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Agreement between patient interview data on prescription medication use and pharmacy records in those aged older than 50 years varied by therapeutic group and reporting of indicated health conditions

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Abstract

Objectives: To estimate the agreement between interview-ascertained medication use and pharmacy records among the population aged older than 50 years, and to identify patient-level predictors of discordance.

Study Design and Setting: The Irish Longitudinal study on Ageing is representative of community-dwelling adults aged 50 years and older in Ireland. Interview-ascertained medication data from 2,621 participants were linked to pharmacy dispensing records. The kappa statistics measured the agreement between the two sources for 19 therapeutic classes. Logistic regression assessed the effect of patient-level characteristics on survey under- and overreporting of regularly dispensed medications.

Results: Agreement was good or very good ($\kappa = 0.64$−0.86) for 15 medication classes, and moderate or poor for antiinflammatory and antirheumatic products ($\kappa = 0.54$), analgesics ($\kappa = 0.50$), psycholeptics ($\kappa = 0.59$), and ophthalmologicals ($\kappa = 0.37$). Not reporting an indicated health condition, less frequent dispensing, older age, and more medications regularly dispensed were associated with survey underreporting, but results varied by therapeutic class. Memory and cognition were not associated with discordance.

Conclusion: Ascertaining medication use via patient interview seems a valid method for most medication classes and also captures nonprescription and supplement use. However, medications applied topically and as needed may be underreported. The source of medication data should be carefully considered when performing pharmacoepidemiological studies.

Keywords: Medicines; Indication; Agreement; Pharmacoepidemiology; Interview; Aged

1. Introduction

Pharmacoepidemiological studies require reliable and valid ascertainment of medication use. Misclassification can bias risk estimates of medication use either toward or away from the null [1], that is, either under- or overestimate the true medication effects.

Pharmacy dispensing records and self-report data are often used to obtain information on medication use. Pharmacy records are potentially recorded more accurately, but may not represent actual use or be available for the population. Self-report (via a self-completed questionnaire [SCQ], telephone interview, or face-to-face interview) provides information on medicines actually used as well as nonprescription use. This can be supplemented by a medication inventory, whereby all medication packages are presented to interviewers, reducing any recall problems. Comparison between pharmacy records and self-reported data is essential for improved understanding of the relative merits of each and the extent of potential misclassification of medication use in pharmacoepidemiological studies. Few studies have investigated the agreement between pharmacy records and self-report in older populations [2−4]. For cardiovascular medications, only the Rotterdam Elderly Study has examined predictors of discordance, and found that neither age, sex, education nor socioeconomic status were associated [2].

These and other studies in the general population report mostly good agreement between self-report and pharmacy

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What is new?

- Ascertaining medication use via patient interview is valid in those aged older than 50 years; however, medications used topically or as needed and psycholeptics may be underreported.
- Reporting of regularly dispensed medications varied according to whether an indicated health condition was reported, and for some classes, dispensing frequency, number of medications, and age.
- Sex, marital status, cognitive function, memory, and mental health did not affect reporting.
- Studies planning to ascertain medication use should carefully consider questionnaire design and interviewer training to better record underreported classes including those with social stigma.
- When performing pharmacoepidemiological analyses, the source of medication data should be adequately considered taking into account the therapeutic classes studied.

records, but agreement has varied significantly by therapeutic group, with less agreement for medications taken topically, as needed, or for shorter periods [3,5,6]. Studies in various settings report worse recall for those who are older [7−10], unmarried [7], and with less education [7,11]. Yet, medication recall often does not vary by gender [2,7−9,11] or income [10]. Despite the potential importance of memory and cognition in recall ability, few studies have examined these and find mixed results [12−14].

We compared the agreement between in-home interview and pharmacy data on prescription medications used regularly within a population-based study of aging in Ireland. Commonly used classes of medications were selected for comparison. Patient-level predictors of discordance were examined, including demographic factors previously reported on, as well conducting the most thorough examination to date of the role of cognitive function and mental health.

2. Methods

2.1. Study population

Data were retrieved from The Irish Longitudinal study on Ageing (TILDA), which is representative of the community-dwelling adults aged older than 50 years in Ireland. In its first wave undertaken from 2009 to 2011, TILDA recruited 8,175 individuals with each participant undergoing an extensive in-home face-to-face interview, and being invited to complete a SCQ and attend a health assessment. Households were selected from a stratified clustered sample of Irish residential addresses resulting in an overall response rate of 62.0%. A description of the sample and preliminary findings are available elsewhere [15].

