Sex, Race and Age Differences in Prevalence of Alzheimer's Disease and Related Dementia in Medicare Claims and Survey Data

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Abstract

Background

A recent estimate showed prevalence of dementia in the U.S. declined, however level and trend estimates vary widely across studies. This study compares prevalence of dementia in nationally representative survey data based on cognitive and functional measures (Health and Retirement Study), or neuropsychological assessment (Aging, Demographics and Memory Study) and health care professional diagnosis (Medicare claims records). We aim to quantify level and trend of dementia prevalence by race, sex and age group across data sources from 2004 to 2012.

Methods

We compare dementia prevalence by race, sex and age group from ADAMS, HRS and Medicare claims in 2004. We analyze trends from 2006 to 2012 based on two measures of dementia: (1) cognitive, functional measures (HRS); (2) diagnosed dementia (Medicare claims). Race is ascertained from self-reports and Centers for Medicare & Medicaid Services (CMS) enrollment data combined with a name-based algorithm. We analyzed prevalence rates of dementia over time for whites, blacks and Hispanics, by age and sex. We analyzed the socio-economic, race and ethnicity, demographic characteristics and time trends associated with prevalent dementia for comparable populations across data sources using logistic regression.

Results

The overall cognitive function-based dementia prevalence in 2006 and 2012 are 13.8% (95% CI [12.8% 14.8%]) and 12.4% (95%CI [11.5% 13.3%]). Comparatively, the overall diagnosis-based prevalence in 2006, 2010 and 2012 are respectively 11.9% (with 95%CI [11.9% 12]), 13.4%(95% CI [13.3% 13.4%]) and 12.9% (95% CI [12.9% 13%]).

The level differences between HRS and Medicare claims dementia prevalence among subgroups above change from 16.8, 14.7, 3.9, and 2.4 percentage points in 2006 to 10.8, 10.6, 0.9, and 1.4 percentage points in 2012 respectively.

Odds ratios of African Americans and Hispanics relative to whites in HRS adjusted by race, sex, age group and wave decline significantly after controlling for education, which changes from 4.74 (95%CI: 4.4 - 5.11) to 3.42 (95%CI: 3.16 - 3.7) among blacks and from 4.1 (95% CI: 3.74 - 4.49) to 2.2 (95%CI: 2 - 2.45) among Hispanics. While ratios in claims among African Americans and Hispanics are much smaller, equal to 1.65 (95%CI: 1.645 - 1.658) and 1.41 (95%CI: 1.399 - 1.413).

Implications for future research

This study is consistent with previous literature suggesting the existence of underdiagnosis at the population level yet it extends previous literature by showing a trend of convergence and comparability across data sources and that the trend of underdiagnosis no longer exists at the population level. Our study affirms the utilization of Medicare claims data in understanding national dementia prevalence by sex and age group. There still exists certain level of

underdiagnosis among ethnic minorities. This study further brings up the importance of adjusting dementia prevalence among ethnic minorities by education in cognitive function test to derive a reliable estimate of dementia prevalence among African Americans and Hispanics. This research points out the rising socioeconomic burden of dementia in US and the importance to understand dementia prevalence at the population level as well as at different racial, sex, and age group level.

Introduction

The demographic trend of aging, resulting from increase in life expectancy, leads to a much higher proportion of older adults in U.S. compared to previous cohorts. This trend is particularly salient for baby boomers that enter their seventies during 2010s to 2030s. Census shows that the percentage of Americans aged 65 and older in the whole population increases from 13% (40 million) in 2010 to 20% (89 million) in 2050 (Zissimopoulos et al., 2015). The proportion of Blacks aged 65 and above will double by 2030, and that of older adults aged 85 and above will increase by 1.6 times (14 percent to 22 percent) from 2012 to 2050 (Alzheimer's Association, 2002 and 2018). This demographic trend alarms the urgency of interventions on Alzheimer's disease and related dementia (dementia).

Accurate estimate of dementia prevalence by race, sex and age is therefore important in providing insights for current and future socioeconomic burden of dementia and optimizing economic and medical resource allocation. Knowledge about dementia prevalence among various groups particularly casts light on cost benefit of prevention and treatment programs that may target at different ethnic, gender and age groups.

