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DESCRIPTIVE EPIDEMIOLOGY OF UNDETECTED DEPRESSION IN INSTITUTIONALIZED OLDER PEOPLE

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Javier Damián, M.D., Ph.D., M.P.H.*†, Roberto Pastor-Barriuso Ph.D.*‡, Emiliana Valderrama-Gama, M.D., Ph.D.§,

* National Center for Epidemiology, Carlos III Institute of Health, Madrid, Spain

† CIBER in Neurodegenerative Diseases (CIBERNED), Madrid, Spain

‡ CIBER in Epidemiology and Public Health (CIBERESP), Madrid, Spain

§ “Campo de la Paloma” Primary Care Center, IMSALUD, Madrid, Spain

Technical assistance: Ana Villaverde-Hueso MPH, pharmacist at the Rare Diseases Research Institute (Carlos III Institute of Health), carried out the identification and classification of medications.

Correspondence: Javier Damián. National Center for Epidemiology, “Carlos III” Institute of Health. Av/ Monforte de Lemos 5; 28029-Madrid, Spain. E-mail: jdamaian@isciii.es. Tel: +34 91 822 2230.

Alternate correspondent: Roberto Pastor-Barriuso. National Center for Epidemiology, “Carlos III” Institute of Health. Av/ Monforte de Lemos 5; 28029-Madrid, Spain. E-mail: rpastor@isciii.es. Tel: +34 91 822 2359.

Running title: undetected depression in homes for the aged

ABSTRACT

Objective. To measure the prevalence and associated factors of undetected depression in institutionalized older people.

Design and Setting. Epidemiologic cross-sectional study in nursing homes and residential facilities.

Participants. A stratified cluster sample of residents 65 years of age and older living in institutions of Madrid (Spain).

Measurements. Residents were considered to be depressed if they met at least one of these three criteria: 10-item Geriatric Depression Scale ≥ 4 , physician's diagnosis, or antidepressant use. Prevalence of undetected depression was defined as the proportion of depressed residents without documented diagnosis or treatment.

Results. 255 of 579 residents had depression (weighted prevalence 46.1%, 95% confidence interval [CI] 41.0–51.3%) and 108 depressed residents were undetected (undetected prevalence 41.5%, 95% CI 33.2–50.2%). Undetection was lower in younger residents, private versus public facilities (sex-, age-, and size-adjusted prevalence ratio [PR] 0.59, 95% CI 0.37–0.94), and larger facilities (sex-, age-, and ownership-adjusted PR 0.94 per 50-bed increase, 95% CI 0.88–1.00). Undetected depression was higher in residents with poor self-rated health (sex- and age-adjusted PR 1.83, 95% CI 1.24–2.73), while the opposite came about for physician-rated health (PR 0.65, 95% CI 0.44–0.95). Undetection decreased 11% (95% CI 4–17%) per 1-medication increase, and it was lower in Alzheimer disease, anxiety, and arrhythmia patients.

Conclusions. Number of medications and self-rated health were the main determinants of undetected depression. Physician-rated health, facility characteristics (size and ownership), and some diseases could also be considered.

Keywords: depression; depressive symptoms; epidemiology; homes for the aged; long-term care.

INTRODUCTION

Depression is highly prevalent in older people, particularly in nursing homes. The prevalence of depression disorders among institutionalized elderly populations varies between 14 and 27%¹⁻³, with an additional 13 to 24% of residents with clinically relevant depressive symptoms^{1,4}. Prevalence of depressive disorders and depressive symptoms depends on incidence and the average duration of the state, the latter being clearly affected by detection rates. Depression in older people living in nursing homes usually involves special features that make detection more difficult. In particular, quiet or retarded depressed residents may be overlooked⁵, and the complex relation of depression with dementia and cognitive impairment further complicates recognition. Although signs of improvement are plausible⁶ and some initiatives are promising⁷, undetected depression in the institutionalized elderly continues to be severe.

The present study aims at estimating the proportion of all depression cases that are undetected, as well as identifying the main determinants of undetected depression, among a representative sample of older people living in nursing and residential homes.

