lockdown period beyond the typically referenced timeframe from March to June 2020 because of

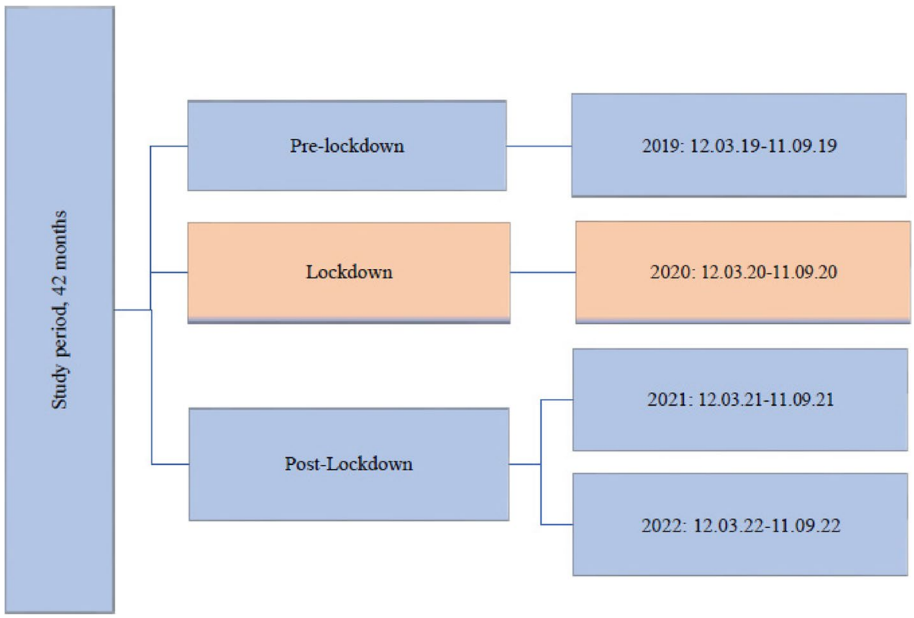

Fig. 1 Study period

the slow commencement of reopening and because many older adults maintained strict social distancing measures. During the post-lockdown period, all infection control measures gradually eased until the Norwegian government removed all statutory measures on 12 February 2022 [47].

Participants

The study population was selected from the HUNT4 70 + database. Detailed sociodemographic and clinical information, along with assessments by healthcare professionals, were collected for each participant [14]. The fourth wave included 11,675 participants (9,930 from North Trøndelag and 1,745 from Trondheim), of whom 7,784 completed the questionnaire on social isolation and fear of COVID-19. We excluded nursing home residents ($n = 866$); those who were admitted to a nursing home, died, or emigrated before March 2019 ($n = 143$); and those with insufficient information for the categorisation of dementia status ($n = 202$). The excluded group was older (85 vs. 76 years), had a higher proportion of women (64% vs. 54%), and had lower education (58% vs. 28%) than the included group. A total of 10,464 participants, of whom 1,062 had dementia, contributed with data in the study period (March 2019 to September 2022, Fig. 2).

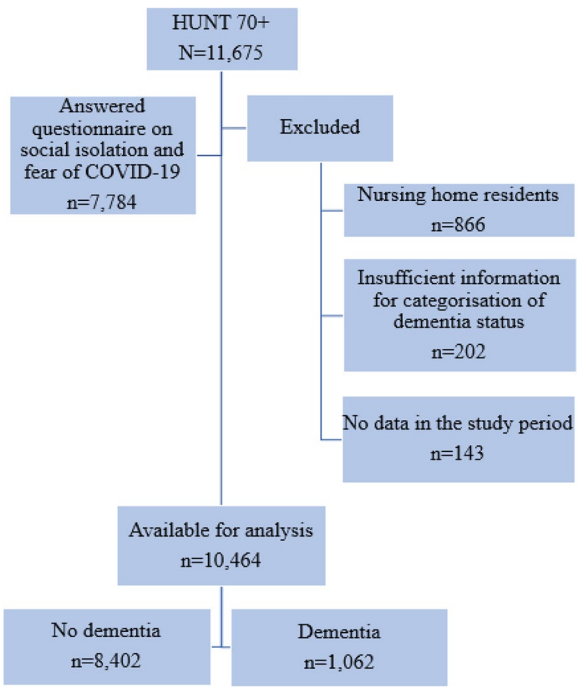

Fig. 2 Flow chart, participant inclusion and categorisation of dementia status

Analgesics and psychotropic medication

Information on the type of medication, prescription year and month, and defined daily doses (DDD) were obtained from the Norwegian Prescription Database (NorPD), which provides information on all prescribed medications dispensed from pharmacies to community-dwelling individuals in Norway. This ensures information on the medications and doses collected by participants from

pharmacies, although it does not confirm actual consumption or adherence to the prescribed instructions. The DDD is the assumed average maintenance dose per day for a drug used as the main indication in adults. DDDs are only assigned to medicines with an Anatomical Therapeutic Chemical Classification (ATC) code [53]. Medications were grouped as opioids (N02A), other analgesics (N02B), antipsychotics (N05A), anxiolytics/sedatives (N05B and N05C), and antidepressants (N06A).

Dementia

The categorization of dementia was done by two experts from a diagnostic working group of nine doctors with extensive scientific and clinical expertise (geriatrics, geriatric psychiatry, or neurology), who independently diagnosed dementia, mild cognitive impairment (MCI), and types of dementia using the DSM-5 diagnostic criteria [2]. During the diagnostic process the experts had access to all relevant information from the HUNT4 70 + dataset, such as education, function in activities of daily living, neuropsychiatric symptoms, cognitive symptom debut and course, cognitive tests (the Montreal Cognitive Assessment (MoCA) scale [34], and the Word List Memory Task (WLMT) [33], and structured interviews with the closest family proxy. If no consensus was reached between the two experts, a third expert was consulted (for details see: [14]). After the diagnostic process, the expert group decided to use established terms, specifically *dementia* (instead of *major neurocognitive disorder*), as defined by the ICD codes [52]. Among the 1,062 participants, 60% had Alzheimer's disease, 6% had vascular dementia, and 34% had other dementias. For the analysis, all dementia groups were combined to enhance statistical power.

Other covariates

Covariates were obtained from the HUNT4 70 + Study (2017–2019) and data on social isolation and fear of COVID-19 were collected from the same population using a postal questionnaire in January 2021. The covariates are briefly described below, and detailed covariate information is provided in the Supplementary Material.

We included sex (females vs. males), age in 2017 (< 80 years vs. ≥80 years), education (primary/secondary vs. tertiary, to differentiate between individuals with fewer or more than 10 years of schooling [25], living situation (living alone vs. living with someone), comorbidity (0–1 self-reported diseases vs. 2 + self-reported diseases, [21], mental health (no mental distress vs. mental distress, assessed using the CONOR Mental Health Index (CON-MHI) with 2.15 as the cut-off [43], physical function (reduced vs. good, using the Short Physical Performance battery (SPPB) [37], social isolation (not isolated vs. isolated [18], and fear related to COVID-19 (low fear vs. fear, assessed using the Fear of Covid-19 Scale [1, 20] with 21 points as cut-off [31].