Studies that utilize clinical assessment to quantify rates of dementia or cognitive impairment in a population have been based on small, non-nationally representative samples in part due to the high cost of conducting clinical evaluations and challenges in recruiting participants (Erkinjuntti et al., 1997; Gurland et al., 1999; Demirovic et al., 2003; Rocca et al., 2011; Brookmeyer et al., 2011; Hebert et al., 2013). An exception is estimate in Aging, Demographics and Memory Study (ADAMS) , which is regarded as gold standard of estimating national dementia prevalence (Plassman et al., 2007; Crimmins et al., 2011). However, this study has not been repeated since 2004 for estimating national dementia prevalence. To derive nationally representative estimates of dementia prevalence over time, researchers utilized weighted estimates from Health and Retirement Study (HRS) (Brookmeyer et al., 2011; Rocca et al., 2011; Hurd et al., 2015; Langa et al., 2017; Hudomiet et al., 2018).

Estimates of dementia prevalence vary widely due to different dementia definition, sample, national representativeness, and methodology. For example, the estimate of prevalence of Alzheimer's disease (AD) derived from the Chicago Health and Aging Project (CHAP) is twice of that derived from the Aging, Demographics, and Memory Study (ADAMS) (Brookmeyer et al., 2011; Rocca et al., 2011; Hurd et al., 2015; Langa et al., 2017; Hudomiet et al., 2018).

Recent estimate of the trend of dementia prevalence is based on Health and Retirement Study (HRS) considering its long panel (2000 to 2012) and rich information about health and socioeconomic status for older adults (Rocca et al., 2011; Hurd et al., 2015; Langa et al., 2017; Hudomiet et al., 2018). All of these studies find a decline in dementia prevalence, ranging from 0.14 to 0.35 percentage points (1 to 3 percent) decline. Yet the potential measurement error in

cognitive function-based test has been one major concern for the validity of HRS cognitive measures. Freedman et al. (2018) utilize the National Health and Aging Trends Study (NHATS), a nationally representative data, to estimate the dementia prevalence from 2011 to 2015. The authors employ a two-round dementia criteria, requiring the individual to meet the criteria of dementia in one of the three aspects, diagnosis, proxy report, or cognitive score in the subsequent wave. This important advance in understanding trends in dementia prevalence is limited by a short time frame and sample that excludes institutionalized persons.

On the other hand, few studies specifically explore dementia prevalence by race, gender and age group. Most related studies were conducted in 1990s (Heyman et al., 1991; Fillenbaum et al., 1990; Perkins et al., 1997; Gurland et al., 1999). According to these findings, the dementia prevalence among African Americans is 1.8 to 3.1 times of that among whites varying by cognitive measures, methods, and samples (Mehta et al., 2017). Most previous researches acknowledge that women have higher dementia prevalence but the estimate about the magnitude of the gender gap ranges from 1.5 percentage points to 6 percentage points (Chene et al., 2015; Plassman et al., 2007; Lobo et al., 2000; Freedman et al., 2018; Langa et al., 2017). There exists little discrepancies in dementia prevalence by age. Most studies agree that the incidence and prevalence of dementia double for every five years increase in age. dementia prevalence reaches 1.4 – 1.9% among 65 to 69 and 3.3 – 4.1% among 70 to 74. However, dementia prevalence among 90+ varies in studies, from 30.1% among 85+ to 47.5% among 90+ (Hurd et al., 2015; Hudomiet et al., 2018; Freedman et al., 2018; Prince et al., 2013;Plassman et al., 2007; Corrada et al., 2008; Ferri et al., 2005).

Method

Data and Study Population

We used data from three sources: Aging, Demographics and Memory Study (ADAMS), Health and Retirement Study (HRS), and 20% random sample of Medicare claims.

The Health and Retirement Study (HRS) is a biennial nationally representative longitudinal survey for older adults aged 50 and above starting in 1992. HRS incorporates rich information including demographic factors, health, wealth and household characteristics of older adults. We utilize data from HRS 2004 to HRS 2012 for older adults aged 67 and above (39,749 persons and 158,996 person-waves). HRS includes community and nursing home residents. Using the HRS sampling weight allows for the national representativeness of HRS estimates.

The ADAMS sample is a subsample of respondents from HRS survey waves 2000 and 2002. It is based on stratified random sampling of demographic factors and cognitive screening tests. We utilize ADAMS wave A to estimate dementia prevalence by race and sex. The Wave A ADAMS is targeted at 1,770 older adults aged 70 and above in both communities and nursing homes, 856 of which were interviewed during 2000 and 2004. ADAMS has an over sample of low-educated and older-aged individuals. Nationally representative estimate of dementia prevalence can be achieved by using the ADAMS sampling weight. However, due to its limited sample size, the estimate of the dementia prevalence among African Americans (64 individuals in total) and Hispanics (45 individuals in total) may not be nationally representative.

