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PREDICTORS OF MEDICATION ADHERENCE IN THE ELDERLY: THE ROLE OF MENTAL HEALTH

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Abstract

The aging population routinely has comorbid conditions requiring complicated medication regimens, yet non-adherence can preclude optimal outcomes. This study explored the association of adherence in the elderly with demographic, socio-economic and disease burden measures. Data were from the fifth visit (2011–2013) for 6,538 participants in the Atherosclerosis Risk in Communities Study, conducted in four communities. The Morisky Green Levine Scale measured self-reported adherence. Forty percent of respondents indicated some non-adherence, primarily due to poor memory. Logit regression showed, surprisingly, that persons with low reading ability were more likely to report being adherent. Better self-reported physical or mental health both predicted better adherence, but the magnitude of the association was greater for mental than for physical health. Compared to persons with normal or severely impaired cognition, mild cognitive impairment was associated with lower adherence. Attention to mental health measures in clinical settings could provide opportunities for improving medication adherence.

Keywords

aging; medication adherence; cognitive impairment

INTRODUCTION

As disease burden continues to rise in the aging population, more complicated medication regimens are routinely required to treat or delay disease progression (An & Nichol, 2013). An estimated one-half of patients with chronic diseases maintain adequate medication adherence, and medication non-adherence accounts for 30–70% of all adverse medication-related hospitalizations in the U.S. (Burkhart & Sabate, 2003; Toh, Jackson, Gascard, Manning, & Tuck, 2010). Hospitalizations due to poor medication adherence cost over $100 billion (Osterberg & Blaschke, 2005), and non-adherence also hinders quality of life and overall public health. The incidence and consequences of non-adherence may be especially

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profound in the elderly due to increased frailty (Chan, Nicklason, & Vial, 2001; Col, Fanale, & Kronholm, 1990). An estimated 75% of older adults have two or more chronic conditions (Anderson, 2010; Paez, Zhao, & Hwang, 2009). Given the high prevalence of chronic diseases and the potential importance of enabling physicians to identify patients at high risk of non-adherence, our study aimed to identify factors associated with medication adherence in the elderly population.

CONCEPTUAL FRAMEWORK

Studies of factors associated with non-adherence in the elderly have been limited in sample size and often have conflicting results, especially in the areas of disease burden, social status, and health literacy (Balkrishnan, 1998; MacLaughlin et al., 2005; Osterberg & Blaschke, 2005). Most studies evaluate a single disease in isolation and rarely account for concomitant diseases (Bramley, Gerbino, Nightengale, & Frech-Tamas, 2006; Gislason et al., 2007; Granger et al., 2005; Jackevicius, Li, & Tu, 2008; Vrijens, Vincze, Kristanto, Urquhart, & Burnier, 2008; Wu, Moser, Chung, & Lennie, 2008). For example, one study assessed medication adherence for six chronic diseases among veterans but analyzed each disease individually without controlling for comorbidities or assessing the implication of disease burden (Neugaard, Priest, Burch, Cantrell, & Foulis, 2011).

Physical and mental health could both affect medication adherence, albeit through potentially different mechanisms. Mental illness can impair functioning such that individuals are less attentive to or interested in adhering to medication regimens. While worse physical health by itself may positively or negatively influence adherence, persons with more medical conditions commonly have more complicated medication regimens and an accompanying lower likelihood of being strictly adherent primarily due to high pill burden. Prior studies show that major predictors of poor adherence include patient mental health (especially depression and cognitive impairment), understanding of their disease (including having asymptomatic disease or a belief in value of treatment), and barriers (e.g., side effects, medication cost, lack of insurance coverage) (Osterberg & Blaschke, 2005). These researchers also identified other problems that might be less amenable to assessment in an office visit (e.g., missed appointments, poor provider-patient relationships) and noted that gender, race and socio-economic status have not been consistently associated with non-adherence. We therefore hypothesized that medication adherence might be determined by demographics and socio-economic status as well as disease burden, including measures of mental as well as physical health.