Statistical analysis

Sample characteristics are presented as the means with standard deviations (SD) or frequencies with percentages. In the statistical analyses, a measure of person-time was used, where one unit of person-time corresponded to a 6-month period. Participants who emigrated ($n = 43$), were admitted to a nursing home ($n = 374$) or died ($n = 1{,}107$) during the 42 months study period were censored and contributed 0.5 units of person-time to the period when they were censored (Table 1).

In the present study, we aimed to investigate whether there was an increase in the number of participants obtaining the medications of interest from Norwegian pharmacies (as indicated by prescription fills) and whether the average dispensed daily dose per person summarised for each period (as indicated by the mean sum DDD per person per period) increased during the pandemic. Thus, our investigation of medication prescriptions over time included two sets of analyses. First, we used Poisson regression to calculate the incidence rate ratios (IRRs) for prescription fills and the corresponding incidence proportions (%) over time. Second, to assess changes in DDDs, we summed the DDDs separately for each person in each period. The mean sum of DDDs per person per period was estimated using a multilevel mixed-effects linear regression model with random intercepts across individuals. Analyses were performed separately for each medication group and 95% confidence intervals (95% CI) were provided for all estimates. We performed a sensitivity analysis to examine the influence of missingness on the COVID-19 questionnaire on our results. Here, we repeated the main analysis only in participants who had answered the COVID-19 questionnaire. The lockdown period (March–September 2020) was used as a reference in all regression models, and the corresponding months before the lockdown (March–September 2019) and after the lockdown (March–September 2021 and March–September 2022) were compared with the reference period. All regression analyses were performed in two steps: unadjusted and adjusted for age and educational level. This adjustment was necessary because the individuals who were censored were older and had lower education levels than those included throughout the study period, ensuring comparability across periods. No sex differences were observed between the censored participants and those included throughout the study period.

To assess whether changes in prescription fills and the mean sum of DDD during the pandemic

Table 1 Number of participants reported from baseline to end of study, including participants censored due to nursing home admission, emigration, or death

	All			**No Dementia**			**Dementia**		
Periods	Persons at start of each period, n	Persons censored per period, n	Period Person Time[1]	Persons at start of each period, n	Persons censored per period, n	Period Person Time*	Persons at start of each period, n	Persons censored per period, n	Period Person Time*
12.03.19–11.09.19	10,464	178	10,375.0	9,402	99	9,352.5	1,062	79	1,023
12.03.20–11.09.20, Lockdown	10,096	188	10,002.0	9,195	124	9,133.0	901	64	869
12.03.21–11.09.21	9,735	195	9,637.5	8,960	137	8,891.5	775	58	746
12.03.22–11.09.22	9,353	230	9,238.0	8,684	174	8,597.0	669	56	641

[1]Persons censored add 0.5 period person time, while those not censored adds 1 person time per period.

differed between people with and without dementia, we repeated the regression analyses, stratified by dementia status. Second, to explore how other individual characteristics potentially affected changes in prescription fills and the mean sum of DDD, we performed the same analyses stratified by age, sex, education, living situation, comorbidity, mental health, physical function, social isolation, and fear of COVID-19. The stratified models were adjusted for age and education (age-stratified analyses were adjusted for education and education-stratified analyses were adjusted for age). All analyses were performed using Stata (version 18.0; [44]. Statistical significance was set at $p < 0.05$.

Results

The study sample comprised 10,464 participants. The mean age as of 1 January 2017, was 76 years (SD: 5.8, range: 68–100 years); 54% were female and 10% had dementia. Participant characteristics across dementia statuses are described in Table 2.

A total of 7,248 participants (69%) were prescribed medications of interest during the study period, with the following distribution: opioids, 36.2%; other analgesics, 50.3%; anxiolytics/sedatives, 33.9%; antidepressants, 6.9%; and antipsychotics, 3.7% (Table 3). People with dementia were prescribed a higher mean sum of DDD per person per period than those without dementia, for all medications (Table 4). For complete data on all unadjusted and adjusted changes in prescription fills and the mean sum DDD between the lockdown and the pre- and post-periods, we refer to the supplementary materials (Tables S1–S6). Results from the sensitivity analyses excluding individuals who did not answer the COVID-19 questionnaire did not differ from the findings including the entire study sample. In the following section, we report the models adjusted for age and education for the entire sample and the changes stratified by dementia status.

Table 2 Description of the study sample[a], across dementia status

	Total $N = 10,464$ n (%)	No dementia $n = 9,402$ n (%)	Dementia $n = 1,062$ n (%)
Sex			
Female	5,643 (53.9)	5,054 (53.8)	589 (55.5)
Male	4,821 (46.1)	4,348 (46.3)	473 (44.5)
Age, mean (SD)	76.4 (5.8)	75.9 (5.5)	80.4 (6.9)
<80	7,716 (73.7)	7,243 (77.0)	473 (44.5)
≥80	2,748 (26.3)	2,159 (23.0)	589 (55.5)
Education ($n = 10,306$)			
Primary	2,861 (27.8)	2,362 (25.4)	499 (49.0)
Secondary/ Tertiary	7,445 (72.2)	6,925 (74.6)	520 (51.0)
Living situation ($n = 10,027$)			
Living alone	3,362 (33.5)	2,947 (32.3)	415 (46.7)
Living with someone	6,665 (66.5)	6,192 (67.8)	473 (53.3)
Comorbidity[1] ($n = 9,260$)			
0-1 self-reported diseases	5,594 (60.5)	5,184 (61.2)	410 (52.5)
>2 self-reported diseases	3,658 (39.5)	3,287 (38.8)	371 (57.5)
Mental health[2] ($n = 8,826$)			
Mental distress	501 (5.7)	401 (5.0)	100 (13.8)
No mental distress	8,325 (94.3)	7,701 (95.1)	624 (86.2)
Physical function[3] ($n = 10,308$)			
Reduced physical function	2,595 (25.2)	1,950 (21.0)	645 (63.1)
Good physical function	7,713 (74.8)	7,335 (79.0)	378 (37.0)
Social isolation ($n = 7,643$)			
Isolated	2,920 (38.2)	2,742 (37.9)	178 (44.3)
Not isolated	4,723 (61.8)	4,499 (62.1)	224 (55.7)
Fear of COVID-19[4] ($n = 7,339$)			
Fear	1,676 (22.8)	1,554 (22.3)	122 (33.4)
Low fear	5,663 (77.2)	5,420 (77.7)	243 (66.6)

[a] Variables collected in HUNT4 70+, except social isolation and fear of COVID-19 which were collected through a separate questionnaire in the same population.

[1] Comorbidity is defined by ≥2 self-reported diseases.

[2] Mental health (CONOR-MHI), range 1-4. The cut-off for mental distress is ≥2.15

[3] Physical function (SPPB), range 0-12 points. The cut-off for reduced physical function is ≤ 8 points

[4] Fear of COVID-19, range 7-35. The cut-off for fear of COVID-19 is ≥21 points

Opioids

Prescription fills

Opioid prescriptions were higher in 2022 than during the lockdown (IRR 1.12, 95% CI 1.03, 1.22) (Fig. 3, Table S1). Analyses stratified by dementia status demonstrated that those without dementia had a higher rate of opioid prescriptions in 2022 (IRR 1.10, 95% CI 1.01, 1.20) compared to that during the lockdown (Fig. 4, Table S3). No differences were found between the lockdown and pre- or post-lockdown periods in participants with dementia (Fig. 5, Table S3).

