Does the Relationship of the Proxy to the Target Person Affect the Concordance between Survey Reports and Medicare Claims Measures of Health Services Use?

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Objectives. To compare concordance of survey reports of health service use versus claims data between self respondents and spousal and nonspousal relative proxies.

Data Sources. 1995–2010 data from the Survey on Assets and Health Dynamics among the Oldest Old and 1993–2010 Medicare claims for 3,229 individuals (13,488 person-years).

Study Design. Regression models with individual fixed effects were estimated for discordance of any hospitalizations and outpatient surgery and for the numbers of under- and over-reported physician visits.

Principal Findings. Spousal proxies were similar to self respondents on discordance. Nonspousal proxies, particularly daughters/daughters-in-law and sons/sons-in-law, had less discordance, mainly due to reduced under-reporting.

Conclusions. Survey reports of health services use from nonspousal relatives are more consistent with Medicare claims than spousal proxies and self respondents.

Key Words. Survey reports, Medicare claims, proxy respondents

The use of proxy respondents is common practice in national health and health services use surveys. When surveying older adults, the use of proxies is particularly relevant due to their higher prevalence of age-related cognitive and physical health limitations, which place a greater burden on study participation. An assumption made in many studies is that proxy responses are as accurate as self responses. While numerous studies have evaluated the concordance of self- and proxy-reports of health conditions and health services use with administrative data such as Medicare claims (Bhandari and Wagner

2006; Wolinsky et al. 2007, 2014, 2015; Day and Parker 2013), research evaluating whether that concordance varies by the relationship of the proxy reporter to the target person is sparse. That nascent literature suggests that spousal reports are acceptable alternatives for self reports, especially for measuring general health status or quality-of-life (The Medical Research Council Cognitive Function Ageing Study [TMRCCFAS] 2000; Sneeuw, Sprangers, and Aaronson 2002; Ayalon and Covinsky 2009). Less is known about the acceptability of spousal reports for measuring health services use. Furthermore, in most studies of proxy concordance there is little distinction between proxy groups based on their relationship with the target person. Indeed, to the best of our knowledge, no prior study has evaluated how the agreement between survey reports and administrative data on health services use varies by the relationship between proxy reporters and their target persons. Addressing this question is important for survey researchers, survey designers, and the agencies that support them.

We investigate differences in the concordance of commonly used measures of health services use between survey reports and claims data based on proxy status and the relationship between proxy reporters and their target persons compared to self respondents. We use a nationally representative sample of older Medicare beneficiaries and employ an individual fixed-effect model that only uses within-individual variation over time and removes time-invariant unobservable confounders.

METHODS

Data and Sample

The sample is taken from the AHEAD (Survey on Assets and Health Dynamics among the Oldest Old) cohort (Juster and Suzman 1995; Myers, Juster, and Suzman 1997), a nationally representative sample of 7,447 older adults

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recruited in 1993 and followed biennially thereafter. Survey data from 1995 to 2010 were linked to Medicare claims from 1993 to 2010 (Denominator, Inpatient, Outpatient, and Physician Part B Standard Analytic Files) for 5,787 participants (78 percent of the original AHEAD sample). Survey reports of health services use focus on the previous 2 years requiring a corresponding 2-year “look back” window in the Medicare claims. The analytical sample was further limited to individuals continuously enrolled in both Medicare Part A and Part B fee-for-service plans prior to their 1995 interviews because managed care Medicare plans have different reporting requirements for Part B claims. Given our focus on proxy reporters versus self respondents, we further excluded self respondents assisted by someone else in the home because no data were available on the relationship between the assisting and target persons. We also excluded nonrelative proxies because their frequency was insufficient for analytic purposes.

Individuals were censored when they were lost to follow-up or were no longer continuously enrolled in Medicare Parts A and B fee-for-service plans. Observations with missing data on study variables were excluded. Because our model only utilizes within-individual variation over time, only individuals who were re-interviewed after 1995 were retained. Thus, the final analytical sample consisted of 3,229 unique individuals who contributed 13,488 person-year observations.

