Research Article

Changes in Health Care Use by Mexican American Medicare Beneficiaries Before and After a Diagnosis of Dementia

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Abstract

Background: Evidence from predominantly non-Hispanic White cohorts indicates health care utilization increases before Alzheimer's disease and related dementias (ADRD) is diagnosed. We investigated trends in health care utilization by Mexican American Medicare beneficiaries before and after an incident diagnosis of ADRD.

Methods: Data came from the Hispanic Established Populations for the Epidemiological Study of the Elderly that has been linked with Medicare claims files from 1999 to 2016 ($n = 558$ matched cases and controls). Piecewise regression and generalized linear mixed models were used to compare the quarterly trends in any (ie, one or more) hospitalizations, emergency room (ER) admissions, and physician visits for 1 year before and 1 year after ADRD diagnosis.

Results: The piecewise regression models showed that the per-quarter odds for any hospitalizations (odds ratio [OR] = 1.62, 95% CI = 1.43–1.84) and any ER admissions (OR = 1.40, 95% CI = 1.27–1.54) increased before ADRD was diagnosed. Compared to participants without ADRD, the percentage of participants with ADRD who experienced any hospitalizations (27.2% vs 14.0%) and any ER admissions (19.0% vs 11.7%) was significantly higher at 1 quarter and 3 quarters before ADRD diagnosis, respectively. The per-quarter odds for any hospitalizations (OR = 0.88, 95% CI = 0.80–0.97) and any ER admissions (OR = 0.89, 95% CI = 0.82–0.97) decreased after ADRD was diagnosed. Trends for any physician visits before or after ADRD diagnosis were not statistically significant.

Conclusions: Older Mexican Americans show an increase in hospitalizations and ER admissions before ADRD is diagnosed, which is followed by a decrease after ADRD diagnosis. These findings support the importance of a timely diagnosis of ADRD for older Mexican Americans.

Keywords: Alzheimer's disease, Health services, Minority aging

Annual Medicare expenditures for older adults with Alzheimer's disease and related dementias (ADRD) are over 3 times higher than older adults without ADRD (1). This is largely due to high rates of hospitalizations, emergency room (ER) admissions, and use of post-acute care services (2,3). Older adults with ADRD also have frequent visits with multiple health care providers to manage comorbid conditions, medications, and ADRD symptoms (4).

Older adults can experience cognitive decline for several years before ADRD is diagnosed (5). Growing evidence indicates these declines coincide with an increase in health care utilization, in particular for hospitalizations and ER admissions (6–12). An analysis of data from the Washington Heights-Inwood Columbia Aging Project detected an increase in hospitalizations and higher use of home health, skilled nursing, and durable medical equipment

during the 2 years before ADRD was diagnosed compared to matched controls (6).

With some exceptions (6,13–15), research on health care utilization trends among older adults with and without ADRD is based on data from predominately non-Hispanic White cohorts. Nearly 10% of adults aged 65 and older in the United States are Hispanic (16). Hispanics experience ADRD symptoms for a longer period of time before ADRD is diagnosed (17) and have more severe symptoms once ADRD is diagnosed than non-Hispanic Whites (18). Hispanics also have more comorbid health conditions when ADRD is diagnosed than non-Hispanic Whites (13). We hypothesize that older Hispanics will exhibit an increase in hospitalizations and ER admissions before ADRD is diagnosed as has been observed in other populations. However, the longer duration of ADRD symptoms, more severe symptoms at diagnosis, and greater number of comorbid health conditions may contribute to Hispanics experiencing a greater increase in hospitalizations and ER visits before ADRD is diagnosed than what has been observed in other populations.

The use of outpatient services by non-Hispanic Whites has also been observed to increase before ADRD is diagnosed (8,9,19). This has been attributed to an increase in visits to physicians who specialize in ADRD diagnosis (19). Such a trend may not be observed for older Hispanics. Hispanics are more likely than non-Hispanic Whites to attribute cognitive changes that may be an early sign of ADRD to normal aging (20). Consequently, older Hispanics may not see a physician because changes in memory and cognition are generally not viewed as a health change that needs a diagnosis (21). The negative stigma associated with ADRD in Hispanic culture can also decrease the likelihood that an older adult and their family will seek a diagnosis because of concerns that a diagnosis will negatively change how others interact with the person (22).

