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Disease prevalence based on older people's self-reports increased, but patient-general practitioner agreement remained stable, 1992-2009

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ABSTRACT

Objectives

Previous studies revealed increases in the prevalence of chronic diseases in older people in most countries. This study investigated if a changed inclination to report diseases underlies these increases, by comparing the agreement between self-reports and general practitioner (GP) records of chronic diseases between 1992-1993 and 2008-2009.

Study Design and Settings

Cross-sectional analyses were performed on data from two waves of the Longitudinal Aging Study Amsterdam. Data from older adults aged 60-85 years came from 1992-1993 ($N = 1,896$) and from the same age group in 2008-2009 ($N = 1,086$). We compared respondent (R) and GP records of lung disease, cardiac disease, peripheral arterial disease, stroke, diabetes, arthritis, and cancer. Multilevel regression models were applied to examine (change in) predictors of over-reporting (R+, GP-) and under-reporting (R-, GP+).

Results

Over-reporting of chronic diseases became significantly more common over time, whereas under-reporting became less common. Agreement and change in agreement differed across the specific diseases. Under-reporting was associated with male gender; over-reporting with female gender, worse self-rated health, and worse physical functioning. Older adults were less accurate in their self-reports than younger adults.

Conclusion

Trends in self-reported chronic diseases may be influenced by changes in reporting behavior, and future studies should take this possibility into account.

1. INTRODUCTION

What is new?

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This study compared the agreement between self-reports and general practitioner (GP) records of chronic diseases in 1992 and 2009.

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Results showed that over-reporting of chronic diseases (GP–, R+) became significantly more common, whereas under-reporting (GP+, R–) became less common over time. Agreement and change in agreement varied across the specific diseases.

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There have been no studies that examined the extent to which older people in recent decades have become more aware of their chronic diseases and how this may influence trends in self-reported chronic diseases.

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Self-reports of chronic diseases by older people are fairly accurate, but, relative to GP records, respondent's inclination to report chronic diseases may change over time. Researchers who use self-reports of chronic diseases to measure trends in health should be aware of this possibility.

Studies among older people have shown an increased prevalence of most chronic diseases over the last decades in Western countries, including The Netherlands [1], [2], [3] and [4]. Tentative explanations that are offered for these increases include improved medical care resulting in earlier diagnosis and increased survival among people with chronic diseases [1] and [5].

Most studies have relied on self-reported data on chronic conditions. A changed inclination of people to report diseases may therefore partly underlie increases in their prevalence [3] and [5]. In The Netherlands, several developments [6] may have influenced the extent to which older patients are inclined to report chronic conditions: Recent cohorts of older patients may be more informed about their diagnoses than earlier cohorts because of their higher educational level and assertiveness. Awareness of some chronic diseases may have increased because of intensive chronic care management programs, the use of other sources of health information (eg, the Internet [7]), and campaigns aiming at improving information provision by general practitioners (GPs) [6]. Owing to increased awareness, the chance that people under-report their diseases may become lower, resulting in more

reliable self-reports. On the other hand, false-positive reports of chronic diseases may increase, which would negatively influence their reliability.

The Dutch health care system is primary care based [8], and consequently a changed likelihood of reporting chronic diseases can best be studied by comparing self-reports to GP diagnoses. Patients are obligatory listed with a GP and can only consult a medical specialist if they are referred to one by their GP. In turn, the GPs always receive all relevant medical information about their patients in specialist care.

Insight into changes in reporting behavior might improve the interpretation of trends in chronic diseases. This study investigated whether the agreement of self-reported chronic diseases with GP-recorded chronic diseases increased between 1992–1993 and 2008–2009 in Dutch older people. Additionally, in both periods, we investigated predictors of (dis)agreement on the presence or absence of chronic diseases between respondents and GPs.

2. MATERIALS AND METHODS

2.1. Study sample

Analyses were conducted using data from the Longitudinal Aging Study Amsterdam (LASA) [9]. In 1992, a random sample of older adults was drawn from the population registries of 11 municipalities in three geographical regions in The Netherlands (aged 55–85 years; $N = 3,107$; cooperation rate 62%). Respondents were examined in their homes by trained and supervised interviewers in 1995–1996, 1998–1999, 2002–2003, 2005–2006, and 2008–2009. In 2002, a new cohort was included (aged 55–65; $N = 1,002$; cooperation rate 62%). The Medical Ethics Committee of the VU University Medical Center approved the LASA study, and informed consent was obtained from all respondents.