Concordance and Proxy Measures

We focus on three of the most commonly used measures of health services use including any hospitalizations, any outpatient surgery, and the number of physician visits, reported at each re-interview for the previous 2 years. The main outcomes for any hospitalizations and outpatient surgery were binary indicators for nonmatching (discordance) between the survey and claims data over the 2 years before the re-interview date. For most observations (95 percent), there was no exact match for the number of physician visits between the survey reports and claims data. Therefore, we evaluated two outcomes: (a) the number of under-reported visits when the claims-based visits exceeded the survey-reported visits, and (b) the number of over-reported visits when the survey-based visits exceeded those in the claims. We considered any visits as an outcome, but because the majority of observations (95 percent) had a match due to most individuals (97 percent) having at least one physician visit over 2 years, we did not estimate a model for discordance on that measure. Similarly, we did not model the number of over- or under-reported

hospitalizations as the majority of the sample (75 percent) had a perfect match on hospitalization counts, and most discordant responses (80 percent) differed by only 1–2 episodes.

The main independent variables were indicators for proxy status. The initial model included a proxy- versus self-respondent indicator. This was then expanded to differentiate between spousal and nonspousal proxy reporters. Further expansion differentiated between daughters/daughters-in-law, sons/sons-in-law, and other relatives. Additional differentiation (e.g., daughters versus daughters-in-law) was not feasible given the relatively small numbers of persons in some of those groups, and the lack of conceptual justification.

Statistical Analysis

Each outcome—indicators for discordance versus concordance for any hospitalizations and outpatient surgery and the numbers of under-reported and over-reported visits—was separately modeled as a function of the progressively differentiating proxy-status indicators. All models adjusted for several demographic (age and age-squared, marital status), socioeconomic (wealth indicators, Medicaid insurance coverage), and health status (self/proxy-rated health status and memory, activities of daily living [ADLs], instrumental ADLs [IADLs], and lower body mobility), which are suggested by previous studies (e.g., Wolinsky et al. 2014) to be relevant for concordance and can also influence proxy status, along with re-interview wave-fixed effects. Briefly, age and wave-fixed effects capture aging and related changes in cognitive status and overall health. Both age and marital status influence the availability of proxies but also health status and health services use. The health status indicators capture specific aspects of health (physical and mental) which could also relate to both proxy availability (such as informal care) and concordance because of memory/cognitive functioning as well as health services use and interactions with the health care system. Finally, wealth and Medicaid insurance also affect health services use and extent of interactions with the health care system, health and cognitive status, and availability of informal care and proxies. All covariates were measured at each interview year. Variable definitions and descriptive statistics for the total sample are shown in Table 1 (descriptive statistics by respondent status are available online in Table S1).

We estimated the models using OLS with individual fixed effects (Wooldridge 2013) because it only uses variation in proxy status within the *same* individual over time and thereby accounts for unobservable individual-level time-invariant variables such as personality traits (observable time-

Table 1: Descriptive Statistics of Study Variables

<i>Variables</i>	<i>Description</i>	<i>Mean (SD) or %</i>
Dependent variables		
Discordant reports of any hospitalization	0/1 indicator for discordant reports of having any hospitalization in survey vs. claims	11.70
Under-reports	0/1 indicator for reporting being hospitalized in claims but not in survey	4.91
Over-reports	0/1 indicator for reporting being hospitalized in survey but not in claims	6.79
Discordant reports of outpatient surgery	0/1 indicator for discordant reports of having outpatient surgery in survey vs. claims	26.55
Under-reports	0/1 indicator for reporting outpatient surgery in claims but not in survey	17.38
Over-reports	0/1 indicator for reporting outpatient surgery in survey but not in claims	9.16
Number of under-reported physician visits	No. of claims-based physician visits that exceed the survey reports among under-reporters	11.84 (10.90)
Number of over-reported physician visits	No. of survey-reported physician visits that exceed the claims records among over-reporters	12.32 (29.88)
Main independent variables		
Any proxy*	0/1 indicator for a proxy-respondent	14.21
Spousal proxy*	0/1 indicator for a spousal proxy	4.21
Nonspousal proxy*	0/1 indicator for a nonspousal proxy	10.00
Daughters/daughters-in-law*	0/1 indicator for a daughter or daughter-in-law as proxy	5.96
Sons/sons-in-law*	0/1 indicator for a son or son-in-law as proxy	2.16
Other relatives*	0/1 indicator for other relatives (e.g., grandchild, sibling, other relatives) as proxy	1.88
Other covariates		
Age	Age in years at time of interview	82.49 (5.70)
Married†	0/1 indicator for being married at time of interview	36.78
Lowest wealth quintile‡	0/1 indicator of being in the lowest wealth quintile of the sample at time of interview	16.00