METHOD

Study population and exclusion criteria

This cross-sectional study uses data from a survey conducted between June 1998 and June 1999 in a probabilistic sample of residents 65 years of age and older of public and private nursing homes in the city of Madrid (Spain) and a surrounding area of 35 km. Study participants were selected through a stratified cluster sampling, including one stratum with 22 public and 25 concerted (privately owned but publicly funded) nursing homes, and the other stratum with 139 private institutions. At a first stage, we sampled 25 public/concerted and 30 private institutions with probability proportional to its size. At a second stage, we randomly sampled 10 men and 10 women within each selected public/concerted facility, and 5 men and 5 women from each selected private nursing home. Four private institutions (totaling 40 sample subjects) refused participation and 45 additional residents could not be selected due to absence or refusal, leading to an overall response rate of 89% (715 of the 800 sample residents). Due to refusal, prolonged absence or sampling frame errors, thirty nine subjects were randomly substituted with residents of the same facility and sex, so that information could be gathered through structured interviews in 754 residents.

For the present study, we excluded 34 residents with less than 60 days of stay to avoid potential transient depressive symptoms linked to a recent nursing home admission, 83 patients with severe cognitive impairment (see definition below), which may invalidate self-rating of depressive symptoms, and 58 subjects with insufficient information to define depression status (see below). Thus, the final study sample comprised 579 residents.

The Research Committee of the Carlos III Institute of Health approved the study. Informed consent was obtained from all subjects or their next of kin.

Depression status

Physician's diagnosis of depression and prescription of antidepressants were ascertained by interviewing nursing home physicians (in 92% of residents) or nurses (8%), and by reviewing medical records. A 10-item version of the Geriatric Depression Scale (GDS) ⁸ was administered verbally to the residents by trained geriatricians or residents in geriatrics. This self-report measurement instrument assesses depressive symptoms over the previous week without focusing on physical complaints, and it has shown adequate diagnostic accuracy in the institutional setting, including residents with mild to moderate cognitive impairment ^{9,10}. Although this shortened version of the GDS has not been validated for Spanish population, translation and adaption of longer 15- and 30-item versions to the Spanish language were straightforward and showed similar psychometric properties to those of the original questionnaires ^{11,12}.

Prevalent depression was defined as a score of 4 or higher on the 10-item version of the GDS ⁹, a physician's diagnosis of depression, or use of antidepressants. Residents with prevalent depression were considered to be detected if they had physician's diagnosis or prescribed antidepressants.

Other relevant variables

Sex, age, marital status, educational level (less than secondary –12 years–, secondary or more), and length of stay in the nursing home were obtained by interview. Chronic conditions other than depression (see Table 4) and number of different medications used in the past 7 days were gathered from the physician's interview and medical records. We further recorded whether subjects used antidepressants (code N06A of the World Health Organization Anatomical Therapeutic Chemical Classification), anxiolytics (code N05B), and antipsychotics (code N05A). Functional dependency in performing basic activities of daily living was assessed by residents (55%) or their main caregivers (if assigned, 45%) using the modified Barthel index ¹³.

Cognitive status was evaluated using the Short Portable Mental Status Questionnaire (SPMSQ, range of 0–10 errors) ¹⁴, which was administrated to the residents with some modifications to adapt to the institutional setting, as well as through the Minimum Data Set Cognition Scale (MDS-COGS, 0–10 point scale) ^{15,16}, which obtains an assessment from the main caregiver based on selected Minimum Data Set questions. According to their scores on both scales, residents were classified into three categories: normal cognition (≤ 2 education-adjusted SPMSQ errors and ≤ 1 MDS-COGS points), mild to moderate cognitive impairment (3–7 SPMSQ errors and ≤ 8 MDS-COGS points, or ≤ 7 SPMSQ errors and 2–8 MDS-COGS points), and severe cognitive impairment (≥ 8 SPMSQ errors or ≥ 9 MDS-COGS points).

Vision and hearing impairments were assessed by means of the two corresponding Minimum Data Set four-category questions ¹⁷, further dichotomized. Residents and facility physicians were also asked to assess independently the resident's general health as very good, good, fair, poor, or very poor, then dichotomized as very good/good versus fair/poor/very poor. No health-related questions that could influence their response were made before rating the resident's health. Finally, residents were asked whether they suffered from pain in the past 7 days, and their responses were classified as none, less than daily, and daily.