DDD

No significant differences in the mean sum DDD per person per period for opioids were observed between the lockdown and pre- or post-lockdown periods (Table S2, Fig. 6). Analyses stratified by dementia status demonstrated that those without dementia had higher mean sum DDD for opioids in 2022 (0.43, 95% CI 0.001, 0.85) compared to the lockdown (Fig. 7, Table S4), whereas no differences were found in participants with dementia (Fig. 8, Table S4).

Table 3 Number (%) of persons with prescription fills for analgesics[1] and psychotropics[2] during the pre-lockdown, lockdown and post-lockdown periods, across dementia status[3]

Psychotropic medication	**Persons at start of each period**		**Opioids**		**Other analgesics**		**Anxiolytics/ sedatives**		**Antidepressants**		**Antipsychotics**	
Total number of persons with prescription fills, n (%)	**10,464**		**3,793 (36.2)**		**5,358 (50.3)**		**3,545 (33.9)**		**1,764 (6.9)**		**388 (3.7)**	
Dementia status N (%)	No Dem	Dem	No Dem	Dem	No Dem	Dem	No Dem	Dem	No Dem	Dem	No Dem	Dem
12.03.19–11.09.19	9,402	1,062	1,024 (10.9)	178 (16.8)	2,043 (21.7)	364 (34.3)	1,809 (19.2)	287 (27.0)	845 (9.0)	218 (20.5)	116 (1.2)	36 (3.4)
12.03.20–11.09.20, Lockdown	9,195	901	965 (10.5)	127 (14.1)	2,160 (23.5)	344 (38.2)	1,831 (19.9)	232 (25.7)	857 (9.3)	195 (21.6)	117 (1.3)	29 (3.2)
12.03.21–11.09.21	8,960	775	981 (10.9)	121 (15.6)	2,257 (25.2)	288 (37.2)	1,806 (20.2)	201 (25.9)	923 (10.3)	149 (19.2)	134 (1.5)	26 (3.4)
12.03.22–11.09.22	8,684	669	1,009 (11.6)	103 (15.4)	2,313 (26.6)	237 (35.4)	1,809 (20.8)	159 (23.8)	927 (10.7)	121 (18.4)	123 (1.4)	28 (4.2)

[1] Analgesics: Opioids and other analgesics.

[2] Psychotropics: anxiolytics/sedatives, antidepressants, and antipsychotics.

[3] Dementia status is divided in No Dementia diagnosis (No Dem) and a diagnosis of Dementia (Dem).

Table 4 Mean sum of defined daily dose (DDD) per person per period for analgesics[1] and psychotropics[2] during the pre-lockdown, lockdown, and post-lockdown periods, across dementia status

Psychotropic medication	Opioids		Other analgesics		Anxiolytics/ sedatives		Antidepressants		Antipsychotics	
Mean sum DDD (SD) per person per period[a]	**3.8 (21.0)**		**19.5 (44.7)**		**22.7 (60.4)**		**17.3 (65.7)**		**0.7 (10.2)**	
Dementia status[2]	No Dem	Dem	No Dem	Dem	No Dem	Dem	No Dem	Dem	No Dem	Dem
12.03.19–11.09.19	3.7 (20.4)	6.8 (26.3)	15.3 (39.2)	34.9 (63.8)	20.7 (57.6)	32.3 (73.7)	14.3 (61.0)	37.1 (96.9)	0.5 (9.6)	1.8 (14.8)
12.03.20- 11.09.20, Lockdown	3.5 (20.3)	6.7 (30.9)	16.6 (39.7)	36.8 (63.2)	21.4 (59.2)	28.2 (64.1)	14.6 (60.8)	35.7 (87.7)	0.5 (9.4)	2.1 (16.9)
12.03.21–11.09.21	3.6 (20.7)	6.8 (28.1)	18.9 (43.8)	38.4 (66.7)	22.2 (59.7)	28.4 (69.1)	16.5 (65.2)	31.2 (81.1)	0.5 (8.8)	2.0 (17.7)
12.03.22–11.09.22	3.8 (20.4)	5.8 (25.7)	20.7 (45.6)	35.8 (64.3)	23.0 (60.4)	27.4 (73.5)	16.7 (64.0)	30.8 (85.7)	0.6 (10.6)	1.9 (14.5)

[a] The whole study sample for the whole study period

[1]Analgesics: Opioids and other analgesics

[2] Psychotropics: anxiolytics/sedatives, antidepressants, and antipsychotics

[3]Dementia status is divided in No Dementia diagnosis (No Dem) and a diagnosis of Dementia (Dem)