In 1995, 2000, 2005, and 2010, all the GPs of respondents who participated in the preceding LASA wave and who had given written informed consent to obtain additional medical information (>95% in both waves) were asked to fill in a questionnaire for each respondent.

For the present study, data from the first (1992–1993) and the most recently completed wave (2008–2009) were compared with GP data obtained in 1995 and 2010, respectively. In 1995, of 447 GPs, 360 (80.5%) returned completed questionnaires on 2,437 patients (82.3% of those who gave informed consent). In 2010, of the 561 GPs, 368 (65.6%) returned completed questionnaires on 1,444 patients (70.2% of those who gave informed consent). From these 1,444 patients, 191 participated for the last time in the wave 2005–2006. These respondents were excluded because any self-reported morbidity information at wave 2008–2009 was missing from them. The final study sample comprised 1,896 respondents in 1992–1993 and 1,086 respondents in 2008–2009. A minority of respondents ($N = 234$) were included in both waves. The age range available in both waves was 61–85 years. We excluded respondents not living in the community ($N = 73$ in 1992–1993; $N = 13$ in 2008–2009) because primary care in residential or nursing homes in The Netherlands is not comparable with the standard general practice care. Those without data on self-reported or GP-recorded diseases were also excluded ($N = 15$ in 1992–1993; $N = 31$ in 2008–2009).

2.2. Measurement of chronic diseases

Respondents were asked if they suffered from chronic nonspecific lung disease (CNSLD; including asthma, bronchitis, and pulmonary emphysema), cardiac disease, peripheral arterial disease (PAD; “Do you suffer from a disease or abnormalities of the arteries or blood-vessels in your belly or legs?”), stroke, diabetes mellitus, arthritis (osteoarthritis and rheumatoid arthritis), or cancer. Response options for each disease were “yes” or “no.” The GP questionnaires included a list with chronic diseases, with some diseases asked more specifically: CNSLD was coded “yes” if either chronic obstructive pulmonary disease (COPD) or asthma was reported present. Cardiac disease was coded “yes” if any of angina pectoris, myocardial infarcts, congestive heart failure, or cardiac arrhythmias were reported to be diagnosed. The GPs were also asked for the year in which the disease had been diagnosed. All diseases diagnosed after the date of the interview with the respondent were considered absent for the purposes of the comparison.

Multimorbidity has a high prevalence in the older population [10], and a disease count was shown to be related to several adverse outcomes [11] and [12]. Therefore, we examined the agreement of self-reports and GP reports on the number of diseases that are reported. Count variables of self-reported diseases and GP-reported diseases ranged from zero to seven. In addition, we studied the agreement on specific diseases. Information from the GPs was used as the criterion with which self-reported diseases were compared.

2.3. Determinants of agreement

Potential factors that might influence the agreement between respondents and GPs were selected based on previous studies [13], [14], [15], [16] and [17]. These studies did not examine agreement on the number of diseases; therefore, specific hypotheses on how they are associated with the agreement on number of diseases are lacking. Gender and age were derived from the municipal registries. Urbanicity level was obtained from Statistics Netherlands and was defined as the mean number of addresses per square kilometer within a circle with a radius of 1 km from the respondent's home [18], categorized into low (<1,000), intermediate (1,000–1,500), and highly urban (>1,500 addresses).

Other factors were assessed by self-report. Education was coded as “low” or “intermediate” vs. “high.” Contact with GP or medical specialist in the previous 6 months was coded as follows: 0 “no contacts with GP or medical specialist,” 1 “one or more contact(s) with GP,” 2 “one or more contact(s) with medical specialist,” 3 “one or more contacts both with GP and medical specialist.”