We also use claims data from a 20% random sample of Medicare beneficiaries enrolled in fee-for-service (FFS) in years 2004 to 2012. These data contain information on age, sex, enrollment,

Part A (hospital stays) claims, and Part B (outpatient) claims. The study sample consists of Medicare beneficiaries who aged 67 years or older at the beginning of each calendar year and were continuously enrolled in FFS for at least 2 years (7,992,748 persons and 50,734,890 person years).

Measurement of Dementia in ADAMS, HRS and Medicare Claims

ADAMS

Diagnosis of dementia in ADAMS was based on neuropsychological and clinical assessments structured in a 3-4 hour in-home interview, which were conducted by a neuropsychology technician and a nurse. Final diagnosis was established by consensus conferences consisting of experienced teams. Several cognitive tests are conducted including the Mini-Mental State Examination (MMSE), Boston naming test, digit span, Symbol Digit Modality Test, animal fluency, word list three trial learning, construction proxis copying, Trail Making Test, Wechsler Memory Scale, Fuld Object Memory Test, Shipley vocabulary test and the WRAT 3 blue reading test (Langa et al., 2005). Proxy reports are conducted based on the Blessed Dementia Ratings, including questions about ability to accomplish household tasks, small amounts of money, remembering short list and so on (Blessed, Tomlinson and Roth, 1968).

HRS

HRS assessed cognitive functions through an adapted version of the Telephone Interview for Cognitive Status (TICS) conducted either by phone or in person, which was modeled after the Mini-Mental State Exam (MMSE) and was extensively used in clinical assessment of cognition (Brandt, Spencer and Folstein, 1988; Folstein, Folstein, and McHuge, 1975). Spanish versions were developed of each questionnaire, and were administered by bilingual interviewers to Spanish-speaking respondents (http://hrsonline.isr.umich.edu/sitedocs/surveydesign.pdf). HRS imputed these measures when missing because they tend to be missing for the more cognitively impaired. The method is described in Fisher et al. (2013). When a respondent does not do the cognitive assessment, cognitive status is determined using information provided by a proxy respondent, typically a spouse or other family member. We assign cognitive state based on scores from three cognitive assessments immediate and delayed word recall; counting down from 100 by 7's test score; and counting back from 20 (Zissimopoulos et al 2014; Langa et al 2017) . For proxy interviews, the cognition score sums the following: number of instrumental activities of daily living; interviewer impairment rating (0 = no cognitive limitations, 1 = some limitations, 2 = cognitive limitations); and proxy informant's rating of the respondent's memory (from 0 [excellent] to 4 [poor]). Both proxy and non-proxy scores are combined into one indicator variable for dementia following Langa et al. 2009 and Crimmins et al. 2011. Some respondent in the HRS transition into and out of dementia. Thus to reduce measurement error we require one wave with dementia and evidence of continued cognitive impairment (either CIND or dementia) in the subsequent wave and thereafter we assume the respondent has dementia. If the respondent with one wave of dementia dies before the subsequent wave, we assume he or she had dementia before dying. (Zissimopoulos et al. 2017).

Medicare Claims Diagnosis

We identify dementia diagnosis in Medicare claims using the Chronic Condition Data Warehouse (CCW) algorithms. Based on Chronic Conditions Data Warehouse (CCW) Condition Algorithms, diagnosis in Medicare claims is ascertained by seeing the following International

Classification of Diseases, Ninth Revision (ICD-9) diagnostic codes within a 3-year reference window: 331.0, 331.11, 331.19, 331.2, 331.7, 290.0, 290.10, 290.11, 290.12, 290.13, 290.20, 290.21, 290.3, 290.40, 290.41, 290.42, 290.43, 294.0, 294.10, 294.11, 294.20, 294.21, 294.8, and 797. We also require a second diagnosis of dementia to reduce measurement error associated with rule out diagnoses.

Analytic Framework

We analyze sample characteristics and compare dementia prevalence by race, gender and age group at a point in time: in ADAMS 2000-2004 (n856) HRS 2004 (n7,768), and Medicare claims 2004 (n3,413,210).

We quantify time trends in dementia prevalence from 2006 to 2012 based on (1) HRS data and dementia assessed by cognitive tests and (2) Medicare claims data and dementia. We utilize logistic regression and adjust for covariates common to both data sources, age, race, gender, to account for differences across data sources. We show time trends separately by race, gender and age. We report odds ratios for each model and for an additional model using HRS data that includes education to assess how the inclusion of education informs our understanding of differences across the two data sources.