In Ireland, the medical card scheme provides free general practitioner and hospital visits and prescription medications at minimal cost to approximately 40% of the population (approximately 1.7 million). Medical cards are available to those aged younger than 70 years with low incomes or for whom medical expenses would cause undue hardship. For those aged older than 70 years, the income threshold is higher resulting in most being eligible.

TILDA participants reporting medical card scheme coverage ($n = 3,975$) were asked for consent to link their medical records and to provide their unique medical card number ($n = 2,862$) to allow linkage. TILDA was approved by the Faculty of Health Sciences Research Ethics Committee of Trinity College Dublin, and participants provided written informed consent before participation in the study. Participants with dementia or with a cognitive impairment severe enough to prevent being able to personally consent to the study (determined at the discretion of the interviewer) were not included in the study.

2.1.1. Self-reported medication data

Interviewers asked participants in their homes "to record all medications that you take on a regular basis, like every day or every week," and to provide medication packages to copy down the correct medication names. Assistance from relatives was permitted. Medications were assigned World Health Organization (WHO) Anatomic Therapeutic Chemical (ATC) Classification codes [16]. An experienced pharmacist (J.P.) coded each medication as likely prescribed or not based on the proprietary name. Medications included in this analysis were those likely prescribed.

2.1.2. Self-reported health data

Within the home interview, the number of doctor-diagnosed chronic diseases (categorized as 0, 1, 2, or >2) were reported from the following: heart disease, cataracts, hypertension, high cholesterol, stroke, diabetes, lung disease, asthma, arthritis, osteoporosis, cancer, Parkinson's disease, peptic ulcer, or hip fracture. Participants also self-reported pain (moderate or severe), urinary incontinence in the past 12 months, and sleep problems (trouble falling asleep most of the time). We examined whether participants reported one of the main indicated health condition(s) in the survey for each therapeutic group they were regularly dispensed.

Depression was defined as scoring 16 or greater on the Center for Epidemiologic Studies Depression Scale during the interview [17]. Anxiety was defined as scoring eight or greater on the Hospital Anxiety and Depression Scale—Anxiety subscale within the SCQ [18]. Poor delayed recall was defined as recalling 3 or fewer words from the 10

presented earlier in the interview. Poor cognition was defined as a Mini-Mental State Examination (MMSE) score of 24 or lower in the health assessment [19].

2.2. Pharmacy records

The Health Service Executive—Primary Care Reimbursement Services (HSE-PCRS) pharmacy database contains information on all prescribed drugs dispensed under the medical card scheme. The data includes patient's age; gender; and for each medicine dispensed, the nonproprietary drug name, proprietary drug name, strength, and quantity dispensed. All prescription items are coded using the WHO ATC classification system. Pharmacy claims data were extracted for the 6 months before each participant's TILDA interview. A medication was considered to be used regularly if it was dispensed at least three times in the past 6 months with at least one dispensing episode in the past month.

2.3. Linkage

The TILDA (''survey'') and HSE-PCRS (''pharmacy'') data sets were linked by matching the eight-digit unique medical card number and additionally at least two of birth month, birth year, and sex. If birth year was the only mismatch, the discrepancy had to be within 10 years. One-digit modifications to the medical card number were allowed to enable successful linkage. Once the linkage was completed, all unique identifiers were removed from the merged data set for analysis. The selection process for participants with linked pharmacy records ($n = 2{,}621$) is displayed in Fig. 1. Most (95%) additionally matched on sex, birth year, and month.

2.3.1. Medication-level and person-level matching

Medications from pharmacy records and self-reported data were compared using the ATC code both at the medication level and within classes at the person level. At the medication level, medications were compared on the full fifth level ATC code.

At the person level, participants were separately categorized if they reported regular medication use or were regularly dispensed medications from each of 19 ATC second level therapeutic classes (classes with >5% prevalence in either data set). As we suspected better reporting for medications dispensed more frequently, we defined high frequency dispensing as six or more dispensing episodes within that class in the previous 6 months, and low frequency dispensing as three to five dispensing episodes in the previous 6 months.