New Contribution

This analysis aims to expand to our knowledge about non-adherence in several ways. First, we use a large community-based sample of elderly individuals with a range of medical conditions rather than the small or disease-specific samples used in many prior studies. Second, we use a validated self-reported scale of overall adherence as well as personal reports of the reasons for non-adherence. Third, while we use indicators of general health as well as specific diseases, we also explore how the relationship between cognition and adherence may vary for elderly persons who are experiencing onset of mild cognitive

impairment. Specifically, we hypothesize that adherence may be most compromised for people experiencing mild cognitive impairment. In contrast, people without cognitive impairment may have relatively good adherence, while persons with severe cognitive impairment may have caregivers who ensure that medications are taken. Since physicians may often be in a position to identify initial cognitive decline in their patients, an understanding of the relationship of adherence with the full range of cognition is important.

METHODS

Study Design, Setting and Sample

The ARIC Study was initiated in 1986 as a prospective epidemiological study comprised of 15,972 participants from four U.S. communities: Forsyth County, North Carolina, Jackson, Mississippi, suburban Minneapolis, Minnesota, and Washington County, Maryland (The ARIC Investigators, 1989). Standardized examinations and interviewer-administered questionnaires were conducted over five visits. The fifth visit, conducted in 2011–2013, collected various measures of socio-economic status and disease burden. In addition, study participants responded to questions concerning medication insurance coverage, number of medications, self-reported medication adherence, and self-reported reasons for non-adherence.

The fifth study visit was conducted with 6,538 of the 10,036 surviving cohort members (65% response rate). Visit participants, 66 to 90 years of age, were younger and healthier than cohort members who did not attend the visit (The ARIC Investigators, 2014). After excluding 259 visit participants for other reasons (223 non-response to the medication survey, 18 taking no medications, and 18 with race other than white or black), the sample available for cross-sectional analysis consisted of 6,279 visit participants (96%) who reported taking one or more medication and responded to the medication adherence questions. No cohort members in the final analysis sample were residing in a nursing home or assisted living facility.

Measures: Medication Adherence

Medication adherence was assessed using the Morisky Green Levine Scale (MGLS), a four-item self-reported questionnaire (Morisky, Green, & Levine, 1986). Adherence was measured using the number of “yes” responses to the four questions (Figure 1): high (0 yes responses), intermediate (1–2), or low (3–4). The MGLS is a validated scale that has been commonly used to measure self-reported medication adherence. In a separate analysis, ARIC cohort participants enrolled in Part D who reported some non-adherence based on the MGLS were less likely to have a current corresponding Medicare claim (Savitz et al., 2016), further supporting the validity of the MGLS. Visit 5 cohort participants who reported less than 100% adherence in the past four weeks were asked to select from a list of 11 potential reasons for non-adherence (Crisp, Burkhart, Esserman, Weinberger, & Roth, 2011).

Measures: Demographics and Socio-economic Status (SES)—Demographic measures included age and gender. SES included race, site, education, marital status, medication insurance, self-reported social status, and reading ability. The MacArthur Scale

of Subjective Social Status (Adler & Stewart, 2007) presents a picture of a "social ladder" (10 rungs) and asks individuals to place an "X" on the rung on which they feel they stand. Reading ability was assessed by the reading component of the Wide Range Achievement Test-3 (WRAT-3). Low reading ability was defined as a score of <32 (DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004).

Measures: Disease Burden

Disease burden measures included: the Short Form-12 (SF-12) Health Survey (Ware, Kosinski, & Keller, 1996) which assesses both physical and mental health (0–100, 0 = worst health, 100 = perfect health); number of medications; satisfaction with care (based on a 5 item Likert Scale); and select chronic conditions based on physical examination, laboratory measurements or hospital stay records/claims. Many of the SF-12 questions on mental health pertain to symptoms of depression or anxiety. Chronic conditions assessed were hypertension, hyperlipidemia, diabetes, atrial fibrillation, lung disease (asthma, bronchitis, and chronic obstructive pulmonary disease), aortic abdominal aneurysm, peripheral arterial disease, and chronic kidney disease. In addition, hospitalizations since 2005 for three conditions were validated by ARIC: heart failure, stroke and acute myocardial infarction, with hospitalization assumed to indicate at least a moderate level of disease.

Measures: Cognitive Status

Cognition measures included the Mini-Mental State Exam (MMSE) and presence of a proxy respondent. The US Preventive Services Task Force indicates that a large body of literature supports an upper MMSE threshold of 23–25 (Moyer, 2014). Prior research shows that the MMSE decreases with age and increases with education (Crum, Anthony, Bassett, & Folstein, 1993), though we control for these measures in our model. Based on a systemic review of diagnosing mild cognitive impairment (Stephan et al., 2013), we chose the following MMSE cutpoints: moderate to severe cognitive impairment (less than 21), mild cognitive impairment (21–24), and normal cognition (25–30).