Health variables included depressive symptoms, cognitive functioning, functional limitations, and self-rated health (SRH). For depressive symptoms, the Center for Epidemiologic Studies Depression Scale [19] was included (range: 0–60). Scores of 16 or higher indicate a clinically relevant level of depressive symptoms. For cognitive functioning, the Mini Mental State Examination [20] was included (range: 0–30). Scores of 23 or lower indicate the presence of a clinically relevant deviation in cognitive function. Functional limitations were defined as the number of daily activities that respondents reported to have difficulty with were counted, ranging from zero to six [21]. The SRH response options ranged from one “very good” through five “poor” [22].

2.4. Statistical analysis

Agreement on the number of diseases between respondents (R) and GPs was categorized as “over-reporting” (R reported more than GP), “under-reporting” (R reported fewer than GP), and “agreement” (R and GP reported equal numbers of diseases). The level of agreement between respondents' self-reports and GP information on specific chronic diseases was examined using Cohen's kappa. Kappa coefficients in 2008–2009 were compared with those in 1992–1993 by inspecting overlap of 95% confidence intervals (CIs).

Statistically significant changes over time (indicated by study year) in over- and under-reporting the number of diseases were examined with binomial logistic multilevel analysis, using STATA 10 (StataCorp. 2007. Stata Statistical Software. College Station, TX: StataCorp LP). Respondents who agreed with their GP on the number of diseases were chosen as the reference group. Model 1 included age, gender, and a variable for study year (2008–2009 vs. 1992–1993). We allowed the model intercept to vary randomly across GPs in a random intercept model. Model 2 additionally included the determinants that were associated with over- or under-reporting in bivariate models ($P < 0.20$). In Model 3, interaction terms of these determinants with study year were included one by one.

‘Models similar to those for the number of diseases were conducted for over-reporting and under-reporting of each chronic disease separately. The GPs' records were chosen as criterion. In these models, we compared respondents who reported a specific disease, whereas their GPs did not (over-reporting) with those without a self-report or a GP diagnosis of this disease. Similarly for under-reporting, respondents who did not report a disease, whereas their GP did were compared with respondents who had this disease both according to their self-report and the GP record.

Because 234 respondents responded both to wave 1992–1993 and 2008–2009, we randomly assigned these respondents to either one of the two measurement waves. Sensitivity analyses, with less parsimonious models including these respondents at both waves and an additional respondent level, yielded similar results with respect to predictors of over- and under-reporting. Descriptive analyses for 1992–1993 were weighted to the distribution of 5-year age and gender groups in 2008–2009 to increase mutual comparability between waves. The level of statistical significance was set at P -value lower than 0.05 for all main effects. Because the power of statistical tests for higher order terms is generally lower than for first-order terms [23] and [24], a P -level lower than 0.10 was used for interaction effects.

3. RESULTS

In both waves, respondents included in the analyses were younger and more often male than people not included in the analyses because of missing data on chronic diseases or not living in the community. In addition, they had fewer chronic diseases (self-reported or GP reported) and functional limitations and had better cognitive functioning ($P < 0.05$). Included respondents in 1992–1993 less often had a depression compared with excluded respondents ($P < 0.001$).

Sample characteristics are shown in Table 1. Between 1992–1993 and 2008–2009, substantial increases were observed in the level of education and the number of self-reported diseases, whereas the number of GP-reported diseases showed only a slight increase. The agreement on the number of diseases reflects this trend (Table 2):

Over-reporting increased from 31% in 1992–1993 to 37% in 2008–2009; under-reporting decreased from 14% to 12%.

[TABLE 1]

[TABLE 2]

Over-reporting increased in most diseases, except in PAD and diabetes (Table 3). At the same time, under-reporting decreased in most diseases, resulting in fairly similar kappa coefficients in both waves; only the accuracy with which diabetes is reported showed a statistically significant improvement ($P < 0.05$). Agreement between self-reports and GP reports was fair for PAD and arthritis and moderate for CNSLD and stroke in 2008–2009. Cardiac disease, stroke in 1992–1993, and cancer showed substantial agreement, and self-reports of diabetes were in almost perfect agreement with the GP reports [25].

[TABLE 3]

3.1. Determinants of agreement

The level of over-reporting significantly increased between the two waves (Table 4). Male gender predicted under-reporting, and female gender was associated with over-reporting the number of diseases. Furthermore, older adults less often reported the number of diseases accurately compared with the younger adults, that is, both over-reporting and under-reporting were more common in older adults. Worse SRH and functioning both increased the chance of over-reporting. Mental health and recent contact with health services were not associated with over- or under-reporting. Although there was no significant association between urbanicity or education and over-reporting, low education became more strongly and high urbanicity less strongly associated with over-reporting over time.