Results

Table 1 exhibits the distribution of demographic characteristics (race, sex, age group and education) among older adults aged 71 and above in ADAMS, HRS and claims in 2004. Appendix 1 shows the chi-square of the distribution of race, gender, age group and education across data sources and explains that the distribution of race and gender in ADAMS and HRS in 2004 are not statistically significantly different from each other. The distribution of demographic factors in claims is statistically significantly different from that in HRS or ADAMS. This result implicates the necessity of examining dementia prevalence adjusting for race, sex, age and education.

Table 2 suggests that dementia prevalence overall and by race, sex and age group in ADAMS and HRS 2004 are not statistically significantly different as their 95% CI overlap with each other (e.g., 95%CI of dementia prevalence for the overall population 14.1%-19.1% in ADAMS and 15% - 16.6% in HRS]). The only exception is that dementia prevalence among African Americans in HRS is statistically significantly higher than that in ADAMS and claims, which are24.1% (95% CI [17.3% 30.8%]) in ADAMS, 39.3% (95%CI [36.1% 42.5%]) in HRS and 16.7% (95%CI [16.6% 16.8%]) in claims (the dementia prevalence with 95% CI among white and Hispanics are respectively15.4% [12.6% 18.3] and 24.7% [15.3% 34.1%] in ADAMS, 12.6% [11.8% 13.4%] and 29.3% [25.2% 33.1%] in HRS, and 12% [11.9% 12%] and11.5% [11.4% 11.7%] in claims). Comparatively, diagnosis-based dementia prevalence overall and by race, sex, and age group are all statistically significantly lower than that in ADAMS and in HRS except for men (with dementia prevalence and 95%CI at 9.4% [9.3% 9.4%] in diagnosis, 12.3% [8.9% 15.8%] in ADAMS and 14% [12.8% 15.2%] in HRS) and those aged 71 to 74 (4.6% [4.5% 4.6%] in diagnosis, 5.3% [1.1% 8.8%] in ADAMS and 7.2% [6.2% 8.2%] in HRS).

As has been illustrated in table 3, the predicted dementia prevalence based on cognitive function overall and across all subgroups do not statistically significantly change from 2006 to 2012 at 95% confidence interval. The only exception is cognitive function-based dementia prevalence among African Americans, significantly declining from 2006 to 2012 (31.8% [30% 33.7%] in 2006, 27.7% [25.9% 29.5%] in 2012). Comparatively, diagnosis-based dementia prevalence

overall and across subgroups statistically significantly increase from 2006 to 2010 then significantly but slightly decline from 2010 to 2012 at 95% confidence interval. For example, the overall cognitive function-based dementia prevalence in 2006 and 2012 are 13.8% (95% CI [12.8% 14.8%]) and 12.4% (95%CI [11.5% 13.3%]). Comparatively, the overall diagnosis-based prevalence in 2006, 2010 and 2012 are respectively 11.9% (with 95%CI [11.9% 12]), 13.4%(95% CI [13.3% 13.4%]) and 12.9% (95% CI [12.9% 13%]).

In addition, there exists an overall trend of convergence between predicted dementia based on cognitive function test and diagnosis. Predicted dementia prevalence based on cognitive function test and diagnosis are no longer statistically significantly different from each other on the overall population level in 2012 (12.4% [11.5% 13.3%] and 12.9% [12.9% 13%]). On the subgroup level, cognitive function-based and diagnosis-based dementia prevalence converge among African Americans, Hispanics, men, and individuals aged 67 to 74 from 2006 to 2012. The level differences between HRS and Medicare claims dementia prevalence among subgroups above change from 16.8, 14.7, 3.9, and 2.4 percentage points in 2006 to 10.8, 10.6, 0.9, and 1.4 percentage points in 2012 respectively. In addition, level differences in predicted dementia prevalence based on cognition and diagnosis among white and those aged 75 to 84 decline from -0.5 and 0.4 percentage points in 2006 to -2.9 and -1.7 percentage points in 2012.

Table 4 shows odds ratios of dementia prevalence based on cognitive test without education (model1) or with education (model2) and based on diagnosis without controlling for education (model3), adjusting for race, sex, age group and wave. Table 4 strengthens findings in table 3 that dementia prevalence based on cognitive function and diagnosis are not declining among older adults aged 67 and above. After adding education as a covariate in model 2, the odds ratios of presence of dementia in 2008, 2010 and 2012 relative to 2006 are respectively 0.99, 1.05 and 0.97 (95%CI: 0.9 to 1.08, 0.96 to 1.15, and 0.89 to 1.06), suggesting no statistically significant change in the trend of cognitive function-based dementia prevalence from 2006 to 2012. Comparatively the odds ratio of dementia prevalence in Medicare claims (model 3) increases from 1 in 2006 to 1.193 (95%CI: 1.188 to 1.198) in 2010 and then declines to 1.162 (95%CI: 1.157 to 1.167) in 2012.