Statistical Analysis

We use logistic regression analysis to assess predictors of medication adherence defined as a dichotomous indicator of high (versus intermediate or low adherence combined). The regression controlled for the demographic, socio-economic and disease burden factors described above. We conducted complete case regression analysis using 4,899 participant observations (78%). We applied inverse probability of response weighting (IPRW) to account for any observed differences between the population sample and those excluded due to missing data (Seaman & White, 2013). Specifically, we constructed weights for IPRW in two ways: (1) for the regression analysis sample versus the surviving ARIC cohort (regardless of participation in the fifth visit); and (2) for the regression analysis sample versus the full sample. The logistic regressions to construct the weights used dependent variables of sample response and controlled for all of the variables used in the regression to assess medication adherence. The results were extremely similar, so we present results using the latter set of weights.

RESULTS

Cohort Characteristics

Table 1 describes baseline characteristics for both the full sample of 6,279 persons responding to the adherence questions and the 4,899 participants with complete data on all measures. The average age of the analysis sample was 75.4±5.1 years (ranging from 66 to 90 years old), and the majority were female, white and married. Roughly 12% of the analysis sample had less than 12 years of education, and 11% reported not having medication insurance coverage. Only 6.1% had poor health literacy (WRAT-reading score < 32 points).

Based on the SF-12, study participants had slightly worse physical health but slightly better mental health than a comparable national sample (based on scores rescaled using national data). The mean number of self-reported medications including over-the-counter medications was 9.3. Most participants reported being very satisfied with their medical care. The most common chronic conditions were hypertension, followed by diabetes, chronic kidney disease, and hyperlipidemia. Only small percentages of participants were hospitalized since 2005 for the three conditions adjudicated by ARIC. While 89.1% of participants exhibited MMSE scores with normal cognition, 8.8% had intermediate cognition and 2.1% had severe cognitive impairment. Only 1.5% of participants had a proxy respondent. Differences in the measures between the full sample and regression analysis sample were accounted for in the analysis by using IPRW.

Medication Non-Adherence and Self-Reported Reasons for Non-Adherence

Based on the four MGLS questions (Figure 1), one-third of participants reported forgetting to take a medication and 10% admitted to being careless at times about medication taking. Overall, only 60% of the 6,279 study participants reported high/optimal medication adherence by responding “no” to all four MGLS questions. Approximately 37% reported intermediate adherence, and only 2.5% reported poor adherence. When questioned about reasons for non-adherence, 73% of the 2,119 subjects reporting less than 100% adherence indicated their non-adherence was due to poor memory. The second most common reason for non-adherence was running out of medication (7%); other specific reasons (feeling better, side effects, not believing drugs would help, could not afford, lack of transportation or directions too confusing/complicated) were each identified less than 3% of the time. Despite being queried with a fairly extensive list of commonly reported reasons, almost 20% of subjects selected “other” as an explanation for non-adherence.

Factors Associated with Medication Adherence

Table 2 provides regression estimates of the associations (odds ratios) of all predictors with self-reported high/optimal adherence. Controlling for other covariates, adherence was significantly higher with increasing age, better physical or mental health status, greater satisfaction with care and lower health literacy. Hypertension and prior hospitalization for stroke were also associated with greater adherence, but persons with diabetes were less likely to be adherent. As hypothesized, adherence was significantly lower for persons reporting mild cognitive impairment compared to persons with normal cognition on the MMSE; persons reporting moderately or severely impaired cognition were more likely to be

adherent compared to persons with normal cognition, though the association was not significant at $p<0.05$.

Odds ratios for continuous linear measures rather than dichotomous measures are difficult to interpret. Therefore, Figure 2 provides predicted rates of adherence for the range of SF-12 physical and mental health component scores calculated for the visit participants. In our sample, SF-12 physical health scores ranged from 7 to 67, while mental health scores ranged from 8 to 74. Predicted adherence varies more for mental health (ranging from 20% for the lowest mental health score to almost 80% for the highest mental health score). In contrast, adherence only ranges from about 42% to 65% for reported variation in physical health.