Statistical analysis

The prevalence of depression and the proportion of all depression cases that are undetected were estimated with their 95% confidence intervals (CIs) by participant sociodemographic characteristics and health conditions. Among those residents with depression, the sex- and age-adjusted prevalence ratios of undetection and their 95% CIs comparing different levels of relevant variables were calculated using robust Poisson models. Poisson regression with robust variance estimators has been shown to provide unbiased point estimates and correct standard errors for prevalence ratios, irrespective of the outcome prevalence ^{18,19}.

Due to the complex sampling design and the different selection probabilities of study participants (residents of public nursing homes and men were oversampled), all analyses were weighted to the underlying population distribution and accounted for the effect of stratification and clustering on point and interval estimates. Analyses were performed using Stata statistical software, release 10 (Stata Corporation, College Station, Texas) ²⁰.

RESULTS

Depression prevalence

From all 579 residents, 172 had depressive symptoms (GDS \geq 4, population-weighted and design corrected prevalence of 32.1%, 95% CI 27.4–37.4%), 147 had physician's diagnosis of depression (prevalence of 27.0%, 95% CI 22.1–32.5%), and 58 used antidepressants (prevalence of 11.6%, 95% CI 8.4–15.8%). Combining these 3 criteria, the overall prevalence of depression was 46.1% (95% CI 41.0–51.3%). Depression figures were substantially higher among those residents with 4 or more chronic conditions, increased polypharmacy, anxiolytic and antipsychotic medications, increased functional dependency, and bad self-rated and physician-rated health. Somewhat higher depression prevalences were also found in women, residents with mild to moderate cognitive impairment, and those with increased pain frequency (Table 1).

Undetected depression

Among 255 residents with depression, 108 were not diagnosed by their nursing home physicians nor received antidepressants (prevalence of undetected depression of 41.5%, 95% CI 33.2–50.2%). Undetection was more prevalent among those depression cases with lower educational level, intermediate multimorbidity level, reduced polypharmacy, no anxiolytic prescriptions, bad self-rated health, and good physician-rated health (Table 1).

The sex- and age-adjusted prevalence of undetected depression was slightly higher in male, espoused, less educated, and long-stay residents (Table 1). There was a positive association of undetection with increasing age, showing a linear behavior (sex adjusted prevalence ratio [PR] of 1.10 [95% CI 0.99–1.23] per 5-year increase). The small protective effect linked to concerted and private facilities notably increased after additional adjustment for facility size, a variable strongly related to ownership status (median number of beds of 394, 213, and 61 for public, concerted, and private institutions, respectively). Compared with public facilities, the sex-, age-, and size-adjusted prevalence ratios of undetected depression were 0.56 (95% CI 0.34–0.92) in concerted and 0.59 (95% CI 0.37–0.94) in private institutions. Also, undetection decreased with increasing facility size, with a sex-, age-, and ownership-adjusted PR of 0.94 (95% CI 0.88–1.00) for each 50-bed increase. Regarding general health conditions, the number of chronic diseases only showed a higher sex- and age-adjusted prevalence of undetected depression in the intermediate range of 2–3 conditions, that increased significantly after additional adjustment for number of medications (PR: 1.50 [95% CI 1.01–2.23] for 2–3 versus 0–1 chronic conditions). A clear negative association was observed for number of medications and anxiolytic use (Table 1); the association was linear, with an 11% reduction in undetection per 1-drug increase (sex- and age-adjusted PR: 0.89 [0.83–

0.96]). The risk of undetection was 41% lower for anxiolytic users compared to nonusers (Table1). Among those with symptoms (≥ 4 on the GDS) undetection decreased with increasing its severity (sex- and age-adjusted PR: 0.88 [95% CI 0.80–0.97] per 1-point increase in GDS). In addition, undetected depression was significantly higher in residents with bad self-rated health (PR: 1.83) and lower in those with poor physician-rated health (PR: 0.65) (Table1).

