

### Additional file 3. Overview of included studies on changes in psychotropic use for BPSD during the COVID-19 pandemic

Authors, year, country	Methods Design; data sources; comparison periods <sup>†</sup>	Setting Type; urbanity; number of beds	PwD Sample size; mean age; female %; race/ethnicity; cognitive function; dementia subtype	Measures	Main relevant findings: Changes in psychotropic use during the pandemic					Summary
					Antipsychotics	Anxiolytics/ Hypnotics (Including BZD)	Antidepressants	Anticonvulsants/ Antiepileptics	Overall use	
<i>Long-term care settings</i>										
Coe et al., 2023 <sup>31</sup> ; US	Quantitative repeated cross-sectional; MDS assessments; <u>pre-pandemic</u> : 01/2018–02/2020 vs. <u>pandemic</u> : 03/2020–06/2021	Over 420 NHs in Michigan; NR; on average 106	37,427; 84.1 ± 8.7; 70%; white 81%, black 17%, other 2%; NR; NR	Monthly percentage of residents receiving each medication; slope change (SC) over two periods	↑* e.g., 14.2% in Feb 2020 vs. 15.1% in June 2021; SC = 0.07, 95% CI [0.02, 0.12]	↑*** e.g., 16.9% in Feb 2020 vs. 19.1% in June 2021; SC = 0.17, 95% CI [0.13, 0.21] (Anxiolytics)	↑*** e.g., 52.4% in Feb 2020 vs. 58.0% in June 2021; SC = 0.41, 95% CI [0.31, 0.50]	N/A	N/A	<ul style="list-style-type: none"> <li>Slope changes comparing pre- and during COVID-19 were significantly positive for the use of antipsychotics, antianxiety drugs, and antidepressants.</li> <li>There was no significant slope change observed in the use of hypnotics.</li> </ul>
Ferro Uniguen et al., 2022 <sup>17</sup> ; Spain ‡	Quantitative repeated cross-sectional; EHR data; <u>pre-pandemic</u> : 04/2018–03/2020 vs. <u>pandemic</u> : 04/2020–03/2021	Seven NHs in Gipuzkoa; NR; NR	163; 83.9 ± 8.9; 70%; NR; severe dementia (GDS: 6-7) 66%; AD 52%, VaD 6%, LBD 5%	Monthly average percentage of residents with prescriptions; absolute difference (AD) between two periods	↓*** 80.5% vs. 78.2%; AD = -2.31, 95% CI [-3.68, -0.93]	→ 32.0% vs. 31.9%; AD = -0.28, 95% CI [-2.40, 2.34] (BZD)	↑*** 63.4% vs. 71.9%; AD = 8.57, 95% CI [6.89, 10.24]	↑*** 36.3% vs. 42.4%; AD = 6.10, 95% CI [3.20, 9.00]	N/A	<ul style="list-style-type: none"> <li>Antipsychotic drug use significantly decreased.</li> <li>The use of benzodiazepines showed no significant change.</li> <li>Antidepressants and antiepileptic drug use increased significantly.</li> </ul>

Additional file 3. Overview of included studies on changes in psychotropic use for BPSD during the COVID-19 pandemic (continued)