Model 1 to 3 illustrate dementia prevalence in HRS before and after controlling for education as well as dementia prevalence in Medicare claims. According to model 1 and model 2, odds ratios of African Americans and Hispanics relative to whites in HRS decline significantly after controlling for education, changing from 4.74 (95%CI: 4.4 - 5.11) to 3.42 (95%CI: 3.16 - 3.7) among blacks and from 4.1 (95% CI: 3.74 - 4.49) to 2.2 (95%CI: 2 - 2.45) among Hispanics. While ratios in claims among African Americans and Hispanics are much smaller, equal to 1.65 (95%CI: 1.645 - 1.658) and 1.41 (95%CI: 1.399 - 1.413).

Discussion

Previous literature report that overall 14.5% to 74% of individuals are underdiagnosed, who are demented but not correctly diagnosed. Specifically, 59% to 91% of demented individuals with mild symptoms are underdiagnosed across studies (Taylor et al., 2009; Bradfold et al., 2009; Savva and Arthur, 2015; Lang et al., 2017; Amjad et al., 2018). Taylor et al (2009) compare dementia cases in ADAMS and Medicare claims and suggest the underdiagnosis rate at the population level is 14.5%. Amjad et al. (2018) find that in 2011, overall 39.5% (weighted) individuals are demented in NHATS yet not demented in Medicare claims. Savva and Arthur (2015) report that 58% of demented older adults (N=307) in ADAMS have a prior diagnosis of

dementia reported by informants. The rate of undetected dementia in US is 60.7% (95%CI: 51.7% to 69%) according to Lang et al (2017) based on a meta-analysis from 8 relevant studies ranging from 1992 to 2010.

In 2004, cognitive function-based dementia prevalence is similar to the "gold standard", dementia prevalence in ADAMS. Although diagnosis-based dementia prevalence is lower than the "gold standard" and cognitive function-based dementia prevalence in 2004[1], the overall trend of "underdiagnosis" diminishes from 2006 to 2012. One potential explanation of this increasing comparability across data sources is the improvement in awareness of physicians and patients in the process of diagnosing dementia.

Previous literature show that potential factors associated with under-detection include being male, dementia identification criteria used by certain studies (DSM-III/IV rather than MMSE), living alone, severity of cognitive impairment, education (Chodosh et al., 2004; Wilkins et al., 2007; Savva and Arthur, 2015; Lang et al., 2017). There exist inconsistent findings about whether age and race is significantly associated with underdiagnoses (lang et al., 2017; Amjad et al., 2018;Chodosh et al., 2004) . Our result supports previous literature stating that being African American, Hispanics, male or at younger ages are associated with underdiagnoses. However, the trend of "underdiagnosis" in claims among these subgroups is diminishing significantly, which is mainly contributed by increase in diagnosis-based dementia prevalence. One exception is the convergence of dementia prevalence among African Americans across data sources, which is contributed both by decline in cognition and increase in diagnosis rate.

Odds ratio of dementia prevalence among ethnic minority adjusted by race, sex, age group, wave and/or education in HRS and claims suggest the importance of adjusting for education in cognitive function test at the individual level. In addition, our conclusion is different from previous studies, which utilize cognitive measures in HRS and NHATS and suggest that dementia prevalence declines since 2000 (Langa et al., 2017; Hudomiet et al., 2018). Although we utilize same cognitive function-based measures in HRS, we develop an absorbed, persistent measure of dementia to minimize measurement error in HRS cognitive tests. Our results are against previous literature and suggest that the trend of dementia prevalence maintains based on cognition and increases based on diagnosis at the population level and across most subgroups by race, sex, and age group.

Limitation

One limitation of this study is that persons enrolled in Medicare Advantage (MA) plans are excluded from Medicare claims records. Previous study exhibit that MA enrollees are younger and more likely to be Black and Hispanics compared to traditional fee-for-service (FFS) enrollees (St Clair et al., 2017). In addition, the population shift from FFS to MA after 2004 may change the characteristics of FFS enrollees and affect the representativeness of Medicare claims records. We use HRS to examine dementia prevalence with and without MA enrollees. We find that dementia prevalence by race, sex or age and years does not differ whether excluding HMO enrollees or not.