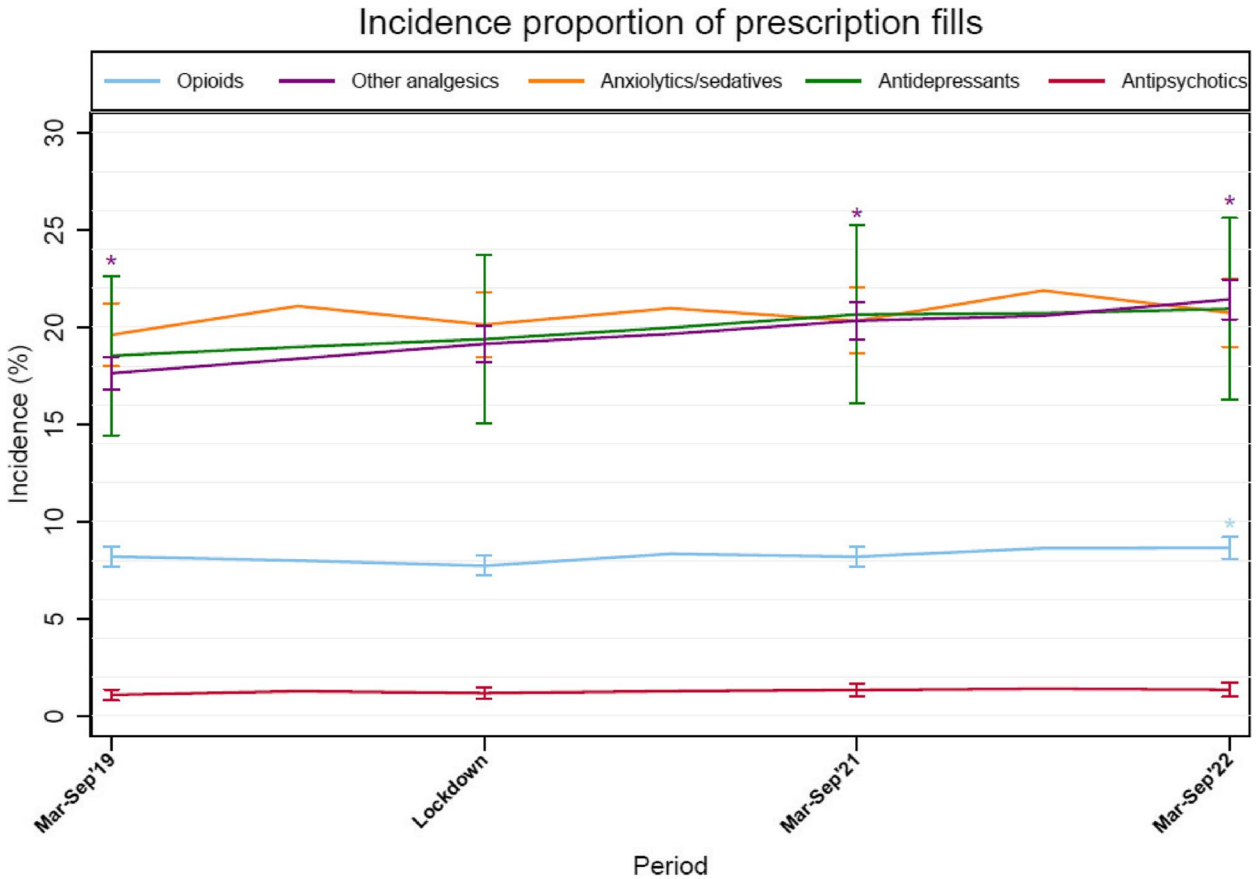

Fig. 3 Age and education adjusted incidence proportion of prescription fills (%) with 95% confidence intervals (95% CI), calculated using Poisson regression analysis

Other analgesics

Prescription fills

The rate of prescriptions for other analgesics was lower in 2019 (IRR 0.92, 95% CI 0.87, 0.98) and higher in 2021 (IRR 1.06, 95% CI 1.00,1.12), and 2022 (IRR 1.12, 95% CI 1.06, 1.18) compared to that during the lockdown (Fig. 3, Table S1). Analyses stratified by dementia status demonstrated that those without dementia had a lower rate of prescriptions for other analgesics in 2019 (IRR 0.93, 95% CI 0.88, 0.98) and higher rates in 2021 (IRR

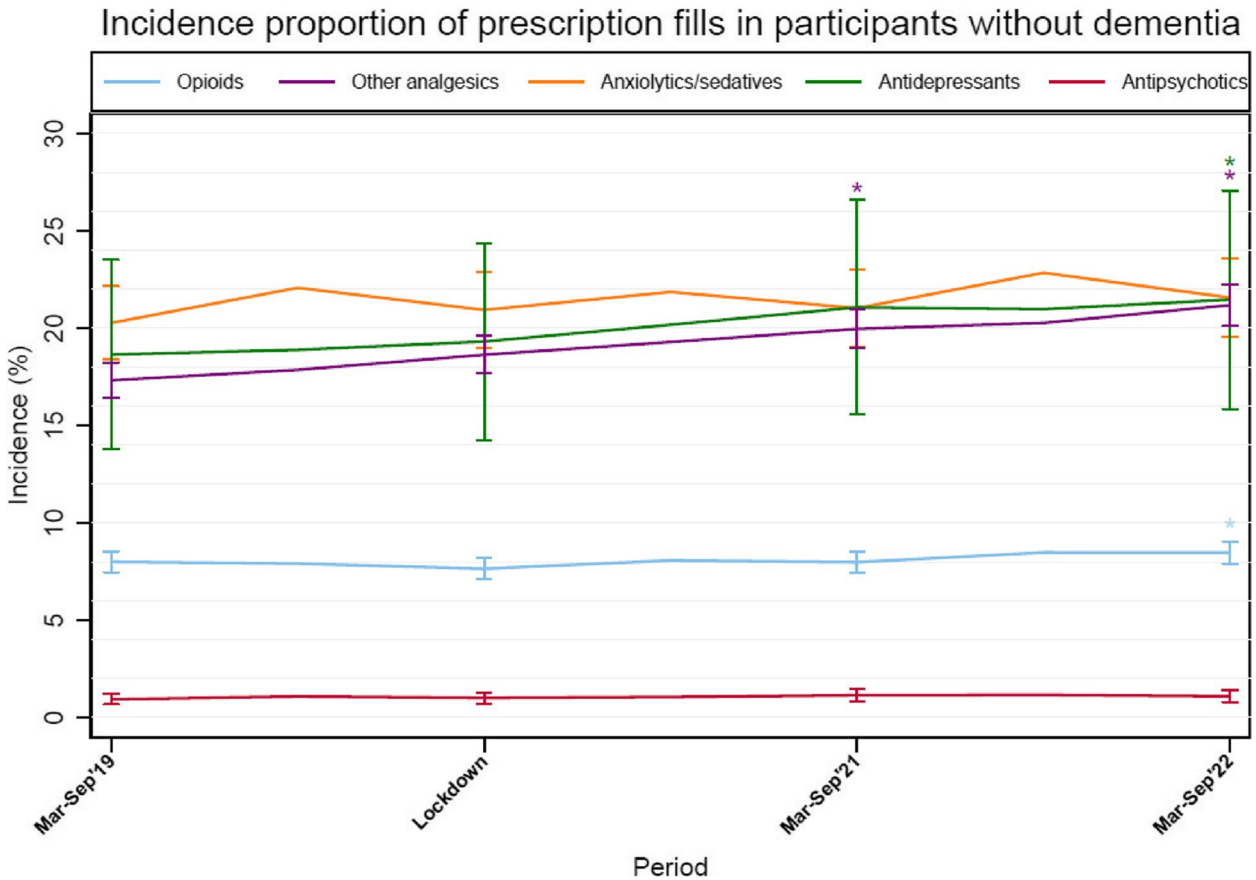

Fig. 4 Age and education adjusted incidence proportion of prescription fills (%) with 95% confidence intervals (95% CI), for participants without dementia, calculated using Poisson regression analysis

1.07, 95% CI 1.01, 1.14) and 2022 (IRR 1.14, 95% CI 1.07, 1.21) compared to the lockdown (Fig. 4, Table S3), whereas no differences were observed in participants with dementia (Fig. 5, Table S3).

DDD

The mean sum of DDD per person per period for other analgesics was lower in 2019 (−1.37, 95% CI 2.26, 0.48) and higher in 2021 (1.92, 95% CI 1.02, 2.82) and 2022 (3.50, 95% CI 2.59, 4.41) compared to that during the lockdown (Fig. 6, Table S2). Analyses stratified by dementia status demonstrated that for participants without dementia, the mean sum DDD per person per period was lower in 2019 (−1.32, 95% CI −2.20, −0.44) and higher in 2021 (1.88, 95% CI 0.99, 2.76) and 2022 (3.65, 95% CI 2.76, 4.54) compared to that during the lockdown (Fig. 7, Table S4). No differences were observed between the lockdown and pre- or post-lockdown periods in participants with dementia (Fig. 8, Table S4).

Anxiolytics/sedatives

Prescription fills

No significant differences in the prescription rates were observed for anxiolytics/sedatives between the lockdown and pre- or post-lockdown periods (Fig. 3, Table S1). No differences were found in the analyses stratified by dementia status (Figs. 4 and 5, Table S3).

DDD

The mean sum DDD for anxiolytics/sedatives was higher in 2022 (1.16, 95% CI 0.03, 2.29) compared to that during the lockdown (Fig. 6, Table S2). Analyses stratified by dementia status did not demonstrate any differences between the lockdown and pre- or post-lockdown periods in participants with or without dementia (Figs. 7 and 8, Table S4).