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					Antipsychotics	Anxiolytics/ Hypnotics (Including BZD)	Antidepressants	Anticonvulsants/ Antiepileptics	Overall use	
<i>Long-term care settings (continued)</i>										
Hoel et al., 2022 <sup>37</sup> ; Germany	Mixed methods cross-sectional; a follow-up questionnaire formed part of a national online survey involving 417 employees at the managerial level; <u>pre-pandemic</u> : not specified vs. <u>pandemic</u> : 07/2020–02/2021	401 NHs nationwide; NR; 86.3 ± 41.2	all NR	One custom-designed item	N/A	N/A	N/A	N/A	↑	• An overall low increase in pharmacological interventions for behavioral symptoms was noted in fewer than six percent (5.6%, n = 344) of the included NHs.
Maxwell et al., 2024 <sup>38</sup> ; Canada	Quantitative population-based, repeated cross-sectional; administrative databases; <u>pre-pandemic</u> : 01/2018–02/2020 vs. <u>pandemic</u> : 03/2020–12/2021	256 publicly subsidized AL settings in Alberta; urban 91%; ≤ 50 22%, 51–100 41%, 101–200 27% > 200 10%	2,874; 82.4 ± 9.8; 68%; NR; moderate/severe impairment 65%; NR	Prevalence ratios (PR) for each medication dispensed	↑* e.g., PR = 1.22, 95% CI [1.16, 1.28] in Sep–Dec 2021	↓* e.g., PR = 0.86, 95% CI [0.78, 0.95] in Jun–Aug 2021 (BZD)	↑* e.g., PR = 1.09, 95% CI [1.06, 1.13] in Sep–Dec 2021	→ e.g., PR = 1.06, 95% CI [0.96, 1.19] in Sep–Dec 2021	N/A	• There has been a significant increase in the use of antipsychotic and antidepressant drugs; antipsychotic use increased to a greater degree than antidepressant use. • Overall, benzodiazepine use decreased significantly.
McDermid et al., 2023 <sup>34</sup> ; UK	Quantitative retrospective cohort; prescribing records; <u>pre-pandemic</u> : 2015–2016 vs. <u>pandemic</u> : 04/2021–01/2022	149 (pre-pandemic) and 69 (pandemic) NHs; NR; NR vs. on average 42	847 vs. 666; 88.4 ± 8.5 vs. 85.5 ± 8.0; 69% vs. 70%; NR; severe dementia 81% vs. 72%; NR	Mean percentage of residents with prescription	↑*** 18% vs. 32%	N/A	N/A	N/A	N/A	• There was a significant increase in antipsychotic prescriptions. • In the pre-pandemic sample, all NHs had prescribing rates ranging from six to 32%, with two outliers at 40% and 52%. • In the pandemic sample, the median prescription rates were 7%, 20%, and 59%, across the low, medium, and high antipsychotic use tertiles, respectively.

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					Antipsychotics	Anxiolytics/ Hypnotics (Including BZD)	Antidepressants	Anticonvulsants/ Antiepileptics	Overall use	
<i>Long-term care settings (continued)</i>										
Sizoo et al., 2022 <sup>39</sup> , Netherlands	Quantitative longitudinal cohort; data from electronic prescription system; pandemic: 02/2020 vs. 08/2020 (during the gradual easing of restrictions after the first wave of COVID-19)	19 NHs in Amsterdam; urban; NR	252; 84 ± 9; 71%; NR; mild/moderate dementia (GDS: 1-5) 30%, severe (GDS: 6-7) 70%; AD 41%, VaD 16%, mixed 14%, other 8%, not specified 21%	Monthly point prevalence of residents prescribed	→ e.g., 21.0% in Feb 2020 vs. 22.9% in Aug 2020	→ e.g., 13.7% in Feb 2020 vs. 13.7% in Aug 2020 (BZD)	→ e.g., 24.4% in Feb 2020 vs. 25.4% in Aug 2020	N/A	N/A	• Throughout the first wave of the pandemic, the use of antipsychotics, benzodiazepines, and antidepressants remained stable over time.
Wang et al., 2023 <sup>36</sup> , Canada	Quantitative retrospective cohort; eMARs data; pre-pandemic: 01/2018–05/2019 vs. pandemic: 01/2020–05/2021	Two LTC settings; urban; over 300 beds	658 vs. 621; 94.4 ± 3.8 vs. 93.9 ± 5.7; 86% vs. 81%; NR; severe dementia 54% vs. 36%; AD 22% vs. 16%, VaD 16% vs. 6%, mixed 11% vs. 9%, other 1% vs. 3%, not specified 51% vs. 66%	Prevalence of residents who received ≥ 1 PRN injections	↑ 5.8% vs. 12.1% (haloperidol); 0% vs. 0.3% (Olanzapine)	↑ 2.0% vs. 3.5% (Lorazepam)	N/A	N/A	N/A	• The prevalence of patients who received PRN haloperidol, olanzapine, and lorazepam increased from 5.8% to 12.1% and from 0% to 0.3%, from 2.0% to 3.5% respectively.
Yan et al., 2023 <sup>33</sup> , US	Quantitative population-based, repeated cross-sectional; MDS and Medicare claim data; pre-pandemic: 2017Q1–2020Q1 pandemic: 2020Q2–2020Q4	15,751 NHs; NR; 141.3 ± 88.4	2,787,961; ≥ 85 51; 68%; White 48%, Black 36%, Hispanic 16%; severe impairment 18%; NR	Percentage of any antipsychotic use during a quarter	↑ <sup>***</sup> 23.7% vs. 24.8%	N/A	N/A	N/A	N/A	• Between 2017Q1 and 2020Q4, antipsychotic use significantly increased across all four race/ethnicity groups, rising from 23.7% to 24.8% (p < .001). • High minority NHs experienced a greater increase in antipsychotic use compared to low-minority NHs.