2.4. Statistical methods

Frequencies of patient characteristics were compared between those with and without data linkage using multivariable logistic regression. For the medication-level matching, the proportions of survey-reported medications that were regularly dispensed and ever dispensed in the last 6 months were summarized in ATC first level classes.

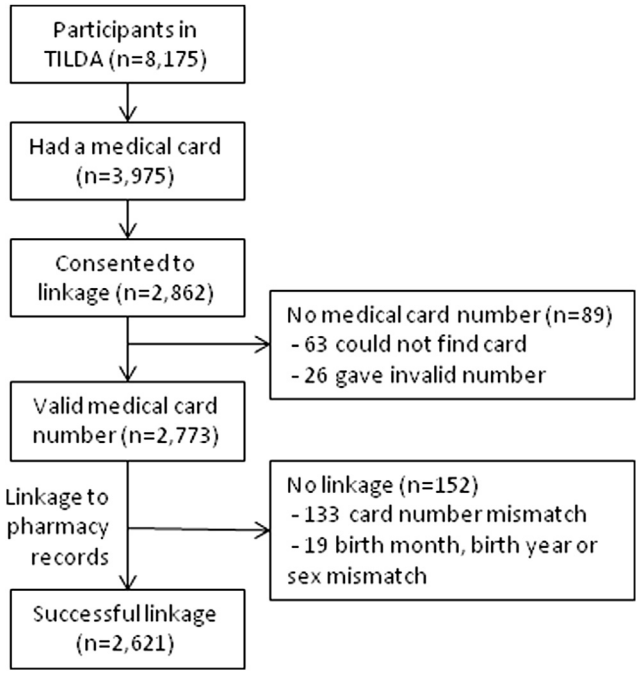

Fig. 1. Selection of participants with pharmacy record linkage. TILDA, The Irish Longitudinal Study on Ageing.

The following analyses were all performed at the person level by comparing use within 19 therapeutic classes. Agreement between the pharmacy and survey data was assessed using the kappa statistic as neither source was considered a gold standard. Interpretation of the value of kappa was guided as follows: poor (<0.20), fair (0.20−0.40), moderate (0.41−0.60), good (0.61−0.80), and very good (0.81−1.00) [20].

Logistic regression was used to examine patient-level characteristics associated with both survey underreporting (omitted in the survey when regularly dispensed) and survey overreporting (reported in the survey when never dispensed in the last 6 months) in each therapeutic group. Patient-level characteristics included sex, age, marital status (married or not), low education (none/primary), the number of medications regularly dispensed, low dispensing frequency, indication reported, depression, anxiety, poor recall, and poor cognition. We adjusted for multiple testing by controlling the false discovery rate at 0.05 for each factor investigated [21]. Multivariate logistic regression was performed for each therapeutic class by adjusting for age, sex, annual household income, number of medications regularly dispensed, dispensing frequency, indication reported, and any statistically significant predictors ($P < 0.05$) in the univariate analysis.

Sensitivity analyses performed for the agreement analyses included: (1) a stricter definition of ''regular use'' within the pharmacy records of 4+ prescriptions in the last 6 months including one in the last month and (2) including

all medications reported in the survey (i.e., not just those likely prescribed). The effect of interviewer variation on the prediction of survey under- and overreporting was tested by adding a random effect for the 126 interviewers administering the surveys. Analyses were performed using SAS Version 9.1 (2004; SAS Institute Inc., Cary, NC) and Stata Version 12.0 (2013; StataCorp, College Station, TX).

3. Results

The characteristics of 2,621 participants with linked pharmacy records compared with those without are displayed in Table 1. Participants with linked pharmacy records were mostly women (56%) and had an average (standard deviation) age of 69 (10) years.

3.1. Medication-level comparisons

In the survey, 9,327 prescription medicines were self-reported, after excluding 385 nonprescription products. In the pharmacy records, 18,940 prescription medications were dispensed in the 6 months before the survey interview, with 9,217 of these dispensed regularly.

Of the prescription medications reported in the survey, 90% ($n = 8,348$) were dispensed in the last 6 months in the pharmacy records. Of the medications dispensed regularly, 72% ($n = 6,625$) were reported in the survey. This proportion was greater than 55% in all but three classes, namely dermatologicals (3%, $n = 2$), anti-infectives for systemic use (39%, $n = 41$), and sensory organ drugs (30%, $n = 54$). In all classes, at least 70% of the survey medications were dispensed at least once in the last 6 months, except for dermatologicals (48%, $n = 11$).