With respect to specific medical conditions (Table 2), undetected depression was significantly lower among residents suffering from Alzheimer disease (PR: 0.28), anxiety disorders (prevalence ratio of 0.55), and arrhythmia (PR: 0.58). The remaining conditions, with the only exception of diabetes (PR: 1.42), were compatible with null effect. Similar results were obtained after further adjustment for multimorbidity.

DISCUSSION

Population features

In Spain the model of care is fundamentally familiar and informal; 83% of dependent older people receive informal care, with a widespread tendency to avoid institutionalization²¹ (this may be changing gradually due to the increasing incorporation of women to workforce and to the development of The Spanish “Promotion of Personal Autonomy and Care for Dependent Persons” Act, 2006). In the Autonomous Community of Madrid, year 2006, there were 43,516 residential places (5 places for every 100 people aged 65 and older), 42% of them were publicly funded (public and concerted places)²². The institutions in Madrid are very heterogeneous. Most are private (91% in 2006), though public institutions use to be larger. Levels of care are also varied. There are institutions with places providing care only to dependent persons, only to independent people (with low level of needs, social problems or with high risk of dependency) and with both types of places. Access to formal social services is based on an assessment of needs and means, and co-payments are considerable, accounting for 75% residential care²¹. More information on Spanish Long term care system can be found in Sancho Castiello et al²² and Costa-Font et al²¹. Our population of institutionalized elderly in Madrid is thus heterogeneous and the case-mix can be defined as intermediate, between residential level and nursing home level (Table 3 provides a comparative outlook with U.S. data from Zimmerman et al²³ including other relevant data²⁴). Physicians (geriatricians or with experience in geriatric care) use to be full-time in large and part-time in small facilities.

Main findings comments

We measured a high prevalence of depression (46%). Antidepressant use was a criterion for the definition of depression but there are instances in which they are prescribed for other conditions, like anxiety or chronic pain. Thus prevalence might be slightly overestimated (the prevalence without considering antidepressant use was 45%). Regarding undetection prevalence, our estimate of 41% was difficult to appraise because comparisons were complicated by relevant differences in the potentially comparable studies, and also due to the absence of normative figures, i.e. which percentages of undetected persons, as measured by a standardized instrument, should be unacceptable? A recent meta-analysis including 41 studies in primary care reported an undetection fraction of 53%²⁵.

One study found undetection rates at admission of 86, 35 and 31% for nursing home physicians, nurses, and family members respectively²⁶. Yet, admission represents a special situation that must be adequately considered: depressive symptoms can be viewed, correctly or incorrectly, as an episodic normal or understandable state in that situation. In addition, physicians naturally tend to be less sensitive and more specific than other staff members. One study found undetection rates of 55, 58 and 63% by nurse aides, nurses and social workers respectively¹. In a recent study in low-level aged care residents, it was reported an undetection rate of 59.2%²⁷. Researchers used DSM-IV major depression disorder as symptom assessment tool and contrasted with diagnosis in the medical record.

With respect to variables associated to detection problems there are few data to contrast with, and none from institutions.

We did not find a clear association with sex but our estimate is more compatible with more detection problems in men. In other settings detection was usually found more problematic in men too. In a study, home care nurses correctly identified depression 1.75 times more in women than in men²⁸. In community-dwelling elderly people, men were at higher risk of undetection²⁹, particularly in the younger age group. Another study in primary care found a better disclosure of depressive symptoms in women³⁰. It has been stated that older people are reluctant to report depressive symptoms spontaneously³¹ and that men seem particularly vulnerable to this type of phenomena³².

We found a possible association of undetection with increasing age. In inpatient psychiatric units, underreporting of depressive symptoms was associated to older age³³, but in a study in the community setting, older people in the intermediate age (74-84) had less detection problems compared with more extreme age groups (65-74 and ≥ 85)²⁹. Perhaps the lower level of activity linked to older ages are viewed as normal, thus occulting some cases of real depression.