[TABLE 4]

In cardiac disease, arthritis, and cancer, over-reporting significantly increased. Under-reporting significantly decreased in cardiac disease and arthritis (Table 5).

[TABLE 5]

4. DISCUSSION

This study compared the agreement between self-reported and GP-recorded chronic diseases between older adults in 1992–1993 and 2008–2009. Results show that the self-reported prevalence of chronic diseases increased to a larger extent during this period than the GP-recorded prevalence did. Over-reporting of chronic diseases (defined in this study as reported by respondents but not by their GP) became more common, whereas under-reporting (reported by GP but not by respondent) became less common. Overall, this trend did not result in lower levels of agreement on specific chronic diseases between 1992–1993 and 2008–2009, but our results have important ramifications for trend studies and scenarios predicting the need for care. An increasing prevalence of chronic diseases is in line with studies that either used self-reports or registration data [1], [5] and [26]. The sum of increased over-reporting

and decreased under-reporting in most diseases does not confirm our hypothesis that recent cohorts of older patients have become better informed about their diseases. After all, agreement improved only in diabetes. Rather, people may have become more aware of chronic disease in general, but not about what diseases they have been diagnosed with themselves. It might also be that similar complaints are nowadays more often attributed to a disease, instead of to old age. Interestingly, over-reporting increased among the lower educated. The group of lower educated older adults has been becoming smaller and has lower average education and worse health [2], which might partly account for this finding.

The highest agreement was observed for diabetes, which confirms the results from previous studies [13], [15], [17] and [27]. The level of agreement for diabetes even increased between 1992–1993 and 2008–2009. Chronic care management programs for diabetes have been introduced in The Netherlands since 2007 [28], which may have resulted in increased awareness of this disease in particular. For other diseases, such as COPD and cardiovascular disease, agreement may improve when care management programs become more widespread as well. Lowest agreement was found in arthritis, predominantly consisting of osteoarthritis diagnoses, corroborating results from previous studies [15] and [17]. Because of the high prevalence of over-reporting in arthritis and the relatively large increase in over-reporting over time, we performed additional analyses excluding arthritis from the disease count. These revealed a significant increase in over-reporting from 15.8% to 17.3% (odds ratio: 1.61; 95% CI: 1.31, 1.97), indicating that the increase in over-reporting was only in part caused by changes in the reporting of arthritis. Over-reporting was defined in our study as diseases that were reported by respondents and not by their GP. These may include true positives as well as false positives (depending on the accuracy with which GPs make their diagnoses), and the true proportions remain unclear. In the case of arthritis, false positives may be more dominant than in the other diseases because symptoms are easily recognized. At the same time, the GPs may not recognize these symptoms as arthritis. Our study emphasizes the discrepancy between self-reports and GP reports, and future studies should examine if either respondents' or GPs' inaccuracies contribute most to the (increasing) prevalence of over-reporting.

Our study confirms findings from previous research in that worse health, operationalized in this study as functional limitations and SRH, are associated with the acknowledgment of diseases [14] and [29]. People perceiving their health as poor may attribute this to a specific disease, sometimes unconfirmed by medical diagnoses. Thus, increasing poor health, for example in levels of disability [1] and [2] may also induce an increased prevalence of over-reporting.

Over- and under-reporting in specific diseases was associated with gender, higher age, recent contact with health care providers, and low education (only in cancer, full models available upon request). Directions of these associations are sometimes different than that found in previous studies [14], [17] and [30]. For example, Manjer et al. [30] showed that women more often under-reported cancer, whereas in our study men more often did. In our study, recent contacts with GPs or specialists were related to over-reporting, but Haapanen et al. [17] showed that more contacts with health services increased the chance of under-reporting. Other studies found no association at all between education [15] and [31] or gender [31] and the level of agreement. Differences in methods and in health care systems across countries might

partly account for these inconsistencies, as other studies did not use GP data [17] and [30], used a different reference category [31], or did not distinguish between over- and under-reporting [15] and [16].