Additional file 3. Overview of included studies on changes in psychotropic use for BPSD during the COVID-19 pandemic (continued)

Authors, year, country	Methods Design; data sources; comparison periods <sup>†</sup>	Setting Type; urbanity; number of beds	PwD Sample size; mean age; female %; race/ethnicity; cognitive function; dementia subtype	Measures	Main relevant findings: Changes in psychotropic use during the pandemic					Summary
					Antipsychotics	Anxiolytics/ Hypnotics (Including BZD)	Antidepressants	Anticonvulsants/ Antiepileptics	Overall use	
<i>Communities</i>										
Cohen et al., 2020 <sup>41</sup> , Argentina	Quantitative cross-sectional; a survey among FCGs of patients with dementia living at home; <u>pre-pandemic</u> : not specified vs. <u>pandemic</u> : 03/2020–04/2020	Home; NR; N/A	119; 81.2 ± 7.0; 65%; NR; mild dementia (CDR 1) 34%, moderate (CDR 2) 32%, severe (CDR 3) 34%; AD 67%, mixed 22%, VaD 6%, others 2%	Questions about whether there was a need to initiate each medication	↑	↑ (BZD)  ↑ (Hypnotics)	↑	N/A	N/A	<ul style="list-style-type: none"> <li>• FCGs reported an increase in the use of antipsychotics (20.2% of respondents), benzodiazepines (15.1%), antidepressants (10.1%), and hypnotics (6.7%).</li> <li>• This finding was independent of the severity of dementia.</li> </ul>
Moretti et al., 2021 <sup>38</sup> , Italy	Quantitative longitudinal cohort; weekly video-phone survey data obtained by patients and their caregivers; <u>pandemic</u> : 03/2020 vs. 05/2020 and 07/2020 (at the end of the lockdown and two months later)	Home; NR; N/A	221; 75.6 ± 6.6; 54%; NR; mild/moderate dementia 66%, severe dementia 34%; VaD only	Percentage of patients prescribed	↑ 17% vs. 35%, and then 22% (Typical neuroleptics); 24% vs. 49% and then 31% (Atypical neuroleptics)	↑ 26% vs. 96% and then 41% (BZD)	N/A	N/A	N/A	<ul style="list-style-type: none"> <li>• During the lockdown period, patients reported an increase in the use of both benzodiazepines and typical and atypical neuroleptics.</li> </ul>

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					Antipsychotics	Anxiolytics/ Hypnotics (Including BZD)	Antidepressants	Anticonvulsants/ Antiepileptics	Overall use	
<i>Mixtures</i>										
Harding et al., 2023 <sup>20</sup> ; UK	Mixed methods cross-sectional; a survey to 24 people with dementia and 184 caregivers living in care homes or communities; <u>pre-pandemic</u> : not specified vs. <u>pandemic</u> : not specified (08/2020–09/2020)	A mixture of care homes and communities; NR; NR	208; NR; NR; NR; NR; young onset, non-memory-led and inherited dementias such as posterior cortical atrophy (PCA), primary progressive aphasia (PPA), etc.	Questions about whether there were changes to medication as a consequence of the lockdown	N/A	N/A	N/A	N/A	↑	• Overall, people with dementia and caregivers reported changes to medication (26%) during lockdown.
Harrison et al., 2021 <sup>41</sup> ; multinational (predominately US)	Quantitative retrospective cohort; TriNetX <sup>8</sup> ; <u>pre-pandemic</u> : 01/2019–12/2019 vs. <u>pandemic</u> : 01/2020–12/2020	A mixture of hospitals, primary care, etc.; NR; N/A	27,050 vs 31,963; 80.7 ± 7.5 vs. 80.7 ± 7.3; 58% vs. 56%; white 76% vs. 74%; black 12% vs. 15%; NR; 75% had more than one type	Proportion of individuals receiving medications	↑ <sup>***</sup> 14.7% vs. 16.4%	N/A	N/A	N/A	N/A	• There was a significant higher proportion of PwD receiving antipsychotics compared to the pre-pandemic period.
Luo et al., 2023 <sup>42</sup> ; multinational (France, Germany, Italy, South Korea, UK, and US)	Quantitative population-based retrospective cohort; EHR and claims data from 8 databases in six countries; <u>pre-pandemic</u> : 01/2016–02/2020 vs. <u>pandemic</u> : 04/2020–2021	A mixture of hospitals, primary care, etc.; NR; N/A	857,238; ≥ 65; 58%; NR; NR; NR	Prevalence of patients being prescribed by year and month; rate ratios (RR) for prescribing rates compared with the same month in 2019	↑ <sup>*</sup>	N/A	N/A	N/A	N/A	• The prescribing rates of antipsychotics increased in 2020 and remained high in 2021 in six databases representing all countries: France, Germany, Italy, South Korea, the UK, and the US.