Regarding socioeconomic variables we found better detection associated with private facilities and with more years of education (the latter less clear). In the case of type of facility, public institutions had higher undetection compared to the private ones, even adjusting for size. In our population the private facilities are clearly smaller. However when we adjusted for ownership, higher undetection prevalence was associated to smaller facilities. In our sample better analysis, taking into account size, proved to be complicated because of lack of variability; there were neither big private nor small public facilities. Finally, after in depth analyses (including interactions, linear, and categorical approaches), results remained consistent with better depression detection in large and private facilities.

We found a nonlinear pattern regarding number of chronic conditions, with increasing risk of undetection only in the range of 2-3 conditions. In a study with younger, predominantly female primary care population, comorbidity decreased the likelihood of discussing depression as a possible diagnosis³⁴. This interesting phenomenon of “competing demands” deserves to be studied in older and in institutionalized populations. In the present work it would only explain part of the effect observed in the category of 2-3 conditions.

We found a clear negative association of undetection with number of medications. We repeated analyses excluding also anxiolytics from the count and the estimate did not virtually change. The potential role of adverse effects of polypharmacy in enhancing depression symptoms should be considered as an explanation for the negative association.

We found that detection was facilitated by severity of depressive symptoms. Two studies in the community reached similar conclusions^{29,30}. Regarding self-rated health, bad perception was strongly associated to undetection. In a study in primary care patients (not only elderly people), doctors were more likely to “fail” diagnosis of depression in those who tended to normalize their symptoms³⁵. In a previous work³⁶ we reported a strong association between bad health ratings and depressive symptoms. It would be possible to take advantage of this association in order to consider depression when facing residents with somatic doubtful complaints. For those with poor subjective health the probability of having depression is 62% (Table 1).

We did not find an association with cognitive status. One study showed results compatible with a higher undetection rate linked to better cognition either by nurse assistants or nurses¹.

Bad overall health, as rated by the physician, favored detection but the association weakened when adjusted for number of diseases (PR= 0.73 [0.51-1.05]).

With respect to prevalent specific diseases, most of them were associated with null or protective effect. Arrhythmia, Alzheimer disease, and anxiety were associated to better detection, and the opposite was observed for diabetes. In the case of Alzheimer disease and anxiety it is conceivable some kind of “diagnostic bias” since its associations with depression are widely accepted and this could facilitate detection. In the case of anxiety another explanation seems plausible. It has been described two types of depression, the retarded (quietly depressed, not mentally retarded) and the agitated³¹. The latter might more clearly draw attention of physicians or care staff. And the opposite apply to those with a retarded type. Consistent with above interpretation is our result of a clear negative association with anxiolytic use. We are not sure of the mechanism leading to a better detection in those diagnosed of arrhythmia but the well known arrhythmogenic properties of many antidepressants might have a role. Regarding diabetes, perhaps some kind of competitive argument previously mentioned can explain its association with undetection.

Limitations

We did not use the DSM criteria for considering depression. Notwithstanding GDS have good specificity (77% for the cut-off used in the present article⁸). Still, it is highly plausible that a fraction of the physician’s diagnosis of depression did not follow DSM IV criteria. All of this probably led to some degree of misclassification, mostly non-differential, that normally result in a dilution of effects. Second, the assessment of depressive symptoms was based on self report. Though we excluded the residents with severe cognitive impairment, a number of subjects with altered cognition could have distorted some results. We replicated all analyses with additional exclusion of those with moderate cognitive impairment (≥ 5 or ≥ 7 for SPMSQ and MDS-COGS respectively) and most results did not virtually change (the only

estimates with a change >10% were as follows. Other dementias, Alzheimer disease, and sex weakened their effects, by 37, 32 and 11% respectively; audition problems and anemia strengthened effects by 25 and 23% respectively, while ischemic heart disease changed by 20% from practically null above 1, to a protective effect). We do not value these changes as meaningful. Yet the Cornell Scale for Depression in Dementia ³⁷, specifically developed for assessment in cases of cognitive impairment, can help in future studies. Finally, due to the cross-sectional design, undetection prevalence can be also affected by determinants of the incidence rate of depression symptoms and by determinants of undetection duration, like mortality.