The GPs should have the most complete records on their patients, but it cannot be excluded that GPs fail to register diagnoses or are not informed correctly, or not in time, by medical specialists. Studies in The Netherlands and in other countries have shown varying quality of electronic patient records [32] and [33]. So, it remains unclear to what extent the GP records could serve as the gold standard. For the interpretation of our results, the important question is whether the accuracy of (multimorbid) disease registration has changed over time. The accuracy of disease recording might have improved in recent years as a result of guidelines to improve consistent recording that accompanied the implementation of electronic medical records [6] and [34]. An increased need to exchange data between care givers may have improved registration as well, for example with practice nurses who are in charge of chronic care management programs [8]. Thus, it remains unsure to what extent diverging prevalences can be attributed to increases in false positives of respondents, or to increasing false negatives of GPs.

An advantage of this study is that self-reports were measured in face-to-face interviews, which might result in higher sensitivity for less serious conditions as compared with self-administered questionnaires [35]. A limitation may be nonresponse and the exclusion of the unhealthiest individuals because of missing data. Unfortunately, we do not have information on the health of initial nonresponders. Dropout of frail older people (<2% per wave) and the exclusion of those with missing data may lead to an underestimation of health problems. It remains unclear whether estimates of accuracy at both waves are influenced by this selection. For example, the GPs and respondents may more often agree on diseases if symptoms are more severe [15]. Finally, the prevalence of poor cognitive functioning in our sample may have been too low to detect any associations, but the relevance of cognition in over- and under-reporting was unclear in previous studies [14], [15] and [29].

Measuring chronic diseases by self-report requires lower costs and less organizational demands. However, this study indicates that the discrepancy between self-reports and GP reports increases over time. More specifically, over-reporting chronic diseases became more prevalent between 1992–1993 and 2008–2009.

Agreement and change in agreement over time differed across the diseases, and future research may address the mechanisms underlying these changes. Researchers who base their conclusions on trends in health solely on self-reported information should be aware of the possibility that reporting behavior has changed. Finally, health comparisons between countries may be affected by trends in reporting. Although increases in chronic diseases have been reported globally [1], [3], [5] and [36], the magnitudes of these increases may depend on trends in reporting in each country.

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TABLES AND FIGURES

[TABLE 1]

Sample characteristics

Characteristics	1992–1993, ^a N = 1,896	2008–2009, N = 1,086
	Mean (SD)/median [IQR]/%	Mean (SD)/median [IQR]/%
Age	73.1 (7.0)	71.5 (6.8)

Characteristics	1992–1993, ^a N = 1,896	2008–2009, N = 1,086
	Mean (SD)/median [IQR]/%	Mean (SD)/median [IQR]/%
Female gender	54.3	54.3
Urbanicity		
Low	41.8	45.7
Intermediate	11.9	14.8
High	46.3	39.6
Education		
Low	64.9	47.4
Intermediate	25.1	33.7
High	10.0	18.9
In the past 6 mo		
No contact with GP or specialist	17.7	16.0
Only GP	35.5	31.4
Only specialist	6.1	7.5
Contact with both GP and specialist	40.7	45.1
CES-D ≥ 16	12.9	11.2
MMSE ≤ 23	9.3	4.2
Limitations (0–6)	0 [0–2]	1 [0–2]
Self-rated health (1–5)	2.4 (0.9)	2.3 (0.9)
Number of GP-reported diseases		
0	47.6	43.0
1	34.4	36.4
2	13.3	15.1
≥ 3	4.8	5.4
Number of self-reported diseases		
0	37.3	26.3
1	36.7	38.8
2	17.7	22.7
≥ 3	8.2	12.2

Abbreviations: SD, standard deviation; IQR, interquartile range; GP, general practitioner; CES-D, Center for Epidemiologic Studies Depression Scale; MMSE, Mini Mental State Examination.

^a

Weighted to age and gender distribution in 2008–2009.

[TABLE 2]

Reporting of the number of diseases in 1992-1993 and 2008-2009

Categories of (dis)agreement	1992-1993, ^a N (%)	2008-2009, N (%)
Agreement	1,020 (55.5)	470 (51.1)
R reports more diseases than GP (over-reporting)	568 (30.9)	344 (37.4)
GP reports more diseases than R (under-reporting)	250 (13.6)	106 (11.5)
Total	1,839 (100)	920 (100)

Abbreviations: R, respondent; GP, general practitioner.