In addition, we cannot directly estimate dementia prevalence in claims adjusting for education as information about education is missing in claims. As a result, we cannot directly compare odds ratios of race in HRS and claims adjusted by education. However, we assume that in the actual

[1] The only exception is dementia prevalence among African Americans in ADAMS, which significantly lower than that in HRS, indicating that cognitive function-based dementia prevalence is higher than "gold standard" and requires further adjustment.

diagnosis process physicians conduct an adjustment based on age and education. Previous literature [further citation needed] support the assumption. We also conduct a sensitivity analysis using HRS-claims linked data. Our results show education does not significantly affect odds ratios of race based on claims compared to the effect of education on odds ratios of race based on cognitive function test.

In this study we cannot extend the window of comparing dementia prevalence in ADAMS, HRS and Medicare claims to 2012 or later due to data limitation. As a result, we do not have gold standard to understand the "true" trend of dementia prevalence overall and by race, sex and age. In addition, the race variable in Medicare claims 2004 is not correctly defined, which possibly bias the diagnosis-based dementia prevalence by race. However, we do find a statistically significant convergence between cognition and diagnosis, which is mainly contributed by increase in diagnosis. The largest gap between cognition and diagnosis exists among ethnic minorities. The decrease in dementia prevalence based on cognition and increase in diagnosis-based dementia prevalence among African Americans suggests that the "true" dementia prevalence lays between cognitive function test estimate and diagnosis estimate. As a result, the pattern of underdiagnoses exists among ethnic minorities.

Conclusion

This study is consistent with previous literature suggesting the existence of underdiagnosis at the population level yet it extends previous literature by showing a trend of convergence across data sources and that the trend of underdiagnosis no longer exists at the population level. Our study affirms the utilization of Medicare claims data in understanding national dementia prevalence by sex and age group. There still exists certain level of underdiagnosis among ethnic minorities. This study further brings up the importance of adjusting dementia prevalence among ethnic minorities by education in cognitive function test to derive a reliable estimate of dementia prevalence among African Americans and Hispanics. Our findings are against previous study suggesting a declining trend of dementia. This research points out the rising socioeconomic burden of dementia in US and the importance to understand dementia prevalence at the population level as well as at different racial, sex, and age group level. Further study is needed to explore education adjustment in cognitive function test and whether and how the transition from "underdiagnosis" to "overdiagnosis" among white and those aged 75 to 84 between cognition and diagnosis may affect the estimate of the future trend of dementia prevalence.

Table 1. Characteristics across Data Sources, 2004

	ADAMS (2000 to 2004)	HRS 2004	Claims 2004
Race			
White	87.0% (723)	86.4% (6,594)	88.6% (2,953,253)
Black	7.6% (64)	8.1% (619)	7.1% (221,714)
Hispanic	5.4% (45)	5.5% (422)	4.3% (135,507)
Gender			
Male	39.2% (334)	40.2% (3,125)	38.7% (1,320,601)
Female	60.8% (518)	59.8% (4,643)	61.3% (2,092,609)
Age Group			
71 to 74	24.4% (203)	28.8% (2,076)	27.9%(952,495)
75 to 84	55.8% (464)	53.2% (3,828)	54.2% (1,849,149)
85 and above	19.8% (165)	18% (1,294)	17.9% (611,566)
Education			
Less than High School	34.8% (297)	32.3% (2,325)	N/A
High School	28.1% (239)	33.1% (2,378)	N/A
College	37.1% (316)	34.7% (2,495)	N/A
Total	852	39,749	3,310,474

Note: ADAMS and HRS sample weighted by sampling weight, sample restricted to older adults aged 70 and above

Appendix 1. Chi-square of distribution of demographic characteristics across ADAMS, HRS and claims in 2004 (p-value in parenthesis)

	ADAMS vs HRS	HRS vs Claims	ADAMS vs Claims
Race	0.2 (0.903)	67.74 (0.000)***	5.2 (0.073)*
Gender	0.3 (0.561)	7.7 (0.005) ***	0.09 (0.759)
Age Group	7.5 (0.023)**	3.6 (0.167)	5.8 (0.056)*
Education	8.6 (0.013)**	N/A	N/A

Note: Information about education in Medicare claims is missing thus cannot be compared to the distribution of education in ADAMS and HRS. *, ** and *** indicates that the distribution is statistically different at 0.01, 0.05 and 0.1 significance level.