Conclusions

Undetection seemed to be a prominent problem but probably less than was found in primary care. Number of medications and self-rated health were the main determinants of undetection. In addition, physician-rated health, facility characteristics, (ownership and size), and some diseases could have a role. Overall it seems plausible that circumstances associated to more contact with the physicians facilitate detection. It is thus advisable a complementary strategy of focusing activities directed to adequate identification of depressive symptoms by nurses and assistants. In this line some experience was found to be positive ³⁸. We speculate on the helpfulness of providing a basic knowledge of depression, highlighting their consideration as a disease, with a variety of effective therapeutic courses, to family members or even residents themselves. Furthermore, in a study of perceptions of depression in long-term care residents, researchers reported a key role of family members when expressing emotions ³⁹. Detection is the first necessary step, and the idea that depression is not a disease or it is a normal state associated to specific situations becomes a barrier. Experts recommend screening 2 to 4 week after admission and every 6 months ⁴⁰, and this research could help to identify relevant factors associated to a final diagnosis of depression.

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Table 1. Prevalence of depression and undetected depression by participant sociodemographic characteristics and health conditions.

Grouping	No. (%) [*]	Depression			Undetected depression		
		No.	Prevalence (95% CI) [*]	P value [‡]	No.	Prevalence (95% CI) ^{*†}	Prevalence ratio (95% CI) [§]
All	579 (100)	255	46.1 (41.0–51.3)		108	41.5 (33.2–50.2)	
Sex				0.08			0.4
Women	307 (74)	150	48.1 (41.4–54.9)		62	40.3 (31.2–50.1)	1.00 (reference)
Men	272 (26)	105	40.2 (34.6–46.1)		46	45.5 (33.9–57.7)	1.18 (0.87–1.61)
Age, years				0.6			0.2
65–74	83 (14)	34	44.0 (31.0–57.8)		9	25.6 (13.1–43.9)	1.00 (reference)
75–84	242 (41)	101	44.0 (37.0–51.3)		42	40.7 (29.1–53.4)	1.62 (0.81–3.24)
≥ 85	248 (46)	117	48.8 (40.5–57.2)		56	46.1 (34.1–58.6)	1.84 (1.04–3.24)
Marital status				0.3			0.2
With spouse	104 (15)	41	41.2 (33.3–49.6)		20	50.4 (35.4–65.4)	1.00 (reference)

With no spouse	470 (85)	210	46.6 (40.8–52.4)	88	40.8 (32.0–50.2)	0.79 (0.57–1.09)
Educational level				0.2		0.05
Less than secondary	490 (85)	217	47.1 (42.1–52.2)	98	44.5 (35.7–53.6)	1.00 (reference)
Secondary or more	78 (15)	32	38.7 (25.9–53.2)	8	21.8 (9.0–44.0)	0.49 (0.21–1.13)
Facility ownership				0.8		0.5
Public	346 (49)	145	45.9 (40.0–52.0)	65	44.9 (33.2–57.2)	1.00 (reference)
Concerted	51 (7)	26	52.5 (30.4–73.6)	8	36.5 (28.2–45.7)	0.70 (0.42–1.17)
Private	182 (44)	84	45.3 (36.7–54.2)	35	38.4 (25.6–53.2)	0.86 (0.54–1.38)
Facility size, no. of beds				0.3		0.7
< 100	109 (26)	56	49.5 (38.2–61.0)	28	46.8 (29.6–64.8)	1.00 (reference)
100–299	220 (38)	89	40.9 (32.2–50.2)	34	37.1 (26.6–49.0)	0.78 (0.46–1.32)
≥ 300	250 (36)	110	48.3 (42.9–53.8)	46	41.2 (27.9–56.0)	0.87 (0.51–1.49)
Length of stay, years				0.4		0.6
0–2	185 (33)	85	50.0 (41.2–58.5)	33	36.3 (27.7–45.9)	1.00 (reference)
3–5	171 (31)	72	42.7 (35.6–50.1)	30	41.5 (29.2–55.0)	1.21 (0.79–1.83)