Well-known cultural biases in cognitive assessments (23) as well as clinicians not always recognizing cognitive changes as early symptoms of ADRD or disregarding a family member's concerns about an older adult's memory (24) can lead to a delayed or missed diagnosis of ADRD. This can have consequences for regular health care visits for other medical conditions. An analysis of 2288 participants from the Adult Changes in Thought study indicated that 53% of older adults with ADRD and 43% of older adults with undiagnosed ADRD missed a scheduled appointment over a 2-year period compared to 29% of older adults without ADRD (25). Regular physician visits are important for managing chronic conditions (26). Missed appointments may contribute to an increase in hospitalizations and ER admissions (25).

This study investigates trends in health care utilization by Mexican American Medicare beneficiaries before and after an incident diagnosis of ADRD. We hypothesize that hospitalizations and ER admissions but not physician visits will increase during the year prior to an incident diagnosis of ADRD. We also hypothesize that hospitalizations and ER admissions but not physician visits will be significantly higher after ADRD is diagnosed compared to those who are not diagnosed with ADRD.

Method

Data

We used data from the Hispanic Established Populations for the Epidemiological Study of the Elderly (EPESE) (27,28) that were linked with Medicare claims files. The Hispanic EPESE began in 1993/1994 and included a sample of 3050 participants aged

65 years and older representative of Mexican Americans living in Texas, Colorado, New Mexico, Nevada, and California. Participants have been interviewed every 2–4 years. A representative cohort of 902 participants aged 75 and older was added to the sample in 2004/2005 (Wave 5).

Participants interviewed at Wave 4 (1999/2000) to Wave 8 (2012/2013) were linked with Medicare Master Beneficiary Summary file, Medicare Provider Analysis and Review (MedPAR) files, Outpatient Standard Analytic files, and Carrier files from 1999 to 2016. A total of 2580 participants have been linked with Medicare claims files (29).

Classification of ADRD

Alzheimer's disease and related dementias status was determined using the Chronic Conditions Segment of the Master Beneficiary Summary file. The Chronic Conditions Segment has a set of flag variables for 27 medical conditions. This includes a variable for a diagnosis of Alzheimer's disease and related disorders or senile dementia. The ADRD flag variable is created using an algorithm in which at least 1 of 23 ICD-9 codes or 22 ICD-10 codes must be present in one or more inpatient, skilled nursing, home health, Part B institutional, or carrier file claims. The date in which the conditions of the algorithm were first met is also recorded.

Health Care Utilization Measures

Hospitalizations were identified using the provider number for acute hospital and critical access hospital stays in the MedPAR file. Emergency room admissions were defined as a charge amount of more than zero dollars in the MedPAR file or an ER revenue center code in the Outpatient Standard Analytic file. Physician visits were identified using the Current Procedural Terminology codes for new and established patient office or other outpatient services located in the Outpatient Standard Analytic file and Carrier file. Participants were classified as having had any (ie, one or more) hospitalizations, ER admissions, and physician visits per quarter.

We also identified the common medical conditions that contributed to hospitalizations that occurred before and after an ADRD diagnosis. For this analysis, we grouped the primary hospital discharge diagnoses into 25 mutually exclusive major diagnostic categories (MDCs). The percentage of hospitalizations by MDC was calculated by dividing the number of hospital discharges for each MDC by the total number of hospital claims for the 1 year before and the 1 year after ADRD diagnosis.

Covariates

Covariates for demographic and self-reported health characteristics were selected from a participant's baseline interview. These variables included age, gender, years of education, marital status, having been born in the United States or Mexico, having completed the interview in Spanish or English, number of self-reported health conditions, and having been recruited into the H-EPESE in 1993/1994 or 2004/2005. Health conditions included having ever been diagnosed with heart attack, stroke, hypertension, cancer, diabetes, fracture, or arthritis.

The demographic and self-reported health conditions were included in a logistic regression model to estimate a propensity score to match participants with an ADRD diagnosis to participants with no ADRD diagnosis (see **study cohort**). For all participants in the matched cohort, we used the Charlson comorbidity index to calculate the number of chronic conditions diagnosed during the year prior to the date of

ADRD diagnosis (30). We also identified participants with an ICD-9-CM (300.4, 301.12, 309.0, 309.1, 311) or ICD-10 (F20.4, F31.3–F31.5, F32.x, F29.x, F30.2, F31.2, F31.5) code for depression during the 1-year period before the date of ADRD diagnosis.