continued

Table 1. *Continued*

<i>Variables</i>	<i>Description</i>	<i>Mean (SD) or %</i>
Highest wealth quintile [‡]	0/1 indicator of being in the highest wealth quintile of the sample at time of interview	23.35
Medigap insurance coverage [§]	0/1 indicator of having supplemental insurance coverage at time of interview	70.38
Self- or proxy-rated memory	Target person memory at time of interview; ranges from 1 to 5; 1 = Poor, . . . 5 = Excellent	2.90 (1.03)
Self- or proxy-rated health	Target person health at time of interview; ranges from 1 to 5; 1 = Poor, . . . 5 = Excellent	2.91 (1.13)
Activities of daily living (ADLs)	No. of ADLs performed with difficulty including bathing, eating, dressing, walking across a room, and getting in or out of bed; ranges from 0 to 5	0.68 (1.30)
Instrumental ADLs (IADLs)	No. of IADLs performed with difficulty including using a telephone, taking medication, handling money, shopping, and preparing meals; ranges from 0 to 5	0.68 (1.36)
Lower body mobility	No. of difficulties in lifting, push-pull, staring, and walking blocks; ranges from 0 to 4	1.36 (1.44)
1998 Interview [¶]	0/1 indicator for being in the 1998 interview	21.03
2000 Interview [¶]	0/1 indicator for being in the 2000 interview	17.99
2002 Interview [¶]	0/1 indicator for being in the 2002 interview	14.04
2004 Interview [¶]	0/1 indicator for being in the 2004 interview	10.69
2006 Interview [¶]	0/1 indicator for being in the 2006 interview	7.66
2008 Interview [¶]	0/1 indicator for being in the 2008 interview	4.95
2010 Interview [¶]	0/1 indicator for being in the 2010 interview	2.07

Notes: Descriptive statistics are based on the total person-year observations (13,488) included in the analysis, except for the numbers of under-reported and over-reported physician visits (10,059 and 2,712 person-years, respectively); omitted categories are *self respondent; [†]unmarried; [‡]2nd, 3rd, and 4th quintiles combined; [§]Medicare coverage only; and [¶]1995.

invariant variables such as sex and race are also captured by the fixed effects). Furthermore, this model includes all person-years for any individual that has at least one change in one or more of the explanatory variables over the study period, which maximizes the amount of variation used to estimate the regression model. Consistent estimates of proxy status and group effects are obtained if unobservable confounders are time-invariant and there are no unobserved time-variant confounders. Our models adjusted for all the time-dependent variables described above. The models were weighted by sampling probability weights, and standard errors were clustered at the individual level to account for repeated individual observations over time. Alternative models like individual-random effects or generalized-estimating-equations are inconsistent (biased) with unobservable time-invariant and/or time-dependent confounders, but are more efficient (lower variance) than fixed effects if there are no unobservable confounders. Hausman tests indicated, however, that the coefficient estimates for model variables as a whole were significantly different between the random effect and fixed effect (detailed results available upon request), suggesting that the random-effect model was biased.

RESULTS

Table 2 reports the coefficients of the proxy-status measures from the linear probability regressions for discordant survey reporting of any hospitalization and any outpatient surgery compared to claims data. For each outcome, three regression models were estimated. The first regression (panel A) reports the coefficient of any relative serving as a proxy respondent versus self respondents. The second regression model (panel B) separates proxy respondents into spousal and nonspousal relative proxies (versus self respondents). The third regression model (panel C) separates the nonspousal proxies into three subcategories: daughters/daughters-in-law, sons/sons-in-law, and other relatives. Within panels B and C, differences in proxy-group coefficients were tested (Table 2). Detailed regression results for all model covariates are available online in Tables S2–S3.