In the sensitivity analysis, the proportion of medications regularly dispensed that were self-reported only increased from 72% to 73% when either separately including likely nonprescription medications in the survey or when using the stricter definition of regular use in the pharmacy claims data.

3.2. Person-level agreement

The 19 therapeutic classes examined include 88% of the self-reported and 87% of the regularly dispensed medications. Antithrombotic agents, agents acting on the renin–angiotensin system, and lipid-modifying agents were more often reported in the survey, but analgesics and psycholeptics were reported less often compared with the pharmacy records (Table 2). Agreement was good or very good ($\kappa = 0.64–0.86$, $P < 0.001$) for 15 classes, but moderate for anti-inflammatory and antirheumatic products ($\kappa = 0.54$), analgesics ($\kappa = 0.50$), and psycholeptics ($\kappa = 0.59$), and poor for ophthalmologicals ($\kappa = 0.37$).

Using the stricter definition of ''regular use'' in the pharmacy data did not substantially alter these results (data not shown).

3.3. Predictors of discordance

Sex, marital status, education, depression, anxiety, cognition, and poor recall were not associated with underreporting (see Table 1/Appendix at www.jclinepi.com). After allowing for multiple testing, older age was associated with underreporting of calcium channel blockers, drugs for the treatment of bone diseases, and analgesics (Table 3). In contrast, older adults were more likely to report regularly dispensed urologicals. Less frequent dispensing was associated with underreporting of five classes (cardiac therapy, anti-inflammatory and antirheumatic products, analgesics, psycholeptics, and drugs for obstructive airway diseases). Those with a greater number of different medications regularly dispensed were less likely to report their lipid-modifying agents and drugs for the treatment of bone diseases. The effect of interviewer was not statistically significant.

Table 1. Characteristics of participants with linked pharmacy records by medical card coverage

Characteristics	Medical card		No medical card ($N = 4,114$), *n* (%)
	Linkage ($N = 2,621$), *n* (%)	No linkage ($N = 1,354$), *n* (%)	
Sex—women	1,465 (56)	780 (58)	2,138 (52)
Age (yr), mean (SD)	69.1 (10.0)	67.8 (10.2)	59 (6.6)
Married	1,475 (56)	743 (55)	3,189 (78)
Primary/no education	1,252 (48)	593 (44)	613 (15)
Not employed	2,305 (88)	1,117 (82)	1,750 (43)
Household income <€20,000[a]	1,187 (45)	602 (45)	551 (13)
3+ Chronic health conditions	1,032 (39)	424 (31)	676 (16)
Poor cognition (MMSE ≤24)[a]	136 (5)	55 (4)	41 (1)
Poor delayed recall[a]	661 (26)	329 (25)	335 (8)
Depression (CES-D ≥16)[a]	327 (13)	173 (13)	265 (6)
Anxiety (HADS-A ≥8)[a]	505 (19)	264 (20)	834 (20)
Polypharmacy[b]	871 (33)	305 (23)	364 (9)

Abbreviations: SD, standard deviation; MMSE, Mini-Mental State Examination; CES-D, Center for Epidemiologic Studies Depression Scale; HADS-A, Hospital Anxiety and Depression Scale—Anxiety subscale.

[a] Missing data: 8% missing income, 27% missing cognition, 2% missing delayed recall, 2% missing depression, and 18% missing anxiety.

[b] Polypharmacy is defined as reporting regular use of five or more prescription medications.

Table 2. Agreement between regular prescription medicine use captured in the survey and pharmacy refill records, assessing the prevalence and agreement by common therapeutic groups