^a

Weighted to age and gender distribution in 2008-2009.

[TABLE 3]

Reporting of specific chronic diseases in 1992-1993 and 2008-2009

Disease	N	R+/R-	1992-1993 ^a N = 1,896			N	R+/R-	2008-2009 N = 1,086		
			GP-	GP+	Cohen's kappa			GP-	GP+	Cohen's kappa
CNSLD	1,872	R-	1,598 (85.4)	60 (3.2)	0.582 (0.518-0.647)	1,048	R-	895 (85.4)	25 (2.4)	0.565 (0.483-0.646)
		R+	89 (4.8)	125 (6.7)			R+	61 (5.8)	67 (6.4)	
Cardiac disease	1,882	R-	1,408 (74.8)	105 (5.6)	0.719 (0.679-0.759)	1,052	R-	759 (72.1)	43 (4.1)	0.748 (0.699-0.796)
		R+	68 (3.6)	301 (16.0)			R+	52 (4.9)	198 (18.1)	
PAD	1,890	R-	1,693 (89.6)	22 (1.2)	0.371 (0.273-0.469)	1,070	R-	983 (91.9)	17 (1.6)	0.404 (0.261-0.547)
		R+	125 (6.6)	50 (2.6)			R+	46 (4.3)	24 (2.2)	

Disease	N	R+/R-	1992 – 1993 ^a	N = 1,896		N	R+/R-	2008 – 2009	N = 1,086	
			GP-	GP+	Cohen's kappa			GP-	GP+	Cohen's kappa
Diabetes	1,873	R-	1,713 (91.5)	22 (1.2)	0.863 (0.818–0.907)	1,064	R-	932 (87.6)	11 (1.0)	0.917 (0.879–0.955)
		R+	14 (0.7)	124 (6.6)			R+	7 (0.7)	114 (10.7)	
Stroke	1,875	R-	1,749 (93.3)	32 (1.7)	0.604 (0.512–0.695)	1,075	R-	1,007 (93.7)	8 (0.7)	0.580 (0.451–0.710)
		R+	37 (2.0)	57 (3.0)			R+	31 (2.9)	29 (2.7)	
Arthritis	1,886	R-	1,086 (57.6)	111 (5.9)	0.311 (0.262–0.360)	1,029	R-	496 (48.2)	42 (4.1)	0.314 (0.255–0.373)
		R+	432 (22.9)	257 (13.6)			R+	302 (29.3)	189 (18.4)	
Cancer	1,894	R-	1,657 (87.5)	57 (3.0)	0.646 (0.583–0.709)	1,064	R-	860 (80.8)	45 (4.2)	0.635 (0.565–0.704)
		R+	58 (3.1)	122 (6.4)			R+	52 (4.9)	107 (10.1)	

Abbreviations: GP, general practitioner; R, respondent; CNSLD, chronic nonspecific lung disease; PAD, peripheral arterial disease.

^a

Weighted to age and gender distribution in 2008–2009.

[TABLE 4]

Predictors of over- and under-reporting the number of diseases

Predictors	Models 1 ^a	Models 2 ^a

<i>N</i> = 2,748	Under-report		Over-report		Under-report			Over-report		
	OR	95 % CI	OR	95 % CI	OR	95 % CI	Time × predictor _b	OR	95 % CI	Time × predictor
Study year: 2008–2009 vs. 1992–1993	0.87	0.65, 1.16	1.30	1.07, 1.59	0.91	0.66, 1.24		1.35	1.09, 1.67	
Female gender	0.73	0.57, 0.94	1.54	1.29, 1.85	0.71	0.54, 0.94		1.40	1.15, 1.70	
Age	1.06	1.04, 1.08	1.02	1.03, 1.03	1.06	1.04, 1.09		1.01	0.99, 1.03	
Intermediate vs. low urbanicity					0.94	0.60, 1.46		0.91	0.66, 1.25	
High vs. low urbanicity					1.22	0.90, 1.65		0.99	0.80, 1.24	–
Intermediate vs. high education					0.94	0.60, 1.46		1.13	0.82, 1.54	
Low vs. high education					1.17	0.78, 1.77		0.96	0.71, 1.30	+
No contact with GP/specialist (ref)										
Only GP					1.16	0.79, 1.70		1.29	0.96, 1.72	
Only specialist					1.11	0.58, 2.14		1.32	0.83, 2.09	
Both specialist and GP					1.20	0.81, 1.78		1.27	0.95, 1.72	
CES-D ≥16					1.18	0.75, 1.86		1.05	0.77, 1.43	
MMSE ≤23					0.66	0.39, 1.11		0.91	0.63, 1.31	