We identified participants who became deceased using the National Death Index and Medicare beneficiary summary file. Follow-up time was calculated as the number of years since the date of a participant's baseline interview and the date of their last interview or date of death. The follow-up time was included as a covariate and was categorized as 0–5 years, 6–10 years, and more than 10 years.

Study Cohort

The cohort selection is presented in Figure 1. We identified 1201 participants from the Medicare linkage sample ($n = 2580$) who had an ADRD diagnosis between 1999 and 2016 (step 1). The remaining 1379 participants never had an ADRD diagnosis between 1999 and 2016. This sample was used to calculate a propensity score to account for differences between participants with and without an ADRD diagnosis. The propensity score was calculated using a logistic regression model that included age, gender, years of education, marital status (married, not married), and number of self-reported health conditions (heart attack, stroke, hypertension, cancer, diabetes, fracture, and arthritis). All variables were selected from a participant's baseline interview. We used self-reported health conditions as opposed to medical conditions identified in the Medicare claims files because the earliest year in which we have Medicare claims files is 1999, which is after the baseline wave for the 1993/1994 cohort.

We excluded participants who had an ADRD diagnosis that did not occur between 2000 and 2015 for the 1993/1994 cohort and between 2004 and 2015 for the 2004/2005 cohort (step 2). This ensured that all participants classified as ADRD were diagnosed within the years in which Medicare claims were available.

We then identified participants with ADRD who had continuous Medicare enrollment for the 4 quarters before being diagnosed with ADRD (step 3). Participants were required to have Medicare Part A and B coverage for all 3 months to be eligible for a quarter. Supplementary Table 1 shows the number of participants by ADRD status who were eligible at each quarter. The analysis included complete pairs in which the ADRD case and control were both eligible for a quarter.

We used the propensity score calculated in step 1 to match the 850 participants with an ADRD diagnosis to a participant with no ADRD diagnosis (step 4). The matching procedure had 4 steps (a–d). First, a participant with ADRD was randomly selected from the sample of 850 participants. Second, the ADRD diagnosis date of the selected participant was applied to the entire control sample ($n = 1379$). Third, we identified participants with no ADRD diagnosis who had continuous enrollment in Medicare for 1 year prior to the assigned ADRD diagnosis date. Finally, all participants with no ADRD diagnosis who had 1-year continuous enrollment were included in the propensity score matching. The ADRD case was matched to all non-ADRD controls using a caliper width of 0.2 SDs of the logit of the propensity score (31) and who were an exact match according to having been recruited into the H-EPESE in 1993/1994 versus 2004/2005, mortality status, and follow-up time. If an ADRD case was matched to multiple non-ADRD controls, then one non-ADRD control was selected at random. The selected non-ADRD control was removed from the sample once they were matched to a participant with an ADRD diagnosis.

Steps a–d were done 850 times, once for each participant with an ADRD diagnosis. A total of 292 ADRD cases were excluded because the logit of the propensity score was more than 0.2 SDs ($n = 29$) or a control that was an exact match could not be identified ($n = 263$). This resulted in a matched sample of 558 ADRD matched cases and controls (total $N = 1116$).

Supplementary Table 2 shows the baseline characteristics of the 3952 participants in the H-EPESE cohort, the 2580 participants included in the linkage sample, and the 1116 participants in the matched sample. Compared to the H-EPESE cohort, participants in the linkage sample were more likely to have been recruited into the H-EPESE in 1993/1994, were younger, were more likely to be married, to have been born in the United States, to have no self-reported comorbidities, to be alive in 2016, and had a longer follow-up duration. Participants in the matched sample were also more likely to be recruited into the H-EPESE in 1993/1994, were younger, more likely to be female, to have 1–4 years of education, to have no comorbidities, and had longer follow-up duration compared to participants in the H-EPESE cohort.

Statistical Analysis

Piecewise regression models were used to evaluate trends in the percentage of participants by ADRD status with any hospitalizations, ER admissions, and physician visits during the 4 quarters before and the 4 quarters after the month that ADRD was diagnosed. For longitudinal data, piecewise regression involves dividing the total observation period into different segments and fitting a regression line to each segment (32). A breakpoint is used to define each segment. Piecewise regression is useful when there is a clear change in the variable of interest at a specific point in time, but it is often difficult for a change in the data to be detected (32). We set the breakpoint for the 2 segments to be the month in which a participant was first diagnosed with ADRD. This

Figure 1. Selection of the analytic sample. ADRD = Alzheimer's disease and related dementias.

allowed us to determine if there were statistically significant differences between participants with and without incident ADRD in the trends in health care utilization during the prediagnosis and postdiagnosis periods.