We found weak evidence that adherence might be associated with race as blacks in Jackson has lower adherence ($p<0.10$) than white in Minnesota; while site and race effects cannot be separated easily in the ARIC study, blacks in Forsyth County has a similar effect (odds ratio). Furthermore, higher self-assessed subjective social status was weakly associated with better adherence ($p<0.10$). Adherence was not significantly related to other factors including sex, education, marital status, medication coverage, number of medications, several chronic disease indicators and use of a proxy respondent.

DISCUSSION

Our study assessed predictors of medication adherence in a contemporary older community cohort. We found that medication non-adherence is prevalent (40%) and multi-factorial. Memory was reported as the most common cause for non-adherence, with 73% of participants citing this reason. Previous literature has also cited forgetfulness as a common barrier to adherence, with reported forgetfulness varying from 22% to 73% across studies (Vervloet et al., 2012). Assessment of executive function and working memory has been suggested to identify older adults at risk for medication non-adherence (Insel, Morrow, Brewer, & Figueredo, 2006b). The prominence of forgetfulness in our study sample likely reflects the age of the sample in combination with confounding factors such as declining cognition. Despite a comprehensive list of potential causes of non-adherence, almost 20% of subjects reported “other” as the reason for non-adherence. Responses of “other reasons” may reflect factors related to cognition, including a possible reluctance of people to acknowledge memory problems in a survey setting; alternatively, people who are non-adherent due to depression might have been less likely to pick any of the specific reasons for non-adherence.

Although some prior studies found conflicting relationships between poor cognition and adherence (Gray, Mahoney, & Blough, 2001; Insel, Morrow, Brewer, & Figueredo, 2006a; Ownby, Hertzog, Crocco, & Duara, 2006; Stoehr et al., 2008), our study emphasizes the potential importance of identifying early declines in cognition for optimal medication adherence, especially given the challenges in assessing barriers to medication adherence in the cognitively impaired population (Campbell et al., 2012). The ARIC study administered the MMSE to a broad sample of individuals from four communities. We found that intermediate cognitive impairment (MMSE scores from 21 to 24) was strongly associated with adherence relative to non-adherence in persons with normal cognition (OR 0.71; 95% CI: 0.57 to 0.89). Although adherence for persons with severe cognitive impairment (MMSE

< 21) did not differ from persons with normal cognition, the magnitude of the effect was large (OR 1.30; 95% CI: 0.80 to 2.11) and adherence was significantly better than for persons with mild cognitive impairment. Persons with severe cognitive impairment may have good adherence due to caregiver supervision of medication administration, while the family of someone experiencing onset of mild cognitive impairment have not yet have identified the need to intervene in supervising medication behaviors. Thus, medication adherence likely should be more closely scrutinized in patients with mild cognitive impairment and methods to identify such patients should be considered for interventions to improve adherence.

Our study addressed adherence in the context of multiple chronic conditions. Studies have shown variability in the relationship between comorbidity and adherence especially in the area of psychological disease (Balkrishnan, 1998; Balkrishnan, Bhosle, Camacho, & Anderson, 2006; Grenard et al., 2011; MacLaughlin et al., 2005). The role of mood disorders such as depression in adherence is extremely complex and dependent on the individual psychological disorder as well as many other factors (Pompili et al., 2013). Our study found that better self-reported physical health and mental health are both associated with greater adherence. Another marker of disease burden, number of medications, was hypothesized to be associated with non-adherence; however, this association was not supported by this analysis. Most commonly, a negative relationship between adherence and medication number previously has been documented in elderly patients (Gazmararian et al., 2006; Stoehr et al., 2008), though prior analyses often did not control for as many factors as this analysis.

Other measures of interest in adherence research have included satisfaction with care, which can include the physician visit experience. Previously, adherence rates have been positively associated with having more physician visits and fewer missed appointments, but negatively associated with having logistical barriers to obtaining medications (e.g., lack of insurance coverage or transportation), giving lower priority to discussing therapy with the physician, and less knowledge about disease. In addition, poor provider-patient relationships have been documented as predicting lower adherence (Grenard et al., 2011; Osterberg & Blaschke, 2005). Our study confirmed the important positive relationship between patient satisfaction with care and adherence.