	Reported in the survey				Regularly dispensed in pharmacy records				
Therapeutic group (ATC class)	Prevalence (%)	Total	Regularly dispensed	%	Prevalence (%)	Total	Survey reported	%	Kappa (95% CI)
Drugs for acid-related disorders (A02)	23	613	458	75	23	612	458	75	0.67 (0.63–0.71)
Drugs used in diabetes (A10)	9	240	193	80	8	205	193	94	0.86 (0.82–0.89)
Mineral supplements (A12)	10	254	179	70	10	262	179	68	0.66 (0.62–0.70)
Antithrombotic agents (B01)	37	982	757	77	33	871	757	87	0.72 (0.68–0.76)
Cardiac therapy (C01)	6	167	121	72	6	161	121	75	0.72 (0.68–0.76)
Diuretics (C03)	15	395	320	81	15	398	320	80	0.77 (0.73–0.81)
Beta blocking agents (C07)	22	577	456	79	19	508	456	90	0.80 (0.76–0.84)
Calcium channel blockers (C08)	14	376	294	78	14	356	294	83	0.77 (0.73–0.81)
Agents acting on the renin–angiotensin system (C09)	35	917	735	80	31	802	735	92	0.78 (0.75–0.82)
Lipid-modifying agents (C10)	41	1,068	821	77	35	910	821	90	0.73 (0.69–0.77)
Urologicals (G04)	6	163	125	77	7	186	125	67	0.70 (0.66–0.73)
Thyroid therapy (H03)	9	245	185	76	8	201	185	92	0.81 (0.78–0.85)
Anti-inflamatory and antirheumatic products (M01)	11	286	158	55	10	252	158	63	0.54 (0.50–0.58)
Drugs for treatment of bone diseases (M05)	7	194	142	73	8	213	142	67	0.67 (0.63–0.71)
Analgesics (N02)	9	235	154	66	12	324	154	48	0.50 (0.46–0.54)
Psycholeptics (N05)	12	306	229	75	15	403	229	57	0.59 (0.55–0.63)
Psychoanaleptics (N06)	11	291	217	75	12	308	217	70	0.69 (0.65–0.73)
Drugs for obstructive airway diseases (R03)	10	254	174	69	10	262	174	66	0.64 (0.60–0.68)
Ophthalmologicals (S01)	3	67	41	61	5	140	41	29	0.37 (0.34–0.41)

Abbreviations: ATC, Anatomic Therapeutic Chemical; CI, confidence interval.

The strongest determinant of successfully reporting a regularly dispensed medication class was whether the participant had also reported being diagnosed with one of the main indications. For example, those reporting a doctor's diagnosis of diabetes were far more likely to report their regularly dispensed diabetes medication than those not reporting a diagnosis. This association was observed for 14 of the 19 therapeutic classes examined. Fig. 2 shows the probability of reporting medications from each therapeutic class given one was regularly dispensed, stratified by whether a main indication was reported.

These associations remain significant after multivariate adjustment, except for the associations between indication and both analgesics and psychoanaleptics, and between dispensing frequency and drugs for obstructive airway diseases, which were both significantly attenuated.

Overreporting of medication use was less common in comparison. Of the 7,098 medication classes reported (from the 19), medications were never dispensed in the previous 6 months for 532 (7%) of these classes. No patient-level characteristics were associated with overreporting after adjusting for multiple testing.

4. Discussion

Within a population-based study of aging, we found good agreement between self-reports of regular prescription medication use and pharmacy dispensing records. Agreement was poorer for medications applied topically or used "as needed," and for psycholeptics. Not reporting an indicated health condition, less frequent dispensing, and older age were generally associated with poorer self-reporting of regularly dispensed medications; however, associations varied by class.

The level of agreement was comparable with that reported in similar studies. The Three-City Study reported similar agreement across medication classes depending on the time frame analyzed in the pharmacy records [3]. Slightly larger kappa values were reported for psycholeptics and psychoanaleptics in the Finnish intervention study of those aged older than 75 years [4], although kappa statistics may be influenced by the greater prevalence of medication use. The proportion of concordance within cardiovascular medications was similar to that found in the Rotterdam study [2]. In line with other studies [3,5,6], we found poorer concordance for medications applied topically and as needed. Medications applied topically may not be perceived as medications [22], and those used as needed may not be perceived as used regularly. Similar to a Danish study of medication use in the general population [5], we found only moderate agreement for psycholeptics suggesting a potential stigmatization bias [23], as only 46% of the regularly dispensed anxiolytics (ATC N05B) were reported in the survey. Also, medications kept by the bedside might have been forgotten when taking packages to the interviewer, for

Table 3. Odds ratios (with 95% confidence intervals) for patient-level factors associated with failure to report regularly dispensed medications by the therapeutic group