The piecewise regression models were estimated using generalized linear mixed models (GLMMs) with a logit link binomial distribution. Model estimation was based on maximum likelihood with Laplace approximation and design-adjusted sandwich estimator (33). The GLMMs included 2 random effects. The first random effect used an unstructured covariance matrix to account for the within-cluster dependence of each matched pair. The second random effect used a first-order autoregression covariance matrix to account for the within-subject dependence from the repeated measurement of participants.

The GLMMs included variables for time (quarter), ADRD status, and an ADRD by time interaction term. Quarter -4 is the reference category for the prediagnosis period and quarter 1 is the reference category for the postdiagnosis period. The variable for ADRD status differentiates between participants with and without incident ADRD. The ADRD by time interaction term was included to test for statistically significant differences in the quarterly trends for participants with ADRD compared to those with no ADRD diagnosis. All models controlled for age, Charlson comorbidity index, and depression status to account for differences in these characteristics between ADRD cases and controls in the matched sample.

Generalized linear mixed models with a logit link binomial distribution were also used to compare the marginal probability at each quarter for any hospitalizations, ER admissions, and physician visits according to ADRD status in the matched sample. The models included a random intercept with an unstructured covariance matrix to adjust for within-cluster dependence of each matched pair. The models also controlled for age, Charlson comorbidity index, and depression. All analyses were performed with SAS 9.4 (SAS Inc., Cary, NC).

Results

Sample Characteristics

Table 1 shows the baseline demographic and health characteristics by ADRD status for the 2580 participants in the linkage sample and the 1116 participants in the matched sample. Compared to participants in the linkage sample with no ADRD diagnosis, those with an ADRD diagnosis were significantly older at their baseline observation wave, more likely to be female, to not be married, completed fewer years of education, were more likely to have been born in Mexico, to have completed their baseline interview in Spanish, and to have a follow-up time of more than 10 years. The average age of ADRD diagnosis was 84.5 years in the linkage sample and 83.7 years in the matched sample.

With the exception of age, there were no statistically significant differences in the baseline demographic and self-reported health characteristics of participants in the matched sample according to ADRD status. Nearly 25% of participants with ADRD had 5 or more comorbidities and 18.8% had a diagnosis of depression compared to 15.8% and 9.7% of participants with no ADRD diagnosis, respectively.

Quarterly Trends in Any Hospitalizations, ER Admissions, and Physician Visits Before and After a Diagnosis of ADRD

Table 2 presents the results for the piecewise regression models that evaluated the quarterly trends in health care utilization before and

after a diagnosis of ADRD. The table shows the adjusted odds ratios (ORs) for any hospitalizations, ER admissions, and physician visits per quarter by ADRD status. We first describe the results for the quarterly trends before an ADRD diagnosis. The difference between ADRD cases and non-ADRD controls indicates if the quarterly trends in health care utilization for participants with ADRD are significantly different than non-ADRD controls.

Participants with an ADRD diagnosis exhibited a statistically significant increase in hospitalizations and ER admissions but not physician visits before ADRD was diagnosed. The odds for any hospitalization was 1.62 (95% CI = 1.43–1.84) times higher per quarter and any ER admission was 1.40 (95% CI = 1.27–1.54) times higher per quarter. Participants with no ADRD diagnosis also had a statistically significant increase in any hospitalizations (OR = 1.27, 95% CI = 1.11–1.45) and ER admissions (OR = 1.20, 95% CI = 1.07–1.35) during the prediagnosis period. The increasing trend in any hospitalizations for participants with ADRD was significantly greater than for participants without ADRD.

Among participants with an ADRD diagnosis, we detected statistically significant decreasing trends in any hospitalizations and ER admissions after ADRD was diagnosed. The odds for any hospitalizations was 0.88 times lower per quarter (95% CI = 0.80–0.97) and the odds for any ER admission was 0.89 times lower per quarter (95% CI = 0.82–0.97). Participants with no ADRD diagnosis showed a decreasing trend in any physician visits that was statistically significant (OR = 0.90, 95% CI = 0.82–1.00). The only difference in the slopes between participants with and without ADRD that was statistically significant was for any ER admissions.