≥ 6	197 (36)	84	43.3 (35.0–51.9)	38	44.3 (29.8–59.8)	1.18 (0.78–1.76)
No. of chronic conditions				0.008		0.02
0–1	167 (29)	63	40.4 (31.1–50.4)	25	39.9 (27.7–53.5)	1.00 (reference)
2–3	253 (44)	99	41.0 (33.6–48.8)	53	54.0 (43.0–64.7)	1.30 (0.90–1.89)
≥ 4	156 (26)	90	59.9 (49.6–69.3)	30	29.6 (16.9–46.5)	0.68 (0.38–1.20)
No. of medications ¶				< 0.001		0.02
0–2	143 (25)	39	30.1 (23.3–38.0)	23	62.5 (46.2–76.4)	1.00 (reference)
3–4	271 (49)	124	47.2 (39.4–55.2)	48	35.9 (25.2–48.2)	0.59 (0.39–0.89)
≥ 5	141 (25)	83	61.4 (53.1–69.2)	30	36.2 (24.7–49.7)	0.57 (0.37–0.89)
Anxiolytic use				0.001		0.007
No	447 (76)	177	41.4 (36.0–46.9)	84	47.5 (37.9–57.4)	1.00 (reference)
Yes	119 (24)	72	61.1 (50.7–70.6)	20	27.3 (17.0–40.7)	0.59 (0.37–0.93)
Antipsychotic use				< 0.001		0.6
No	519 (91)	218	43.1 (38.0–48.4)	92	42.0 (33.2–51.4)	1.00 (reference)
Yes	47 (9)	31	75.7 (61.7–85.8)	12	35.8 (17.2–59.9)	0.83 (0.42–1.66)

Functional dependency				0.004			0.5
Independent	177 (27)	58	37.8 (29.5–46.9)		24	38.8 (25.7–53.8)	1.00 (reference)
Mild	158 (29)	65	40.4 (31.8–49.6)		27	40.7 (25.9–57.3)	0.98 (0.61–1.56)
Moderate	131 (25)	66	49.0 (38.0–60.1)		32	49.8 (36.8–62.8)	1.19 (0.79–1.86)
Severe	100 (19)	59	62.8 (52.1–72.4)		22	35.8 (23.1–50.9)	0.85 (0.51–1.41)
Cognitive impairment				0.03			0.5
Unimpaired	286 (64)	114	42.4 (34.8–50.4)		41	36.8 (23.3–52.7)	1.00 (reference)
Mild/moderate	147 (36)	78	55.0 (47.4–62.3)		36	42.9 (30.3–56.4)	1.11 (0.65–1.90)
Vision impairment				0.4			0.5
No/mild	444 (87)	195	45.5 (39.8–51.4)		86	43.0 (34.1–52.4)	1.00 (reference)
Moderate/severe	62 (13)	32	51.8 (37.7–65.6)		17	50.5 (32.5–68.3)	1.17 (0.76–1.80)
Hearing impairment				0.6			0.3
No/mild	434 (88)	191	45.5 (40.3–50.8)		89	45.4 (37.0–54.1)	1.00 (reference)
Moderate/severe	62 (12)	31	49.4 (32.8–66.0)		12	37.1 (22.5–54.5)	0.71 (0.44–1.13)
Self-rated health				< 0.001			0.001

Very good/good	305 (55)	90	31.5 (24.7–39.3)	25	28.5 (18.9–40.6)	1.00 (reference)
Fair/poor/very poor	266 (45)	157	61.7 (54.9–68.0)	83	51.8 (42.1–61.3)	1.83 (1.24–2.73)
Physician-rated health						
				< 0.001		0.04
Very good/good	325 (58)	102	33.3 (26.7–40.6)	51	50.5 (38.0–62.9)	1.00 (reference)
Fair/poor/very poor	238 (42)	147	64.2 (57.2–70.3)	53	34.5 (24.8–45.6)	0.65 (0.44–0.95)
Pain frequency						
				0.05		0.7
None	271 (44)	102	39.8 (33.4–46.5)	49	46.2 (35.8–56.9)	1.00 (reference)
Less than daily	127 (23)	57	45.0 (36.6–53.6)	23	39.4 (25.7–55.1)	0.84 (0.56–1.28)
Daily	171 (33)	88	53.3 (43.3–63.0)	36	41.4 (29.2–54.8)	0.91 (0.64–1.31)

* Weighted percentages.