Antidepressants

Prescription fills

The rate of antidepressant prescriptions was higher in 2022 (IRR 1.11, 95% CI 1.01, 1.22) compared to that

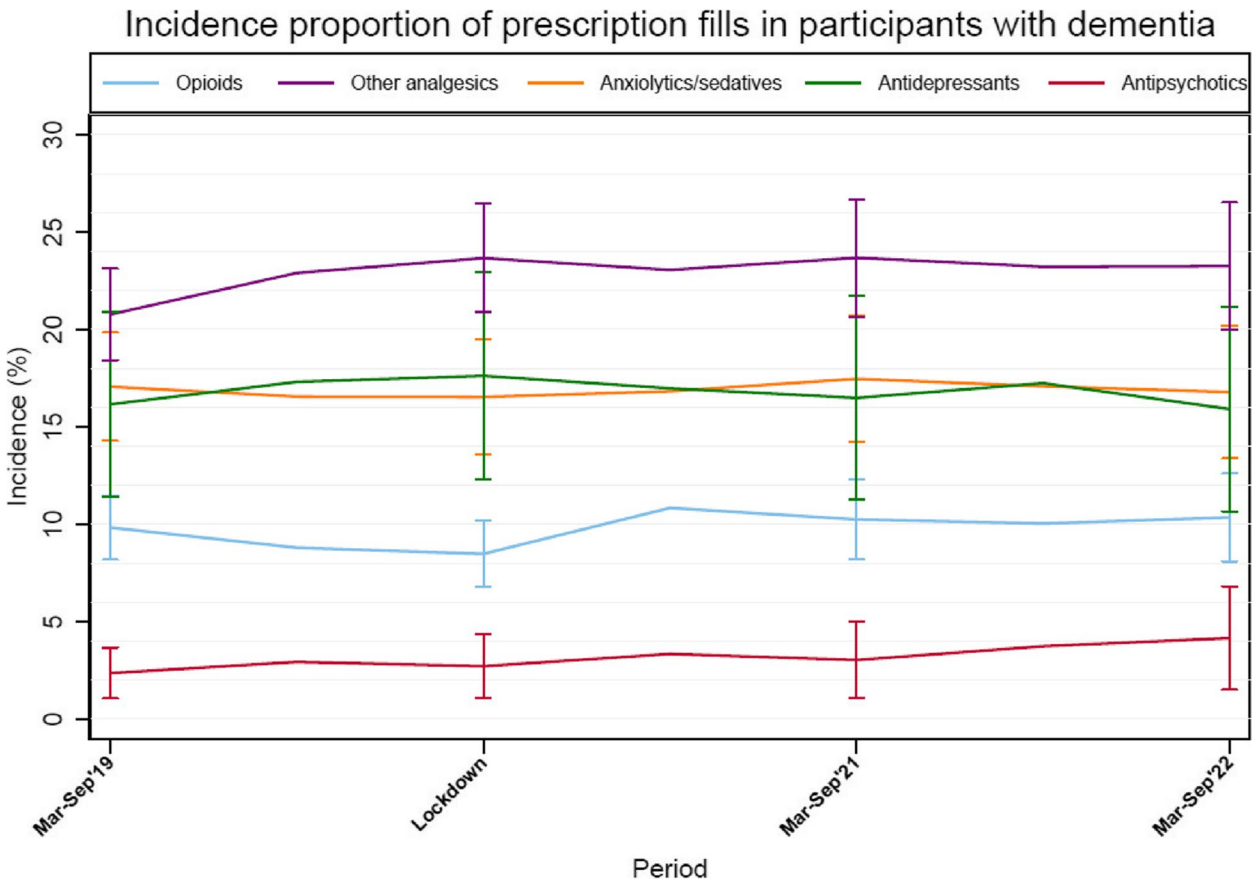

Fig. 5 Age and education adjusted incidence proportion of prescription fills (%) with 95% confidence intervals (95% CI), for participants with dementia, calculated using Poisson regression analysis

during the lockdown period for participants without dementia (Fig. 4, Table S3). No differences were observed between the lockdown and pre- or post-lockdown periods in participants with dementia (Fig. 5, Table S3).

DDD

No differences in the mean sum of DDD per person per period for antidepressants were observed between the lockdown and pre- or post-lockdown periods (Fig. 6, Table S2). Analyses stratified by dementia status demonstrated that the mean sum DDD for antidepressants was higher in 2021 (1.32, 95% CI 0.10, 2.53) and 2022 (1.31, 95% CI 0.09, 2.54) compared to that during the lockdown for participants without dementia (Fig. 7, Table S4). No differences were observed between the lockdown and pre- or post-lockdown periods in participants with dementia (Fig. 8, Table S4).

Antipsychotics

Prescription fills

No differences in the prescription rates of antipsychotics were observed before, during, or after the lockdown (Fig. 3, Table S1). Analyses stratified by dementia status and other covariates did not demonstrate any differences in the rate of antipsychotic prescriptions between participants with and without dementia (Fig. 4/5, Table S3).

DDD

No differences in the mean sum of the DDD per person per period for antipsychotics were observed before, during, or after the lockdown (Fig. 6, Table S2). Analyses stratified by dementia status did not demonstrate any differences in the mean sum of the DDD for antipsychotics for those with or without dementia (Fig. 7/8, Table S4).

Other covariates

Our secondary aim was to explore how changes in prescriptions were associated with individual, social, and clinical characteristics, such as age, sex, education, comorbidity, living situation, mental health and physical function, social isolation, and fear of COVID-19 during the pandemic. Findings from the stratified analysis are described in the Supplementary Materials and Tables S5 and S6. In short, an increase in prescription fills and/or