Differences in Hospitalizations, ER Admissions, and Physician Visits by ADRD Status

Figure 2 shows the results from the GLMMs that compared the marginal probability at each quarter for any hospitalizations, ER admissions, and physician visits by ADRD status. The observed number and percentage of participants with any hospitalization, ER admission, and physician visit as well as the average number of physician visits at each quarter by ADRD status are shown in Supplementary Table 3.

Participants with an ADRD diagnosis were significantly more likely to have any hospitalizations than those with no ADRD diagnosis at 1 quarter before ADRD was diagnosed (Figure 2). Approximately 22% of participants with ADRD had any hospitalizations compared to less than 10% of participants with no ADRD diagnosis. In the quarters after ADRD was diagnosed, participants with an ADRD diagnosis with any hospitalization were significantly higher at quarter 1 and quarter 3 compared to non-ADRD controls.

Participants with ADRD were significantly more likely than those with no ADRD diagnosis to have any ER admissions 3 quarters before ADRD was diagnosed (Figure 2). The largest difference occurred 1 quarter before ADRD was diagnosed in which more than 30% of participants with ADRD had any ER admissions compared to 15% of participants with no ADRD diagnosis. Participants with an ADRD diagnosis were significantly more likely than participants with no ADRD diagnosis to have any ER admissions at quarter 1 and quarter 3 during the postdiagnosis period.

Over 75% of participants with an ADRD diagnosis had any physician visits per quarter during the pre- and postdiagnosis periods (Figure 2). With the exception of fourth quarter before ADRD diagnosis, there were no significant differences in the percentage of participants with any physician visits by ADRD status during the prediagnosis or postdiagnosis periods. The average number

Table 1. Descriptive Characteristics of Hispanic EPESE Participants Included in the Medicare Linkage Sample and the Final Matched Sample

Variable	Linkage Sample		<i>p</i> Value	Study Sample		<i>p</i> Value
	ADRD <i>N</i> = 1201	Non-ADRD <i>N</i> = 1379		ADRD <i>N</i> = 558	Non-ADRD <i>N</i> = 558	
Cohort ^a , <i>n</i> (%)			.84			1.00
1993/1994	987 (82.18)	1129 (81.87)		469 (84.05)	469 (84.05)	
2004/2005	214 (17.82)	250 (18.13)		89 (15.95)	89 (15.95)	
Baseline age ^b , mean (<i>SD</i>)	74.5 (7.24)	73.2 (6.73)	<.001	73.5 (6.77)	72.3 (6.54)	.002
Age ADRD diagnosis, mean (<i>SD</i>)	84.5 (6.23)	NA		83.7 (5.71)	NA	
Gender ^c , <i>n</i> (%)			<.001			.30
Male	437 (36.39)	666 (48.30)		221 (39.61)	204 (36.56)	
Female	764 (63.61)	713 (51.70)		337 (60.39)	354 (63.44)	
Education ^d , mean (<i>SD</i>)	4.5 (3.86)	5.4 (4.06)	<.001	4.8 (3.73)	4.6 (3.76)	.32
Marital status ^e			<.001			.76
Married	601 (50.04)	821 (59.54)		304 (54.48)	309 (55.38)	
Not married	600 (49.96)	558 (40.46)		254 (45.52)	249 (44.62)	
Nativity ^f , <i>n</i> (%)			.03			.40
United States	667 (55.54)	823 (59.77)		317 (56.81)	331 (59.32)	
Mexico	534 (44.46)	554 (40.23)		241 (43.19)	227 (40.68)	
Interview language, <i>n</i> (%)			<.001			.65
English	226 (18.82)	358 (25.96)		115 (20.61)	109 (19.53)	
Spanish	975 (81.18)	1021 (74.04)		443 (79.39)	449 (80.47)	
Comorbidity ^{g,h} , mean (<i>SD</i>)	1.4 (1.19)	1.4 (1.18)	.85	1.3 (1.16)	1.3 (1.16)	.92
Mortality ⁱ , <i>n</i> (%)			.10			1.00
Dead	1019 (84.85)	1137 (82.45)		452 (81.00)	452 (81.00)	
Alive	182 (15.15)	242 (17.55)		106 (19.00)	106 (19.00)	
Follow-up duration ^j , <i>n</i> (%)			<.001			1.00
0–5 y	344 (28.64)	519 (37.64)		125 (22.40)	125 (22.40)	
6–10 y	324 (26.98)	418 (30.31)		182 (32.62)	182 (32.62)	
>10 y	533 (44.38)	442 (32.05)		251 (44.98)	251 (44.98)	
Logit of propensity score	–0.1 (0.39)	–0.2 (0.40)	<.001	–0.1 (0.36)	–0.1 (0.36)	.82
Charlson comorbidity ^k						
No. of conditions, <i>n</i> (%)	NA	NA		2.9 (2.17)	2.3 (2.05)	<.001
0 conditions	NA	NA		77 (13.8)	120 (21.5)	<.001
1–2 conditions	NA	NA		190 (34.1)	215 (38.5)	
3–4 conditions	NA	NA		156 (28.0)	135 (24.2)	
≥5 conditions	NA	NA		135 (24.2)	88 (15.8)	
Depression ^l , <i>n</i> (%)	NA	NA		105 (18.8)	54 (9.7)	<.001