Table 2. Dementia Prevalence by Race, Gender and Age Group across ADAMS, HRS and Claims

	ADAMS (2000 to 2004)	HRS 2004	Claims 2004
Race			
White	15.4% [12.6% 18.3%]	12.6% [11.8% 13.4%]	12% [11.9% 12%]
Black	24.1% [17.3% 30.8%]	39.3% [36.1% 42.5%]	16.7% [16.6% 16.8%]
Hispanic	24.7% [15.3% 34.1%]	29.3% [25.5% 33.1%]	11.5% [11.4% 11.7%]
Gender			
Male	12.3% [8.9% 15.8%]	14% [12.8% 15.2%]	9.4% [9.3% 9.4%]
Female	19.3% [15.8% 22.8%]	17% [15.9% 18.1%]	14.0% [14% 14.1%]
Age Group			
71 to 74	5.3% [1.8% 8.8%]	7.2% [6.2% 8.2%]	4.6% [4.5% 4.6%]
75 to 84	14% [10.6% 17.3%]	15.5% [14.3% 16.7%]	12% [11.9% 12%]
85 and above	39.6% [33.9% 45.3%]	34% [31.6% 36.5%]	27.8% [27.7% 27.9%]
Total	16.6% [14.1% 19.1%]	15.8% [15.0% 16.6%]	12.2% [12.2% 12.3%]

Note: ADAMS and HRS sample weighted by sampling weight, sample restricted to older adults aged 70 and above

Table 3. Predicted dementia prevalence by age group/race/sex and year

		2006	2008	2010	2012
Age Group					
67 to 74	HRS	6.6% [6.1% 7.3%]	6.4% [5.8% 7.0%]	6.4% [5.9% 7.1%]	5.9% [5.3% 6.5%]
	Claims	4.2% [4.2% 4.2%]	4.5% [4.5% 4.5%]	4.7% [4.7% 4.7%]	4.5% [4.5% 4.5%]
75 to 84	HRS	13.8% [12.8% 14.9%]	13.7% [12.7% 14.7%]	12.7% [12.7% 14.8%]	12.6% [11.7% 13.6%]
	Claims	13.4% [13.3% 13.4%]	14.3% [14.3% 14.4%]	14. 8% [14.7% 14.8%]	14.3% [14.3% 14.4%]
85 and above	HRS	33.7% [31.8% 35.6%]	32.5% [30.6% 34.4%]	33.3% [31.4% 35.2%]	31.5% [29.6% 33.3%]
	Claims	31.2% [31.1% 31.3%]	32.9% [32.8% 33%]	33.6% [33.6% 33.7%]	33.3% [33.2% 33.4%]
Race					
White	HRS	11.1% [10.3% 11.9%]	10.8% [10.0% 11.7%]	10.6% [9.8% 11.4%]	9.7% [9.0% 10.5%]
	Claims	11.6% [11.5% 11.6%]	12.6% [12.5% 12.6%]	13.0% [13% 13.1%]	12.6% [12.6% 12.6%]
Black	HRS	31.8% [30.0% 33.7%]	30.5% [28.7% 32.4%]	30.3% [28.5% 32.2%]	27.7% [25.9% 29.5%]
	Claims	16.1% [16.0% 16.1%]	17.08% [17.0% 17.1%]	17.7% [17.6% 17.8%]	17.2% [17.1% 17.3%]
Hispanic	HRS	26.9% [25.0% 28.9%]	26.8% [24.9% 28.8%]	27.0% [25.2% 29.0%]	25.1% [23.3% 27.0%]
	Claims	13.1% [13.2% 13.3%]	14.4% [14.3% 14.5%]	15.2% [15.1% 15.3%]	15% [14.9% 15.0%]
Gender					
Male	HRS	12.4% [11.5% 13.4%]	12.2% [11.3% 13.1%]	11.8% [10.9% 12.8%]	10.9% [10.0% 11.7%]
	Claims	9.3% [9.2% 9.3%]	10.1% [10.1% 10.1%]	10.5% [10.5% 10.6%]	9.7% [9.7% 9.7%]
Female	HRS	14.8% [13.8% 15.8%]	14.6% [13.6% 15.6%]	14.6% [13.6% 15.6%]	13.5% [12.6% 14.5%]
	Claims	13.8% [13.7% 13.8%]	14.8% [14.8% 14.9%]	15.4% [15.3% 15.4%]	14.2% [14.1% 14.2%]
Total	HRS	13.8% [12.8% 14.8%]	13.6% [12.6% 14.6%]	13.4% [11.5% 14.4%]	12.4% [11.5% 13.3%]
	Claims	11.9% [11.9% 12%]	12.9% [12.8% 12.9%]	13.4% [13.3% 13.4%]	12.9% [12.9% 13%]

Note: Dementia prevalence (95% Confidence Interval in parentheses) are weighted by HRS sampling weights in “HRS” models; logit regression adjusts for race, sex, age group and wave in “HRS” and “Claims” model.