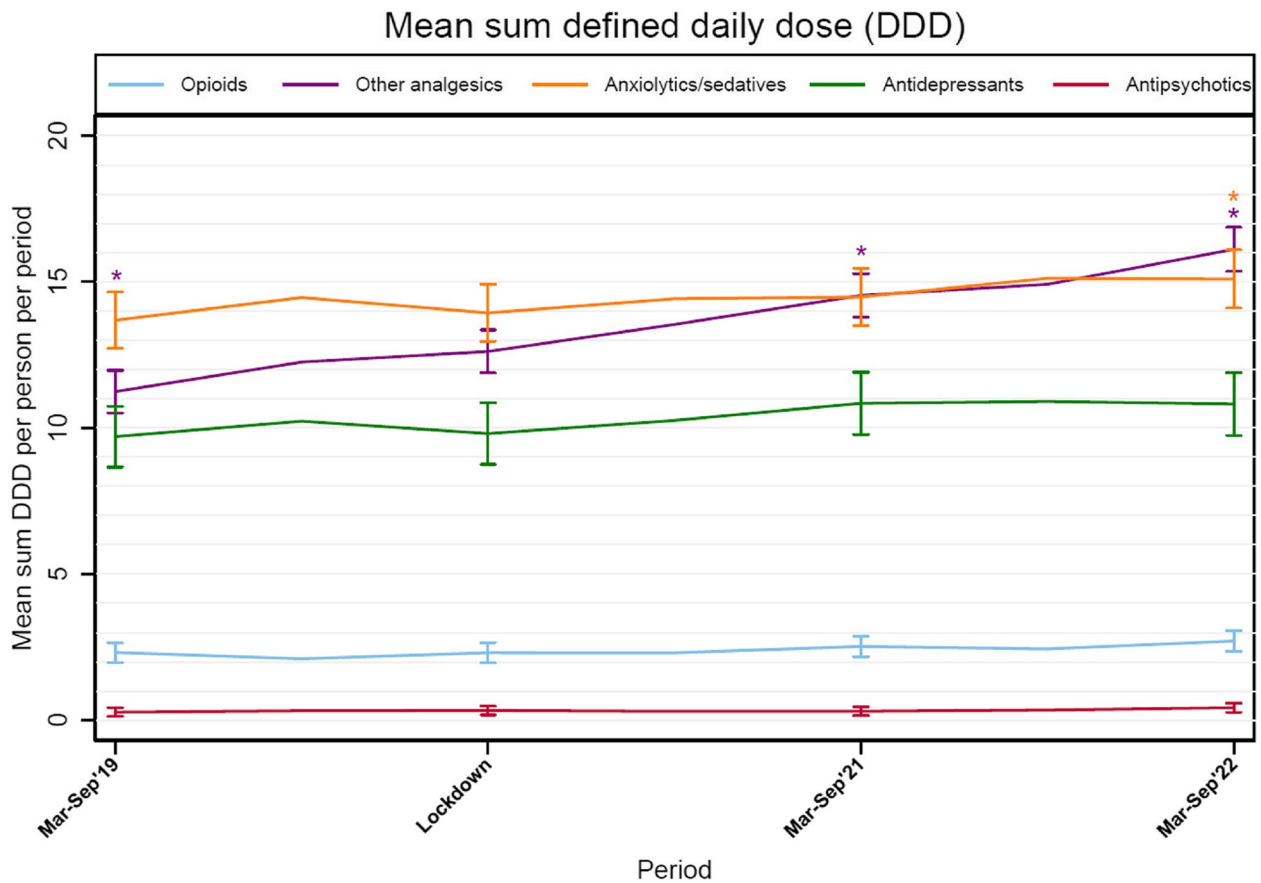

Fig. 6 Age and education adjusted mean sum of defined daily dose (DDD) per person per period with 95% confidence intervals (95% CI), calculated using multilevel mixed-effects linear regression

mean sum DDD of opioids, other analgesics, anxiolytics/sedatives, and antidepressants between the lockdown and 2022 was found among the younger and healthier parts of the study sample, for example < 80 years of age, no comorbidity, no mental distress, good physical function, low fear of COVID-19, and no social isolation during COVID. For other analgesics, the change in prescriptions (lower in 2019 and higher in 2021 and 2022 compared with the lockdown) included fewer healthy members of all dichotomous groups, except those with mental distress. For anxiolytics/sedatives, we found sex differences, where males experienced an increase in 2022 compared to the lockdown period, whereas no changes were observed in females. An increase in the prescription fills of anxiolytics/sedatives was also observed in patients with comorbidities in 2022 (Tables S5 and S6).

Discussion

Two years after the Norwegian lockdown in March 2020, there was an overall increase in the number of older adults prescribed opioids and other analgesics, alongside an increase in the mean sum DDD of other analgesics and anxiolytics/sedatives compared with the lockdown period. For other analgesics, the increase began during the pre-pandemic period in 2019. Differences based on dementia status showed that increases in prescription fills and the mean sum of DDD occurred only in participants without dementia, whereas no differences were observed in participants with dementia. Our analyses revealed that increases in prescription fills and the mean sum DDD were primarily observed among the youngest old and healthier participants in the study sample.

Over the past decade, opioid use has increased worldwide [15]. However, a study examining opioid utilisation among older adults in Nordic countries from 2009 to 2018 revealed a decrease in all countries, except Iceland, where opioid use remained stable [15]. Our observation of an increase in opioid prescriptions 2 years after the pandemic indicates an increase in opioid utilisation in the older population, although we cannot be certain that this can be causally attributed to the pandemic. The increase in opioid prescriptions could be linked to the reduction or closure of non-pharmacological interventions such as physiotherapy and exercise facilities,

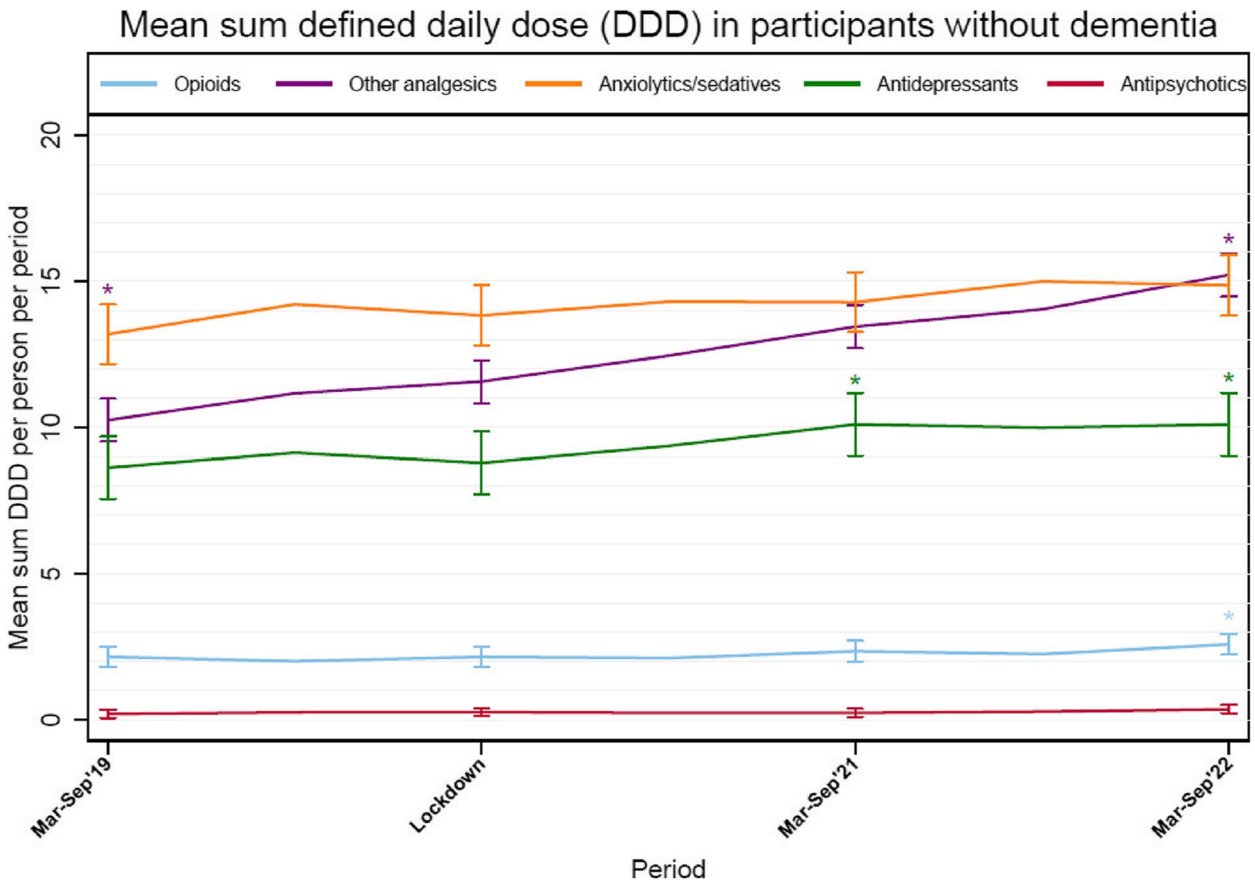

Fig. 7 Age and education adjusted mean sum of defined daily dose (DDD) per person per period with 95% confidence intervals (95% CI) for participants without dementia, calculated using multilevel mixed-effects linear regression