Predictors	Models 1 ^a				Models 2 ^a					
	Under-report		Over-report		Under-report			Over-report		
	OR	95 % CI	OR	95 % CI	OR	95 % CI	Time × predictor ^b	OR	95 % CI	Time × predictor
<i>N</i> = 2,748										
Functional limitations					0.95	0.85, 1.06		1.09	1.01, 1.17	
Self-rated health (1 = very good, 5 = poor)					0.89	0.74, 1.06		1.43	1.26, 1.61	

Abbreviations: OR, odds ratio; CI, confidence interval; GP, general practitioner; CES-D, Center for Epidemiologic Studies Depression Scale; MMSE, Mini Mental State Examination.

Bold coefficients are significant at $P < 0.05$.

^a

Reference category in these binomial logistic models is the agreement category.

^b

Reference year for interaction effects is 1992, – and + indicate significant negative or positive interaction effects of time × predictor ($P < 0.10$).

[TABLE 5]

Changes over time in over- and under-reporting specific diseases

Predictors	CNSLD		Cardiac disease		PAD		Diabetes		Stroke		Arthriti		Cancer	
	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Over-reporting														
Study year: 2008–2009 vs. 1992–1993	1.23	0.86, 1.75	1.52	1.1, 2.28	0.70	0.49, 1.01	1.05	0.41, 2.70	1.22	0.73, 2.03	1.61	1.32, 1.96	1.74	1.29, 2.69
Female	0.9	0.6	1.0	0.7	1.1	0.8	1.5	0.6	0.6	0.3	2.1	1.8	2.1	1.3

Predictors	CNSLD		Cardiac disease		PAD		Diabetes		Stroke		Arthritis		Cancer	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
gender	4	7, 1.3 2	2	0, 1.4 8	3	2, 1.5 5	4	3, 3.7 3	1	8, 1.0 0	8	1, 2.6 3	3	6, 3.3 3
Age	1.0 2	1.0 0, 1.0 5	1.0 6	1.0 3, 1.1 0	1.0 3	1.0 1, 1.0 6	1.0 4	0.9 7, 1.1 0	1.0 6	1.0 2, 1.1 0	1.0 1	1.0 0, 1.0 3	0.9 8	0.9 5, 1.0 2
Under-reporting														
Study year: 2008–2009 vs. 1992–1993	0.7 1	0.3 7, 1.3 4	0.6 5	0.4 3, 0.9 8	2.2 6	0.7 8, 6.5 8	0.5 6	0.2 5, 1.2 3	0.5 3	0.2 0, 1.3 9	0.4 4	0.2 7, 0.7 1	0.7 7	0.4 4, 1.3 6
Female gender	0.5 6	0.3 1, 1.0 0	1.4 8	1.0 2, 2.1 5	1.1 4	0.4 3, 3.0 1	0.7 9	0.3 8, 1.6 4	1.5 5	0.7 2, 3.3 5	0.2 9	0.1 9, 0.4 4	0.5 2	0.3 1, 0.8 8
Age	1.0 1	0.9 7, 1.0 6	1.0 1	0.9 8, 1.0 4	1.0 4	0.9 6, 1.1 2	0.9 8	0.9 3, 1.0 4	0.9 8	0.9 3, 1.0 5	1.0 2	0.9 8, 1.0 5	1.0 1	0.9 7, 1.0 5

Abbreviations: CNSLD, chronic nonspecific lung disease; PAD, peripheral arterial disease; OR, odds ratio; CI, confidence interval.

Bold coefficients are significant at $P < 0.05$.