The relationships between adherence to various cardiovascular medications and improved outcomes have also been well documented (Chowdhury et al., 2013). In our study, adherence was only significantly associated with three of the chronic conditions explored: hypertension and prior hospitalization for stroke were associated with greater adherence, while diabetes was associated with less adherence. The strong association for stroke hospitalization may reflect cognitive challenges and likely caregiver involvement that accompany this disease. The contrasting findings observed with hypertension and diabetes, two relatively silent diseases, could be imbedded in issues associated with management of these conditions. The potential benefits of disease prevention could motivate individuals with either hypertension or diabetes to be more vigilant in adhering to medication regimens. In contrast, diabetics who develop comorbid conditions with associated symptomatology (e.g., diabetic neuropathy) may be discouraged from being adherent due to higher pill burden and worse

overall physical health. Furthermore, underlying behaviors, such as poor diet and sedentary lifestyle, that initially contributed to development and/or progression of diabetes may be challenging to overcome. Admittedly, these latter arguments could also be made for patients with hypertension, though some participants with hypertension likely had relatively uncomplicated disease. The lack of statistical significance for other diseases may be due, in part, to relatively low prevalence in the sample, or to multicollinearity with other measures such as number of medications.

Evidence from previous studies shows conflicting relationships between non-adherence and age as well as socio-economic status (Balkrishnan, 1998; Balkrishnan et al., 2006; MacLaughlin et al., 2005; Mathes, Jaschinski, & Pieper, 2014; Monane et al., 1996). Our study demonstrated that within a sample of individuals over age 70, adherence increased with age while controlling for a number of other factors. Being non-white or having low income has been associated with non-adherence, and higher adherence has also been reported in those living in areas with higher income in addition to higher education (Couto et al., 2014) (Balkrishnan, 1998; Couto et al., 2014; Holmes et al., 2012; Rolnick, Pawloski, Hedblom, Asche, & Bruzek, 2013), We found weak evidence ($p<0.10$) that adherence was lower in persons with low subjective social status and for blacks in one community, though it is not possible to disentangle the effects of race and geographic site in the ARIC study. Education and insurance coverage for medications were also not associated with adherence once the other measures were controlled.

While one study suggested no definite association between health literacy and medication adherence in older adults (Loke, Hinz, Wang, & Salter, 2012), our study found that persons with low reading scores were more adherent when controlling for other measures. The WRAT reading score in the elderly may be confounded by poor cognition, though significant effects were found for both measures. While some advocate that healthcare providers utilize a screening tool to independently assess literacy, our study suggests that the WRAT should be interpreted cautiously in this population.

The study had several limitations. Cross-sectional analysis does not allow for causal inferences. The initial cohort was population-based, but the current sample is of participants in the fifth ARIC visit are known to be healthier than non-participants; we used inverse probability weighting to adjust for selection into visit participation based on observed variables. Medication adherence was self-reported and not specific to individual disease states; the latter factor is a strength, though studies validating concordance of the Morisky Green Levine Scale have only assessed adherence in individual disease states (Shi et al., 2010). Errors in self-report of adherence, both deliberate and unintentional, could bias the estimated associations, though a comparison of self-reported adherence using the MGLS supported the validity of the scale (Savitz et al., 2016). Random error in reported adherence would bias estimates towards zero, but we still find statistically significant associations for many factors including mild impairment versus normal cognition. Medications documented at the fifth visit included both prescribed and over-the-counter medications; this fact may be either a strength or weakness of this study. Including over-the-counter medications such as aspirin represents real world medication burden, and many recommend assessing such as standard of practice. Finally, additional measures that may be associated with adherence,

such as prescriber continuity, were not obtained, and the ARIC study design precluded separating race from community effects.

The high prevalence (40%) of self-reported non-adherence among the elderly is concerning, given the clinical and financial ramifications of non-adherence. Our analysis does not provide guidance for specific MMSE cutpoints for use in clinical practice, since other factors such as age or education should be considered (Moyer, 2014). Screening tools such as the MMSE could be used by providers or researchers to identify patients with declining cognition who would benefit from targeted adherence interventions. Indications of depression may also be more indicative of proclivity for non-adherence and therefore potential benefit from interactions to increase adherence than other measures of physical or clinical disease burden.