which are commonly used for pain management following the introduction of control measures [46, 50]. Our recent finding that older adults increased their contact with their general practitioners during the pandemic when other healthcare services were reduced or closed [18], might suggest an increased reliance on medication-based pain management, potentially contributing to a greater prescription of opioids. However, our findings contrast with those of a study from the USA, which found a decrease in opioid use during the first year of the pandemic in older adults despite a 30% reduction in non-pharmacological interventions [27]. A plausible explanation for these differences is that, unlike the USA, Norway had full national coverage for telephone and video consultations with healthcare services during the pandemic [49], which enabled the prescription of opioids to older adults, if necessary.

For other analgesics, the observed increase may be related to the recommendation to use such medications to manage COVID-19 symptoms during and after an infection [12]. Whether the increase observed between 2019 and the lockdown period was a result of the pandemic or whether the prescriptions for other analgesics had already risen before the COVID-19 outbreak remains unknown. However, other analgesics may be substitutes for non-pharmacological interventions for pain treatment. Contrary to expectations, we did not find any association between comorbidities or reduced physical function and prescriptions of opioids or other analgesics.

Our findings demonstrating an increase in the mean sum DDD for anxiolytics/sedatives during the COVID-19 pandemic, indicating an increase in treatment intensity, corresponds with earlier research conducted among older adults [7, 36, 48]. However, in contrast to previous studies, our results did not reveal any changes during the first year after the lockdown but showed an increase in the mean sum of DDD of anxiolytics/sedatives over a 2-year period. This suggests long-term deterioration linked to psychological stress resulting from the control measures imposed during the COVID-19 pandemic, where anxiolytics/sedatives may be seen as a proxy for the intensity of anxiety and sleep disorders among those who have already experienced such psychological stress.

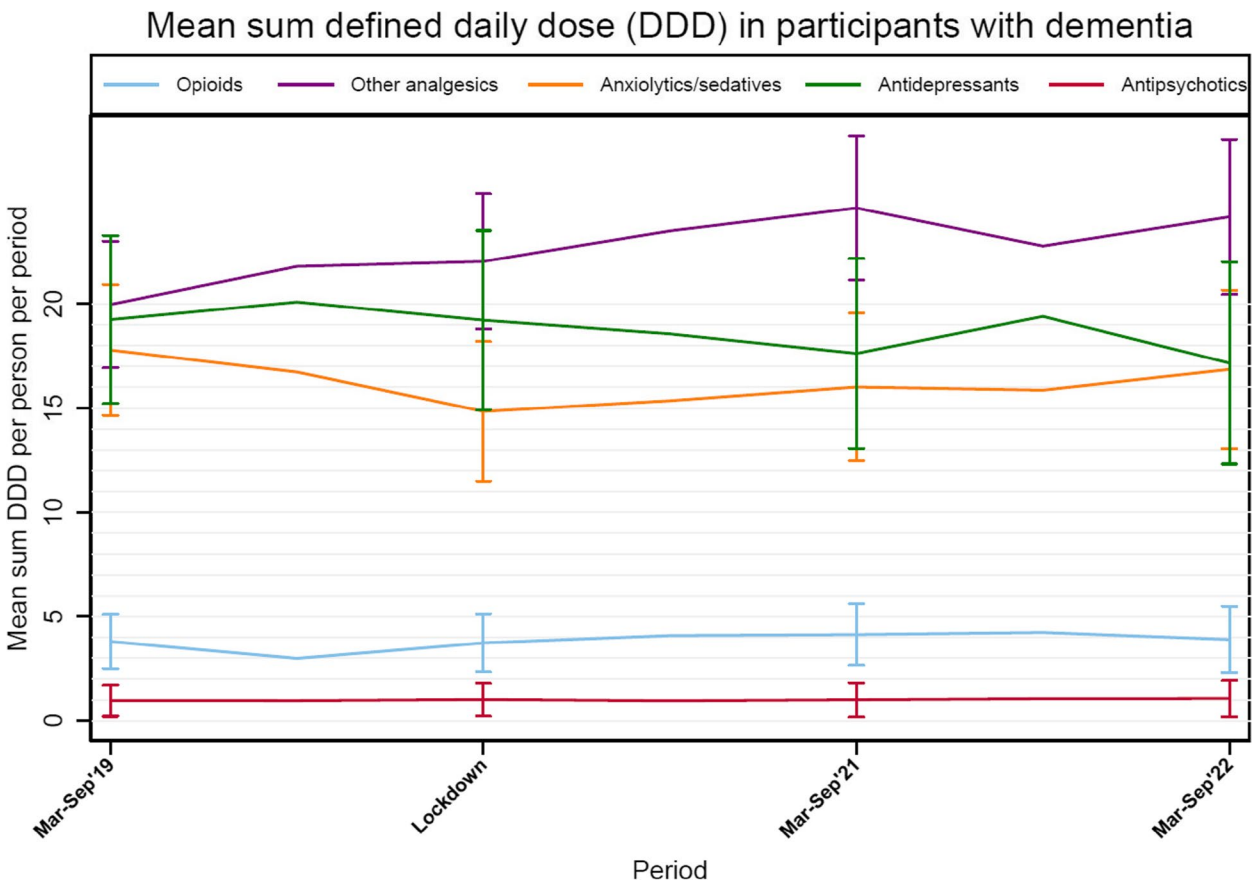

Fig. 8 Age and education adjusted mean sum of defined daily dose (DDD) per person per period with 95% confidence intervals (95% CI) for participants with dementia, calculated using multilevel mixed-effects linear regression

Furthermore, we found that participants with comorbidities had a higher mean sum of DDD for anxiolytics/sedatives in 2022 than during the lockdown period. This increase may be related to heightened anxiety about contracting COVID-19, as individuals with comorbidities are considered particularly vulnerable to severe health consequences [16]. There is also a concern that the observed increase in the mean sum DDD may be linked to the use of larger pack sizes, introduced to reduce pharmacy visits during the pandemic. While this might explain changes for other analgesics, though we have found no evidence to support this, it is less likely to account for the increase in DDD for anxiolytics/ sedatives, which emerged two years after the COVID-19 outbreak. At this point, containment measures had been lifted, reducing the likelihood that larger pack sizes were being used as a strategy to limit pharmacy visits.

It has previously been suggested that an increase in social isolation and fear of COVID-19 infection may have contributed to an increase in use of benzodiazepines (sedatives) during the pandemic [36]. However, we did not find any such an association. We found that males had a higher rate of prescription fills and mean sum DDD of anxiolytics/sedatives in 2022 than during the lockdown period, whereas no differences between the lockdown and pre- or post-lockdown periods were observed for females. This finding can be explained by the fact that women are more frequent users of such medications than males [6], leading to a less pronounced increase among females. Furthermore, research during the pandemic has shown that older males had less contact with others through screen-based media than do females [9], and additional studies have indicated that those who did not use technology to stay connected experienced higher levels of psychological stress [5, 29].