Table 4. Odds Ratios for dementia Prevalence in HRS and Claims 2006 to 2013

Presence of Dementia	(1) HRS (No Education)		(2) HRS (Education)		(3) Claims (No Education)	
	Odds Ratio	95%CI	Odds Ratio	95%CI	Odds Ratio	95%CI
Male	1	[1 1]	1	[1 1]	1	[1 - 1]
Female	1.05	[0.99 1.12]	1.07*	[1.01 1.14]	1.323***	[1.320 - 1.326]
white	1	[1 1]	1	[1 1]	1	[1 - 1]
black	4.74***	[4.40 5.11]	3.42***	[3.16 3.70]	1.651***	[1.645 - 1.658]
Hispanic	4.09***	[3.74 4.49]	2.22***	[2.01 2.45]	1.406***	[1.399 - 1.413]
Other races					0.942***	[0.936 - 0.948]
less than high school			1	[1 1]		
High school			0.34***	[0.31 0.36]		
college and above			0.19***	[0.17 0.21]		
67 to 74	1	[1 1]	1	[1 1]	1	[1 - 1]
75 to 84	2.48***	[2.30 2.67]	2.41***	[2.23 2.60]	3.590***	[3.579 - 3.601]
85 and above	8.92***	[8.22 9.68]	8.69***	[7.99 9.46]	10.35***	[10.32 - 10.39]
2006	1	[1 1]	1	[1 1]	1	[1 - 1]
2007					1.081***	[1.076 - 1.086]
2008	0.95	[0.87 1.03]	0.99	[0.90 1.08]	1.134***	[1.129 - 1.139]
2009					1.178***	[1.173 - 1.184]
2010	0.97	[0.89 1.06]	1.05	[0.96 1.15]	1.193***	[1.188 - 1.198]
2011					1.179***	[1.174 - 1.184]
2012	0.87**	[0.80 0.95]	0.97	[0.89 1.06]	1.162***	[1.157 - 1.167]
2013					1.092***	[1.087 - 1.097]
Constant	0.046***	[0.042 0.050]	0.11***	[0.10 0.12]	0.0315***	[0.0313 - 0.0316]
Observations	39,479		39,473		32,855,743	
Pseudo R-squared	0.138		0.195		0.1084	

Appendix 2. Odds Ratios using HRS and Claims Definition, in HRS-Claims Linked Data

	Self-report definition in HRS		Diagnosis in Medicare claims	
	No Education	Education	No Education	Education
	(1)	(2)	(3)	(4)
Female	1.023	1.064*	1.204***	1.218***
	(0.954 - 1.096)	(0.990 - 1.144)	(1.122 - 1.291)	(1.135 - 1.307)
Black	5.068***	3.491***	1.452***	1.282***
	(4.658 - 5.513)	(3.194 - 3.815)	(1.318 - 1.598)	(1.160 - 1.416)
Hispanic	4.515***	2.345***	1.629***	1.335***
	(4.011 - 5.082)	(2.071 - 2.656)	(1.422 - 1.866)	(1.159 - 1.538)
High School		0.308***		0.709***
		(0.283 - 0.336)		(0.651 - 0.772)
College		0.196***		0.671***
		(0.178 - 0.216)		(0.616 - 0.731)
75-84	2.598***	2.496***	3.860***	3.799***
	(2.385 - 2.830)	(2.287 - 2.725)	(3.514 - 4.239)	(3.458 - 4.173)
85+	9.806***	9.136***	11.70***	11.20***
	(8.941 - 10.76)	(8.306 - 10.05)	(10.60 - 12.91)	(10.15 - 12.36)
2002	1.007	1.049	1.184***	1.197***
	(0.907 - 1.119)	(0.941 - 1.169)	(1.063 - 1.319)	(1.074 - 1.334)
2004	0.972	1.047	1.245***	1.270***
	(0.877 - 1.078)	(0.940 - 1.166)	(1.120 - 1.384)	(1.142 - 1.413)
2006	0.903*	1.011	1.217***	1.254***
	(0.812 - 1.004)	(0.906 - 1.128)	(1.094 - 1.355)	(1.126 - 1.397)
2008	0.809***	0.956	1.081	1.129**
	(0.724 - 0.904)	(0.853 - 1.072)	(0.967 - 1.208)	(1.009 - 1.263)
Constant	0.0472***	0.106***	0.0346***	0.0446***
	(0.0424 - 0.0526)	(0.0941 - 0.119)	(0.0307 - 0.0389)	(0.0393 - 0.0506)
Observations	31,185	31,184	31,185	31,184

*** p<0.01, ** p<0.05, * p<0.1

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