Notes: ADRD = Alzheimer's disease and related dementias; EPESE = Established Populations for the Epidemiological Study of the Elderly; NA = not applicable.

^aParticipants were required to be an exact match.

^bVariable was included in propensity score model.

^cVariable had missing data.

^dSelf-reported chronic conditions, including heart attack, stroke, hypertension, cancer, diabetes, fracture, and arthritis.

^eBased on Medicare claims during the one year period before the index date of ADRD.

Table 2. Quarterly Trends in the Percentage of Hispanic EPESE Participants With Any Hospitalizations, ER Admissions, and Physician Visits Before and After a Diagnosis of ADRD

	Hospitalizations		ER Admissions		Physician Visits	
	OR (95% CI)	<i>p</i> Value	OR (95% CI)	<i>p</i> Value	OR (95% CI)	<i>p</i> Value
ADRD						
Quarterly trend before diagnosis	1.62 (1.43–1.84)	<.001	1.40 (1.27–1.54)	<.001	1.09 (0.97–1.22)	.15
Quarterly trend after diagnosis	0.88 (0.80–0.97)	.009	0.89 (0.82–0.97)	.006	1.02 (0.92–1.14)	.71
Non-ADRD						
Quarterly trend before diagnosis	1.27 (1.11–1.45)	.001	1.20 (1.07–1.35)	.002	1.00 (0.90–1.11)	.99
Quarterly trend after diagnosis	1.02 (0.91–1.13)	.76	1.03 (0.94–1.13)	.49	0.90 (0.82–1.00)	.04
Difference between ADRD and non-ADRD						
Difference in trend before diagnosis	1.28 (1.06–1.54)	.01	1.16 (0.99–1.35)	.06	1.09 (0.93–1.27)	.28
Difference in trend after diagnosis	0.86 (0.75–1.00)	.05	0.86 (0.77–0.98)	.02	1.13 (0.98–1.30)	.10

Notes: ADRD = Alzheimer's disease and related dementias; EPESE = Established Populations for the Epidemiological Study of the Elderly; ER = emergency room. Models adjusted for age, Charlson comorbidities, and depression during the year before ADRD diagnosis. Bold values indicate statistical significance ($p < .05$).

Figure 2. Marginal probability for any hospitalizations (A), emergency room (ER) admissions (B), and physician visits (C) per quarter before and after a diagnosis of ADRD. EPESE = Established Populations for the Epidemiological Study of the Elderly; ADRD = Alzheimer's disease and related dementias. Blue solid line represents participants with an ADRD diagnosis and the gray dashed line represents participants with no ADRD diagnosis. The asterisk indicates the difference between ADRD and non-ADRD participants is statistically significant at $p < .05$. Full color version is available within the online issue.

of physician visits per quarter during the pre- and postdiagnosis periods for participants with ADRD ranged from 2.69 to 2.78 and 2.74 to 3.04, respectively (Supplementary Table 3). This was similar to the average number of physician visits for participants with no ADRD diagnosis (pre-period: 2.48–2.61; post-period: 2.55–2.66).