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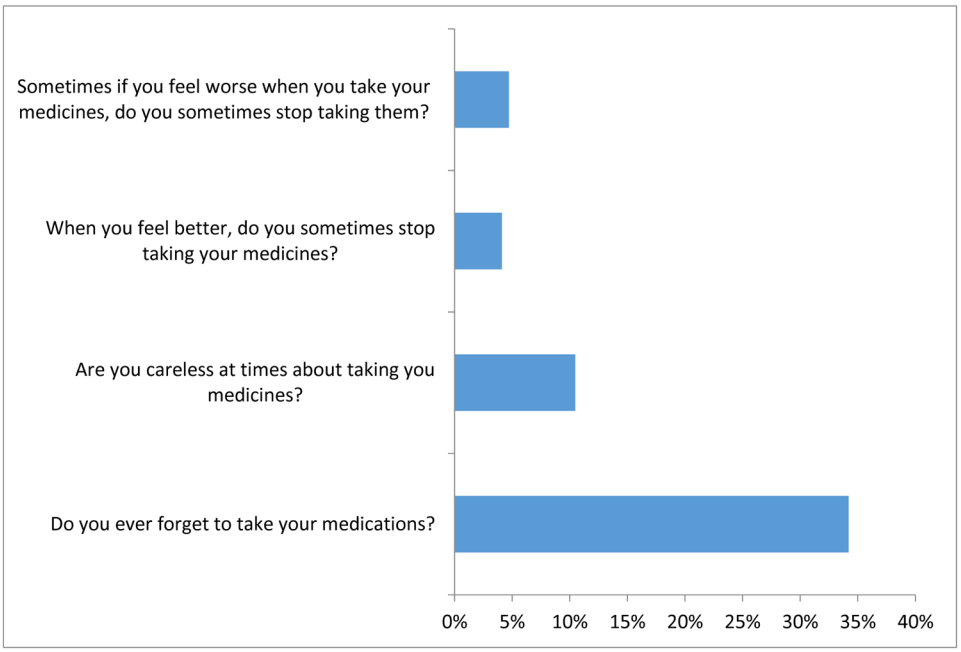

Figure 1.

ARIC Cohort Responses to the Four Morisky Green Level Scale Questions (n=6,279 ARIC participants)