In our study, the increase in prescriptions of opioids, other analgesics, and anxiolytics/sedatives was primarily observed in the "healthiest groups", that is, those younger than 80 years, with high education, living with someone, no comorbidities, no mental distress, high physical function, no social isolation during COVID, and low fear of COVID-19. There were only a few exceptions, such as an increase in opioid prescriptions among participants aged ≥ 80 years and those living alone, and an increase

in prescriptions of other analgesics among those living alone and those experiencing fear of COVID-19. One reason for this may be that the "healthiest" represent the largest groups in the analysis. However, it is possible that this group finds it more challenging than more vulnerable groups when their quality of life is compromised. Our findings also suggest that individuals with more resources are more likely to obtain the medications they need, which aligns with trends observed in earlier research [17]. Previous research has indicated that vulnerable groups such as those with dementia, comorbidities, reduced mental health, and reduced physical function tend to use more medication than healthy individuals [8, 38], possibly resulting in a less pronounced increase in medication use among these groups. Furthermore, vulnerable groups may already receive more (specialised) care and are more easily offered alternative treatment options within that care, making it unnecessary to start or increase medication.

We noticed some exceptions in the study, with higher opioid prescription rates among individuals aged ≥ 80 years and those living alone. This may partly be explained by the oldest old experiencing higher levels of pain than their younger counterparts and requiring additional assistance to implement non-pharmacological pain management strategies. For this age group, activities such as walking or exercising independently may be challenging, potentially resulting in increased reliance on medication for pain relief. In a prior study on healthcare services, we found that older adults aged ≥ 80 years without dementia experienced increased hospitalizations after the COVID-19 lockdown compared to before the lockdown, suggesting significant health declines during the pandemic [19], likely resulting in a greater need for pain medication. Similarly, those living alone may require more opioids and other analgesics for pain management, as they likely face challenges initiating physical activity independently, contributing to reduced physical function and greater pain. Moreover, while fear of COVID-19 might be expected to increase psychotropic medication use, an increase in analgesic use could suggest that fear manifests as somatic symptoms. This aligns with evidence linking fear and health anxiety to heightened somatic complaints, such as pain or other physical discomforts [23].

For all medications analysed, participants with dementia had a higher number of prescriptions than those without dementia during the study period. Studies from other countries have indicated an increase in the prescription of psychotropic medications for people with dementia during the initial months of the pandemic [26, 32], which persisted until 2021 [26, 30, 45]. However, while those without dementia experienced an increase in prescriptions of opioids, other analgesics, and antidepressants, we did not observe any change in prescriptions for those with dementia. Our findings may have been different if people with dementia admitted to nursing homes were included in the study sample, as they represent individuals with more severe dementia and may be more vulnerable to the pandemic's impact on medication use [26, 30]. However, our findings are consistent with previous Norwegian findings [13], suggesting that the pandemic had no overall effect on the use of analgesics or psychotropic medications among home-dwelling people with dementia. Furthermore, our recent study on healthcare services found that, although people with dementia experienced a temporary reduction in healthcare services during the lockdown, these services were restored within 6–12 months. Additionally, home-dwelling individuals with dementia experienced a similar increase in general practitioner visits during the lockdown and subsequent months as other older adults, ensuring equal opportunities for new prescriptions [19]. However, we cannot know whether people with dementia were prescribed drugs which they did not collect from a pharmacy, as we only have information on dispensed prescriptions. Nevertheless, the availability of multi-dose dispensing systems and home care services should help mitigate these challenges and ensure that people with dementia received appropriate medical care during the pandemic.

Strengths and limitations

The strength of this study lies in its use of individual longitudinal data from a large population-based survey sample linked to the unique national registry data on medication prescriptions. Because data from the HUNT Study were collected just before the pandemic exposure, they were not affected by recall bias. However, data on social isolation and fear of COVID-19 were gathered 1 year after the COVID-19 outbreak, potentially introducing memory-related biases. All participants were residents of the central region of Norway, which may not be representative of the population in other regions of Norway or internationally. Furthermore, the study sample predominantly comprised individuals of Norwegian ethnicity, which limited the generalisability of the results to other ethnic groups. In HUNT4, diagnostic codes and health care use were similar between participants and invitees, but participants aged > 80 years had more general practice visits, while non-participants more often used home nursing [3]. Although the study included a significant number of participants diagnosed with dementia, they accounted for only 10% of the sample, which possibly reduced the ability to detect significant differences over time in the dementia group. The lack of consideration for incident cases of dementia during the study period may limit the study's ability to fully capture

differences in medication between those with and without dementia over time. Additionally, individuals with dementia who were admitted to nursing homes were censored from the study due to the unavailability of prescription data in such settings. This exclusion may have introduced a bias by systematically removing individuals requiring higher medication use, for example, to manage neuropsychiatric symptoms. Misclassification arising from the inclusion of incident dementia cases in the "no dementia" group would most likely bias the observed differences towards null, hence it is possible that the observed differences are smaller than what would be expected had incident dementia cases been captured.

Conclusion

Two years after the COVID-19 lockdown, we found an increase in the prescription of analgesics and psychotropic medications in older adults in Norway, which may indicate a long-term decline in the health of older adults after the COVID-19 outbreak. Hence, our results imply that a national stressor such as a pandemic may place older adults at risk of increased medication use during and after the event. We found no impact of the pandemic on medication prescriptions among home-dwelling people with dementia, suggesting that vulnerable individuals in high-income countries, such as Norway, appear to have been adequately cared for. However, our findings suggest that the pandemic may have rendered otherwise healthy older adults more vulnerable, leading to increased medication use with the potential risk of inappropriate use. These findings are important for improving health policies to address future major stressors that impair social interactions and threaten mental health. Additionally, these findings emphasise the importance of reassessing medication prescriptions in older adults after the pandemic.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12877-025-05745-8.

Additional file 1.

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Authors' contributions
GS led the study project and is responsible for the concept and design of the study, together with BHS, SB and TLI. EZ, BHS and TLI conducted the analysis. TLI, EZ, BHS, SB, DG, GL, HL, SEM, ROV, AMMR, and GS contributed to interpreting the data. TLI drafted the paper, with substantially contributions from all the authors in revising the drafted work. All authors read and approved the final manuscript

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Data availability
The data supporting the findings of this study are available from the HUNT database and the Norwegian Prescription Database via Helsedata. However, due to licensing restrictions, these data are not publicly accessible. Data may be obtained from the authors upon reasonable request, pending approval from the HUNT database and Helsedata.no

Declarations

Ethics approval and consent to participate
This study received approval from the Regional Committee for Medical and Health Research Ethics, Norway (REK Southeast B, reference number 182575). All procedures followed REK's guidelines, in alignment with the principles of the Declaration of Helsinki. This study is part of a larger project registered at ClinicalTrials.gov (ID: NCT 04792086). Informed written consent was obtained from all participants in the HUNT4 70+ study. For participants with reduced capacity to consent, their next of kin provided consent on their behalf. The consent form clearly stated that collected data may be linked to other registries for the purpose of conducting approved research projects, as was done in this study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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