MDCs for Hospitalizations Before and After ADRD Diagnosis

The 10 most common MDCs according to ADRD diagnosis are shown in Figure 3. The blue-shaded bars represent the percentage of hospitalizations for each MDC before ADRD was diagnosed (prediagnosis period for non-ADRD controls) and the pink-shaded bars are for hospitalizations after ADRD was diagnosed (postdiagnosis period for non-ADRD controls). In general, the distribution of the 10 most common MDCs before and after an ADRD diagnosis by ADRD status was similar. For participants with ADRD, hospitalizations for conditions in the circulatory system and respiratory system were the 2 most common MDCs before (27.5% and 10.6%, respectively) and after (25.8% and 11.5%, respectively) an ADRD diagnosis. The remaining top 5 MDCs for participants with and without ADRD included conditions of the digestive system, nervous system, and musculoskeletal system.

Sensitivity Analyses

We conducted a series of analyses in which we restricted the sample to include participants with ADRD who were eligible for at least 2, 3, and 4 follow-up quarters after an ADRD diagnosis. This was done to determine if the decline in any hospitalizations and ER admissions after an ADRD diagnosis could be due to sicker patients with ADRD dropping out of sample and thus leaving relatively healthy participants with ADRD who may be

less likely to be hospitalized or to visit the ER. Supplementary Figure 1 shows the adjusted quarterly rates for any hospitalizations and any ER admissions before and after an ADRD diagnosis. Supplementary Table 4 shows the number of matched cases and controls for each sensitivity analysis.

The results for the sensitivity analyses are consistent with the main analysis. Regardless of the number of follow-up quarters in which participants were required to be eligible, we observed an increase in any hospitalizations and any ER admissions before ADRD was diagnosed, which was followed by a decrease after ADRD was diagnosed.

Discussion

We used data from a cohort study of Mexican American older adults that has been linked with Medicare claims files to investigate trends in any hospitalizations, ER admissions, and physician visits per quarter for 1 year before and 1 year after a claims-based diagnosis of ADRD. Older Hispanics are an understudied population and available evidence on changes in health care utilization before and after an ADRD diagnosis is largely based on studies of non-Hispanic White cohorts.

Consistent with evidence from studies of predominately non-Hispanic White cohorts (7,8,10–12), we detected increasing trends in hospitalizations and ER admissions before ADRD was diagnosed. Participants with ADRD did not have a significantly higher percentage of any hospitalizations until 1 quarter before an ADRD diagnosis, whereas the percentage of any ER admissions was significantly higher at 3 quarters before an ADRD diagnosis. Older Mexican Americans rely heavily on family for informal care (34). Informal caregivers often do not have the knowledge or experience to prevent or manage medical emergencies in the home (35).

Figure 3. Ten most common major diagnostic categories for hospitalizations before and after a diagnosis of Alzheimer's disease and related dementias. Full color version is available within the online issue.

Consequently, family members may take a person with ADRD to the ER for medical conditions or events that do not require being admitted to the hospital (36). This may contribute to the quarterly rate of any ER admissions to increase before hospitalizations.

We observed decreasing quarterly trends in any hospitalizations and ER admissions after ADRD was diagnosed. A similar trend has been reported for total Medicare expenditures after an ADRD diagnosis (37). In general, however, these findings are contrary to evidence from predominately non-Hispanic White cohorts that health care utilization continues to increase after ADRD is diagnosed (7,10,11).

We investigated potential explanations for the decreasing trends in hospitalizations and ER admissions after ADRD diagnosis. We first explored if the most common primary diagnoses for hospitalizations before an ADRD diagnosis were different than after an ADRD diagnosis. Among participants diagnosed with ADRD, approximately 25% of hospitalizations were for circulatory system conditions and 11% were for respiratory system conditions. These were the 2 most common MDCs before and after an ADRD diagnosis for participants with and without ADRD.

A second explanation we considered was that participants with ADRD who are more likely to be hospitalized or to visit the ER may drop out of sample in the quarters after ADRD was diagnosed. The results of the sensitivity analyses indicated that there was a decline in any hospitalizations and ER admissions after ADRD was diagnosed regardless of how many quarters participants were required to be observed during the postdiagnosis period.

It is not clear why the percentage of participants who experienced a hospitalization or ER admissions declined after ADRD was diagnosed. Hospitalizations and ER admissions are highly burdensome events for older adults with ADRD. Our results may partly reflect the older adult's or family's desire for less aggressive medical treatment once ADRD is diagnosed (38). This may

be especially true for Hispanics with ADRD who are at the end-of-life (39).