Therapeutic group (ATC class)	Age (per 10 yr)	Low dispensing frequency	Number of medications regularly dispensed	Main indication(s) in survey	Indication reported
Drugs for acid-related disorders (A02)	1.0 (0.9–1.3)	1.2 (0.7–2.0)	1.0 (0.9–1.0)	Stomach ulcer	0.6 (0.3–1.0)
Drugs used in diabetes (A10)	2.3 (1.1–4.6)	1.4 (0.2–1.5)	1.0 (0.9–1.2)	Diabetes	0.1[a] (0.0–0.5)
Mineral supplements (A12)	1.3 (1.0–1.7)	1.3 (0.7–2.6)	1.0 (1.0–1.1)	Osteoporosis	0.5[a] (0.3–0.9)
Antithrombotic agents (B01)	1.3 (1.0–1.6)	0.7 (0.3–1.6)	1.0 (0.9–1.1)	Heart attack, stroke, TIA, angina	0.6[a] (0.4–0.9)
Cardiac therapy (C01)	1.4 (0.8–2.3)	4.7[a] (1.6–3.7)	1.0 (0.9–1.1)	Abnormal heart rhythm, heart failure	0.4[a] (0.2–0.9)
Diuretics (C03)	0.9 (0.7–1.2)	1.2 (0.5–2.7)	1.0 (0.9–1.1)	Hypertension, heart failure	0.8 (0.5–1.4)
Beta blocking agents (C07)	0.9 (0.6–1.2)	0.5 (0.1–2.3)	1.1 (1.0–1.2)	Hypertension, heart failure, angina, abnormal heart rhythm	0.7 (0.3–1.5)
Calcium channel blockers (C08)	1.7[a] (1.2–2.4)	1.1 (0.4–2.7)	1.1 (1.0–1.2)	Hypertension, angina	0.3[a] (0.2–0.6)
Agents acting on the renin–angiotensin system (C09)	1.4 (1.0–1.8)	1.6 (0.7–3.9)	1.1 (1.0–1.2)	Hypertension, heart attack	0.3[a] (0.2–0.6)
Lipid-modifying agents (C10)	1.0 (0.8–1.3)	1.5 (0.8–3.0)	1.1[a] (1.0–1.2)	High cholesterol, heart attack, stroke, TIA	0.5[a] (0.3–0.7)
Urologicals (G04)	0.6[a] (0.5–0.9)	1.4 (0.6–3.7)	1.0 (1.0–1.1)	Urinary incontinence (women only)	0.5 (0.1–1.9)
Thyroid therapy (H03)	1.1 (0.6–2.0)	2.3 (0.5–1.2)	1.1 (1.0–1.2)	N/A	N/A
Anti-inflamatory and antirheumatic products (M01)	1.0 (0.7–1.3)	2.4[a] (1.3–4.3)	1.0 (1.0–1.1)	Arthritis, pain	0.3[a] (0.2–0.6)
Drugs for treatment of bone diseases (M05)	1.6[a] (1.1–2.2)	0.8 (0.3–2.0)	1.1[a] (1.1–1.2)	Osteoporosis	0.4[a] (0.2–0.7)
Analgesics (N02)	1.4[a] (1.2–1.8)	2.9[a] (1.7–5.1)	1.0 (1.0–1.1)	Pain, cancer, arthritis	0.4[a] (0.2–0.8)
Psycholeptics (N05)	1.1 (0.9–1.3)	5.0[a] (2.6–9.6)	0.9 (0.9–1.0)	Any emotional problem[b], sleep problems, alcohol/substance abuse	0.3[a] (0.2–0.5)
Psychoanaleptics (N06)	1.1 (0.9–1.4)	1.4 (0.6–3.0)	1.0 (0.9–1.1)	Any emotional problem[b], serious memory impairment[c]	0.3[a] (0.2–0.5)
Drugs for obstructive airway diseases (R03)	0.9 (0.7–1.2)	2.3[a] (1.2–4.4)	0.9 (0.9–1.0)	Chronic lung disease, asthma	0.3[a] (0.2–0.6)
Ophthalmologicals (S01)	0.8 (0.5–1.3)	5.3 (1.2–3.5)	0.9 (0.8–1.0)	Glaucoma, other eye disease	0.4[a] (0.2–0.9)

Abbreviations: ATC, Anatomic Therapeutic Chemical; TIA, transient ischemic attack; N/A, not available.

[a] Associations significant after adjusting for multiple testing.

[b] Any emotional problem includes self-reported doctor's diagnosis of "any emotional, nervous, or psychiatric problems, such as depression or anxiety."