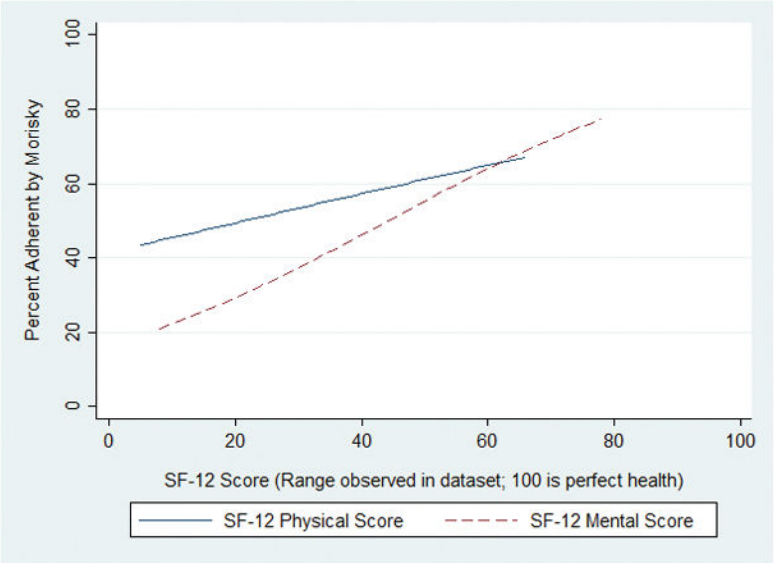

Figure 2.
Predicted Adherence Based on SF-12 Scores

Table 1

Cohort Descriptive Statistics

	Full Sample N=6,279	Regression Sample N=4,899
Demographic and Socio-Economic Status		
Age in Years (±SD)	75.8 (5.2)	75.4 (5.1)
Sex, Male	40.9%	40.1%
Education Less Than 12 Years	15.0%	12.4%
Married	65.8%	67.8%
ARIC site and race		
Minneapolis, MN (100% white)	29.4%	31.4%
Forsyth County, NC (white)	20.4%	19.4%
Forsyth County, NC (black)	1.6%	1.4%
Jackson County, MS (100% white)	21.7%	20.1%
Washington Country, MD (100% white)	26.9%	27.7%
No Medication Insurance Coverage	10.8%	11.0%
MacArthur Scale of Subjective Social Status	6.3 (1.9)	6.4 (1.8)
Low Wide Range Achievement Test-3 Reading (<32)	7.40%	6.1%
Disease Burden		
Physical and Mental Health & Well-being SF-12		
Physical Health	45.7 (10.5)	46.7 (9.9)
Mental Health	55.2 (7.8)	55.4 (7.5)
Number of Reported Medications	9.4 (4.9)	9.3 (4.8)
Very Satisfied with Care	78.3%	78.4%
Select Diseases[^]		
Hypertension	75.5%	74.0%
Diabetes	29.7%	27.6%
Chronic Kidney Disease (GFR<60)	28.8%	26.9%
Hyperlipidemia	21.4%	21.9%
Lung Disease	16.8%	15.6%
Atrial Fibrillation	7.7%	6.7%
Peripheral Arterial Disease with Leg Pain	2.2%	2.1%
Abdominal Aortic Aneurysm	2.1%	1.9%
Myocardial Infarction Hospitalization	3.3%	3.2%
Heart Failure Hospitalization	2.6%	2.2%
Stroke Hospitalization	1.9%	1.8%
Mini-Mental State Exam		
Normal cognition (score>24)	85.5%	89.1%
Mild cognitive impairment (score 21–24)	10.2%	8.8%
Moderate to severe cognitive impairment (score <21)	4.3%	2.1%
Use of Proxy	2.9%	1.5%

Columns provide means (with standard deviations in parentheses) or percent.

^Select diseases defined by standard ARIC conventions.[50] Hypertension was based on systolic≥140, diastolic≥90, or hypertension medication. Hyperlipidemia was defined LDL>129 mg/dL. Diabetes was defined as fasting serum glucose>126 md/dL or diabetes medications. Atrial fibrillation was defined as reported prevalent by visit 5. Lung disease includes asthma, bronchitis, and chronic obstructive pulmonary disease. Aortic abdominal aneurysm is measured by diagnosis during hospitalization or abdominal ultrasound with abdominal aortic diameter greater than 30 mm. Peripheral arterial disease is measured by ankle brachial index less than 0.9 or greater than 1.3 units in conjunction with reported leg pain. Kidney disease is measured by glomerular filtration rate (GFR) less than 60 mL/min. Heart failure, stroke, and acute myocardial infarction were based on inpatient hospital record abstraction.

Table 2

Logistic Regression Analysis of Factors Associated with Medication Adherence (n=4,899)

	Odds Ratio	95% CI
Demographic and Socio-Economic Status		
Age in Years (±SD)	1.02***	(1.01 – 1.03)
Sex, Male	0.97	(0.85 – 1.11)
Education Less Than 12 Years	1.09	(0.89 – 1.34)
Married	1.01	(0.879 – 1.16)
ARIC site and race		
Minneapolis, MN (100% White)	Reference	
Forsyth County, NC Whites	1.06	(0.89 – 1.26)
Forsyth County, NC Blacks	0.84	(0.51 – 1.38)
Jackson County, MS (100% Black)	0.83*	(0.68 – 1.00)
Washington Country, MD (100% White)	0.96	(0.82 – 1.12)
No Medication Insurance Coverage	1.00	(0.83 – 1.21)
MacArthur Scale of Subjective Social Status	1.03*	(1.00 – 1.07)
Low Wide Range Achievement Test-3 Reading (< 32)	1.62***	(1.20 – 2.18)
Disease Burden		
Physical and Mental Health & Well-being SF-12		
Physical Health	1.02***	(1.01 – 1.03)
Mental Health	1.04***	(1.03 – 1.05)
Number of Reported Medications	1.00	(0.99 – 1.02)
Very Satisfied with Care	1.18**	(1.02 – 1.36)
Selected Diseases^		
Hypertension	1.16**	(1.01 – 1.33)
Diabetes	0.83***	(0.72 – 0.95)
Stroke Hospitalization	1.96***	(1.18 – 3.26)
Mini-Mental State Exam [versus normal cognition (score >24)]		
Mild cognitive impairment (score 21–24)	0.71***	(0.57 – 0.89)
Moderate to severe cognitive impairment (score <21)	1.30	(0.80 – 2.11)
Use of Proxy	1.08	(0.64 – 1.84)

*** p<0.01

** p<0.05

* p<0.10

^ Additional diseases besides hypertension, diabetes and stroke controlled for in the regression included: chronic kidney disease (GFR<60), hyperlipidemia, lung disease atrial fibrillation, myocardial infarction requiring hospitalization, heart failure hospitalization, peripheral arterial disease with leg pain, abdominal aortic aneurysm.