Hispanics are likely to receive unnecessary or burdensome medical care (40). A national study of Medicare beneficiaries revealed that 12.8% of Hispanic beneficiaries with ADRD received a feeding tube while in the hospital compared to 4.6% of non-Hispanic Whites with ADRD (41). The insertion of a feeding tube is discouraged for older adults with ADRD because of the minimal benefits, overall discomfort, and high risk for complications (42). Low quality of care and negative interactions with providers for Hispanics has been reported for other chronic diseases, such as diabetes (43). It is possible that prior experience with low-quality care may discourage older Hispanics with ADRD from seeking treatment in the future as symptoms become more severe.

We found that the percentage of participants who had any physician visits per quarter during the prediagnosis period was similar between participants with and without ADRD. While not reported by all studies (6,7), the use of outpatient services by older adults with ADRD has been found to be higher before ADRD is diagnosed (8,9). Older Hispanics regularly visit physicians and use outpatient services (29), but language barriers and skepticism of the health care system are among several factors that contribute to a delay in treatment seeking behavior for ADRD among Hispanics (44). Poor access to physicians who specialize in ADRD can also keep Hispanics from receiving follow-up care by a specialist after ADRD is diagnosed (45).

In general, the percentage of participants with any physician visits at each quarter during the postdiagnosis period was significantly higher for ADRD cases than controls. Although, the absolute difference by ADRD status in the percentage of participants with any physician visits was less than 5% at each quarter (Supplementary Table 2). We also found that the average number of physician visits per quarter was similar for participants with and without an ADRD

diagnosis. Thus, our results provide little evidence that an incident ADRD diagnosis is associated with a meaningful increase in physician visits by Mexican American Medicare beneficiaries.

Our analysis has limitations. First, we identified participants with ADRD according to ICD-9 and ICD-10 diagnoses included in Medicare claims data files. Medicare claims data have low sensitivity for ADRD (46), especially for Hispanics (47). This makes it likely that participants in our sample with an ADRD diagnosis were in the more severe stages of ADRD. We may have also underestimated the differences in health care utilization by ADRD status because some participants may have been misclassified as not having ADRD.

Despite the known limitations in using Medicare claims data to identify older adults with ADRD, nearly 50% of participants in the H-EPESE cohort had an ADRD diagnosis. The average age of ADRD diagnosis in our sample was approximately 84 years of age. As a comparison, the reported prevalence of ADRD among Hispanics aged 75–84 in the Washington Heights-Inwood Columbia Aging Project is 27.9% and 62.9% for Hispanics aged 85 and older (48). The long-life expectancy and high prevalence of ADRD risk factors among older Hispanics may contribute to the high prevalence of ADRD in this population.

Another potential limitation is we used data from a cohort of Mexican Americans living in the Southwestern United States. Over 60% of Hispanics living in the United States are Mexican American (49). However, our findings may not be generalizable to Hispanic populations that have different demographic and health characteristics than Mexican Americans (50).

Conclusions

In summary, we investigated short-term trends in health care utilization among Mexican American Medicare beneficiaries before and after an ADRD diagnosis. We observed that quarterly rates for any hospitalizations and ER admissions increased during the year prior to an ADRD diagnosis with the highest rates being observed at 3- and 9-month prediagnosis, respectively. An ADRD diagnosis does not appear to have a substantial impact on trends in physician visits for this population.

Hospitalizations and ER admissions can be burdensome to older adults with ADRD and their family caregivers. Our findings suggest that older adults and their family caregivers may be at a high risk for this burden before ADRD is diagnosed. Our findings also support early diagnosis of ADRD so that family caregivers can become knowledgeable on strategies to prevent unnecessary hospitalizations and ER admissions. Future research should describe health care utilization over several years to identify long-term trends in health care utilization in Hispanic populations before and after ADRD is diagnosed.

Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences* online.

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Conflict of Interest

None declared.

Author Contributions

B.D. was involved in the study design, interpreting of results, and writing of the manuscript. S.A.S. was involved in the study design, interpreting of results, and revising the manuscript. L.-N.C. conducted the statistical analysis and was involved in revising the manuscript. Y.-F.K. supervised the data analysis and was involved in the interpretation of results and revising the manuscript. M.R., K.S.M., and K.J.O. were involved in the interpretation of results and revising the manuscript.

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