[c] Serious memory impairment includes self-reported doctor's diagnosis of dementia, Alzheimer's disease, or serious memory impairment.

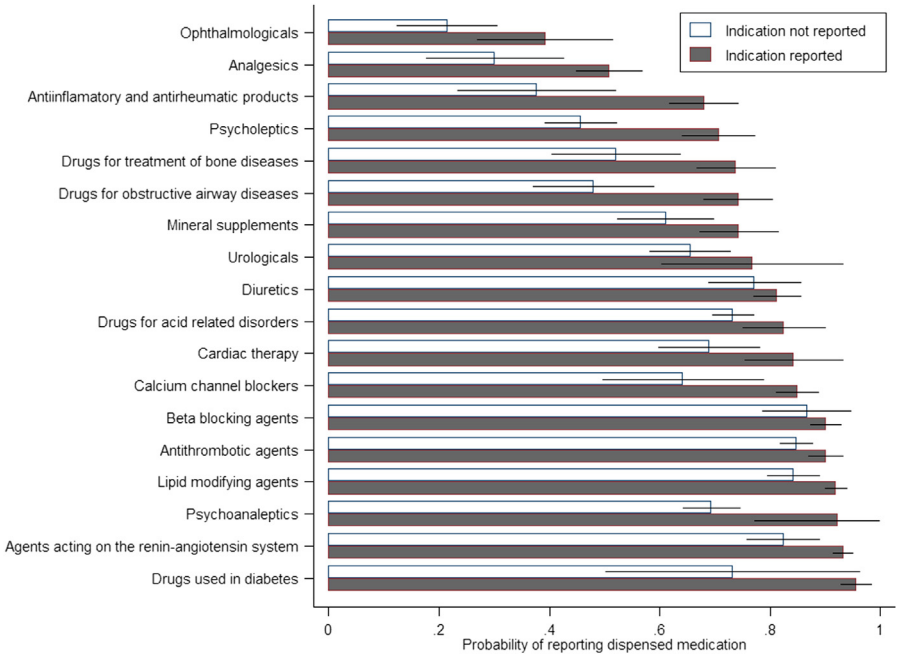

Fig. 2. Proportion (with 95% confidence intervals) of participants self-reporting regularly dispensed medications by therapeutic class and reporting of a main indication.

example, only 56% of the regularly dispensed hypnotics and sedatives (ATC N05C) were reported in the survey.

Few demographic factors were associated with underreporting, similar to findings from the Rotterdam study [2]. We observed a weaker association between older age and poorer reporting than studies that did not use face-to-face interviews or medication inventories [7−10], suggesting that these may reduce age effects. Very few effects of cognition or mental health were found, in line with previous research [12−14], suggesting that recall bias in older populations is minimal when medications are ascertained in the home with the assistance of relatives.

The strongest predictor of reporting a regularly dispensed medication was reporting an indicated health condition, which to our knowledge has not been previously shown. It is not clear why those who fail to report a diagnosed health condition were more likely to fail to report an associated medication, but stigma, poor health awareness, and poor adherence may be the underlying factors. Previous studies have suggested that knowledge of their medications' indications may be poor among older people [14,24], and that the communication style between physician and patient can strongly predict verbal recall of prescription medications [12]. Knowledge about indications has implications for adherence, patient−doctor communication, and knowledge about adverse effects [24]. The factors underlying this finding need further exploration.

We found underreporting of two medication classes among those who regularly dispensed more medications. Recall also reduced for those prescribed more medications in a previous cohort study [8]. Studies have also shown better agreement for medications taken for longer periods [8,11]. Although we did not examine duration, we found that medications dispensed more frequently were more likely to be reported in some classes. This may be owing to the interpretation of ''regular'' use by participants when considering medications used for a short period of time.

Previous concordance studies have highlighted the need to carefully consider the time window examined in the pharmacy records [3−5,25]. Most studies use fixed-time periods [2−7,25], but often suggest that the optimum period may vary by drug [3−5]. Studies comparing use of a legend-time method to estimate the actual period of drug use based on daily defined doses (DDDs) [2,5,25] were often limited by DDDs being unavailable for some medications, and conclude that they confer no real advantages over fixed-time periods. The way medication use is asked in the survey and the dispensing rules of the country also need to be taken into consideration [4,25]. As the interview called for regular medication use, and most prescriptions are dispensed at least monthly under the scheme, we used two definitions; the main definition based on frequency of use (three episodes within a 6-month period) and another based on any use in 6 months. We also performed a sensitivity analysis on the main definition and found little change to the results.