### Additional file 3. Overview of included studies on changes in psychotropic use for BPSD during the COVID-19 pandemic (continued)

Authors, year, country	Methods Design; data sources; comparison periods <sup>†</sup>	Setting Type; urbanity; number of beds	PwD Sample size; mean age; female %; race/ethnicity; cognitive function; dementia subtype	Measures	Main relevant findings: Changes in psychotropic use during the pandemic					Summary
					Antipsychotics	Anxiolytics/ Hypnotics (Including BZD)	Antidepressants	Anticonvulsants/ Antiepileptics	Overall use	
<i>Mixtures (continued)</i>										
Richards et al., 2022 <sup>32</sup> ; US	Qualitative; interviews with 4 FCGs and 3 NPs caring for people with dementia living in NHs, and 7 FCGs of people with dementia living at home; <u>pre-pandemic</u> : not specified vs. <u>pandemic</u> : not specified (10/2020–05/2021)	A mixture of NHs and communities; NR; N/A	all NR	Semi-structured interview	N/A	↑ (Hypnotics)	N/A	N/A	N/A	• Both of caregivers living in NHs and communities reported increased sleep medication use to manage worsened sleep disturbances and nighttime agitations.
Schnier et al., 2023 <sup>35</sup> ; UK	Quantitative population-based retrospective cohort; EHR data from Welsh databank; <u>pre-pandemic</u> : 01/2016–02/2020 vs. <u>pandemic</u> : 03/2020–08/2021	A mixture of primary care and care homes (14.4%); NR; N/A	57,396; median 82; 61%; NR; AD 44%, VaD 31%, LBD 2%, FTD 1%, not specified 31%	Number of prescriptions per 10,000 person-months	↑ (Overall, Risperidone, Olanzapine) ↓ (Quetiapine)	↓ (BZD)	N/A	N/A	N/A	• Antipsychotic drug use increased throughout 2020, with the absolute change being relatively small, ranging from 1,253 prescriptions per 10,000 person-months in March 2019 to 1,305 in September 2020. • There was a downward trend in benzodiazepine use from the pre-pandemic period and the pandemic period.

AD, Alzheimer's disease; AL, assisted living; BZD, Benzodiazepine; CDR, Clinical Dementia Rating; CI, confidence interval; EHR, electronic health records; EMR, electronic medical records; eMARs, electronic medication administration records; FCG, family care giver; FTD, frontotemporal dementia; GDS, Global Deterioration Scale; LBD, Lewy body dementia; MDS, Minimum Data Set; N/A, not applicable; NH, nursing home; NP, nurse practitioner; NR, not reported; PRN, Pro Re Nata (as necessary); PwD, people with dementia; VaD, vascular dementia.

<sup>†</sup> We presented the data collection period in parentheses if the comparison period was not specified.

<sup>‡</sup> We included data from psychogeriatric units, where 90% of residents had dementia, because more than half of the residents in geriatric units did not have dementia.

<sup>§</sup> TriNetX is a global federated health research network, providing access to statistics on EMR from participating healthcare organizations, predominately in the US.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$