† Prevalence (95% confidence interval) of undetected depression defined as the proportion of all depression cases that are undetected.

‡ P value for heterogeneity of prevalence by participant characteristics.

§ Sex- and age-adjusted prevalence ratio (95% confidence interval) of undetected depression comparing each category with the reference group.

|| Number of chronic conditions other than depression.

¶ Number of prescribed medications excluding antidepressants.

Table 2. Prevalence ratios of undetected depression by specific medical condition.

Disease	Undetection prevalences *	PR † (95% CI)	PR ‡ (95% CI)
Cancer	41/42	1.00 (0.66–1.66)	1.06 (0.62–1.81)
Obstructive pulmonary disease	42/41	0.97 (0.68–1.37)	1.06 (0.75–1.50)
Arrhythmia	28/46	0.58 (0.35–0.97)	0.59 (0.36–0.97)
Hypertension	40/42	0.96 (0.71–1.30)	0.97 (0.71–1.35)
Ischemic heart disease	43/39	1.01 (0.65–1.55)	1.04 (0.68–1.58)
Congestive heart failure	37/43	0.82 (0.52–1.29)	1.03 (0.69–1.53)
Peripheral arterial disease	40/41	0.92 (0.64–1.32)	0.96 (0.66–1.38)
Stroke	37/41	0.87 (0.34–2.19)	1.14 (0.48–2.68)
Diabetes	53/39	1.42 (0.95–2.11)	1.41 (0.97–2.04)
Anemia	37/42	0.80 (0.49–1.31)	0.86 (0.52–1.41)
Alzheimer disease	13/44	0.28 (0.09–0.89)	0.29 (0.10–0.86)
Other dementias	38/42	0.91 (0.59–1.40)	1.01 (0.67–1.53)
Parkinson disease	40/42	0.96 (0.50–1.86)	1.09 (0.56–2.16)

Epilepsy	22/43	0.55 (0.18–1.65)	0.60 (0.22–1.66)
Anxiety disorders	29/52	0.55 (0.38–0.80)	0.59 (0.42–0.83)
Arthritis	38/44	0.84 (0.59–1.19)	0.88 (0.63–1.22)

* Prevalence (%) of undetection in those with/without the disease.

† Sex- and age-adjusted prevalence ratio.

‡ Sex-, age-, and multimorbidity-adjusted prevalence ratio.

Table 3. Case-Mix of U.S. residential care/assisted living (U.S. RC/AL) and nursing homes (NH), and Madrid institutions. Percentages.

Resident characteristic	U.S. RC/AL *	U.S. NH *	Madrid, whole sample	Madrid, present work †
Age 85 and over	52	49	47	45
Female	76	72	75	74
ADL ‡	26	83	69	61
Cognition §	36	51	35	17
Behavioral	43	30	15	8

* Based on the Collaborative Studies of Long term Care. Values of U.S. RC/AL are weighted averages of percentages corresponding to three types of facilities provided in table 4 of Zimmerman et al's article ²¹ Values of nursing homes, also provided in that table, comes from Krauss & Altman ²²)

† Excluded those with severe cognitive impairment or a stay of less than 2 months (see methods).

‡ Impairment in at least one of six activities of daily living (ADL) including transfer, locomotion, dressing, eating, toilet use, and bathing. Madrid estimates refer to the fraction of those not completely independent in the activity.

§ For RC/AL cognitive impairment was scored as moderate or severe dementia, and assessed by a score <17 on the Mini-mental State Examination; if unavailable, by a score of >3 on the MDS-COGS; or if both were unavailable, by a reported diagnosis of dementia. For NH, dementia was based on information recorded on the MDS. Madrid estimates include those with MDS-COGS>3 or SPMSQ >4 (last column with the above mentioned exclusion criteria).

|| At least one form of problematic behavior (verbally or physically abusive, socially inappropriate, wandering or resistance to care, in the last two weeks, based on the Cohen- Mansfield agitation Inventory. Madrid estimates include all except “resistance to care”, and are referred to last seven days.

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