The main strength of our study was the use of a large population-based cohort who underwent a detailed assessment of their socioeconomic characteristics, and mental and cognitive health, allowing us to examine predictors of discordance individually for 19 commonly used therapeutic classes. The linkage of the survey data to the pharmacy dispensing records was reliable.

However, pharmacy linkage was not available for all study participants, mainly owing to pharmacy records only

existing for those covered by public health care schemes. Participants with pharmacy records were older, had less education, lower incomes, and fewer were employed than in the general population. They also reported more chronic diseases, medications, and depressive symptoms. The agreement reported would therefore likely underestimate the agreement among those aged older than 50 years. Associations with survey underreporting are not likely to be affected by the participant selection, as results mostly remained unchanged in the multivariable analysis. The MMSE and anxiety questionnaires were only completed by a subsample of participants; however, a missing MMSE score was not associated with underreporting of any medication class (data not shown), and delayed recall, which was completed for 98% of the sample, showed no association with agreement. TILDA also excluded those with dementia; however, individuals with dementia are unlikely to be asked to self-report their medications in an epidemiological context. Not completing the anxiety questionnaire was only associated with one class (drugs for treatment of bone diseases), so the association between anxiety and this class should be interpreted with caution.

The pharmacy records are considered accurate, but may be incomplete for participants newly eligible for a medical card. However, the pharmacy database represents the vast majority medical card dispensing; and indeed, 90% of the survey reported that medications could be traced back to the pharmacy records. In the survey, prescription status was not ascertained, but our classification seemed robust as including all medications did not add many matches to the regularly dispensed medications.

Discordance between self-report and pharmacy records could be caused by (1) poor adherence to prescribed medications; (2) inaccurate reporting through, for example, poor memory, lack of interest, poor health awareness, or stigma; or (3) methodological issues, for example, defining regular use, questionnaire design, interviewer error, or pharmacy database coverage. Most of our findings are consistent with poor adherence being partly responsible for discordance. Medication classes we found with only moderate agreement, for example, hypnotics, analgesics, bronchodilators, benzodiazepines, and symptomatic drugs, have been identified as being poorly adhered to in the elderly [14,26,27]. Lack of insight into illness has also been identified as a major predictor of poor adherence [28], and adherence decreases with more medications taken [29]. However, we found no relationship between depression and cognition and discordance, which are often identified as major predictors of poor adherence [28], suggesting that this does not fully explain the discordance in this study. Strong associations with reporting the indication suggest that health awareness is important. Stigmatization bias also potentially affects the reporting of psychotropics and urologicals. Interviewer variation had no effect on recall suggesting that interviewers were trained and performed uniformly.

Future studies ascertaining medication use should take adequate care over the questionnaire design. A systematic review found that questionnaire design was an important factor in the recall of medications [30]. Recall improved when using indication-oriented questions and pictures as memory aids [11,30]. Best practice would be to also perform a medication inventory [31], with linkage to pharmacy records to supplement or assess agreement where possible. Interviewers should be encouraged to prompt participants to remember medications kept in other places, for example, the bedside, and to tease out more information on topical medications and those used as needed.

For researchers conducting pharmacoepidemiological analyses, the source of medication data requires careful consideration depending on the purpose of the analysis [3]. Pharmacy data may better capture current use, use of medications taken topically and as needed, and include information on dose and duration, but may not be available for the whole population. On the other hand, interview data may better capture medications used chronically and adhered to and over-the-counter use. Differential misclassification appears minimal across sociodemographic and cognitive factors, although care should be taken when analyzing the effects of medications whose reporting is known to be affected by stigmatization bias.

In summary, ascertaining medication use via patient interview is valid in those aged older than 50 years. Agreement was moderate or poor for only a small proportion of therapeutic classes (those applied topically and as needed) and associated with not reporting an indicated health condition, and in some classes less frequent dispensing and older age. When performing pharmacoepidemiological studies, the source of medication data should be adequately considered.

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Appendix

Supplementary data

Supplementary data related to this article can be found online at http://dx.doi.org/10.1016/j.jclinepi.2013.02.016.

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