The coefficients in Table 2 indicate how the average bias in the measurement of having any hospitalizations and any outpatient surgery use (or alternatively the bias in measuring these outcome rates) from surveys instead of claims data differs between the proxy groups and self respondents. Using any type of proxy (panel A) was associated with a lower probability of discordance by 5.8 percent points for any hospitalization and by 7.3 percent points for any

Table 2: Differences in Probability of Discordance in Survey Reports versus Claims between Proxy Groups and Self Respondents for Any Hospitalizations and Outpatient Surgery

<i>Proxy Status and Relationship</i>	<i>Any Hospitalization</i>	<i>Any Outpatient Surgery</i>
(A) Any proxy	−0.058*** (0.020)	−0.073*** (0.024)
(B) Spousal and nonspousal proxy groups		
Spousal	−0.031 (0.030)	−0.026 ^b (0.032)
Nonspousal	−0.069*** (0.022)	−0.092***, ^b (0.026)
(C) Detailed nonspousal proxy groups		
Spousal	−0.031 ^a (0.030)	−0.026 ^a (0.032)
Daughters/daughters-in-law	−0.086***, ^a (0.024)	−0.096***, ^a (0.031)
Sons/sons-in-law	−0.049 (0.037)	−0.096** (0.038)
Other relatives	−0.040 (0.040)	−0.077 (0.051)

Notes: The table reports regression coefficients and standard errors (in parentheses) from individual fixed-effect models for discordance of survey reports of any hospitalizations and outpatient surgery with claims data adjusting for all covariates shown in Table 1. Separate models are estimated for each outcome and proxy status/relationship specification (panels A, B, and C). The reference/omitted category in all models is self respondents.

Within each panel and outcome, ^a and ^b indicate coefficients are significantly different between spousal proxies and other proxy groups at $p < .1$ and $p < .05$, respectively.

** $p < .05$; *** $p < .01$.

outpatient surgery. These changes are meaningful, representing declines in reporting error close to one-fifth of the 36 percent rate of any hospitalization based on claims, and one-fourth of the 29 percent claims-based rate of any outpatient surgery.

Differentiating proxy respondents into spousal and nonspousal relatives (panel B) showed no significant differences between spousal proxies and self respondents. However, discordance was lower among nonspousal proxies by 6.9 percentage-points for any hospitalizations (one-fifth of the claims-based hospitalization rate) and 9.2 percentage-points for any outpatient surgery (one-third of the claims-based outpatient surgery rate) compared to self respondents. The coefficient for nonspousal proxy respondents was also significantly different from the spousal coefficient for outpatient surgery discordance ($p < .05$).

Among nonspousal proxy relatives (panel C), only daughters/daughters-in-law had significantly less discordance for any hospitalizations by 8.6 percentage points (one-fourth of the claims-based hospitalization rate) compared to self respondents, and their coefficient was marginally different from that of spousal proxy respondents ($p < .1$). For outpatient surgery, both daughters/daughters-in-law and sons/sons-in-law had significantly less discordance compared to self respondents by 9.6 percentage points (one-third of the

claims-based outpatient surgery rate); the coefficient for daughters/daughters-in law was also marginally different from spousal proxy respondents ($p < .1$).

Table 3 reports the proxy-status coefficients from the regressions for the number of under-reported physician visits among under-reporters compared to claims data and the number of over-reported visits among over-reporters under the same three panels reflecting the expansion of proxy definitions mentioned above (full regression results are available online in Tables S4 and S5). These coefficients indicate how the average bias in survey-based measures of the number of physician visits differs in either direction (under- and over-reports) between the proxy groups and self respondents. Also reported are results of testing differences in proxy-group coefficients within each panel. Using a proxy (panel A) was associated with reduced under-reporting compared to self respondents by about 3 visits or 17 percent relative to the average number of visits (17) based on claims. This effect, however, is driven by nonspousal proxies (panel B) who had 3.5 fewer under-reported visits on average compared to self respondents. In contrast, there was no significant difference in under-reported visits between spousal proxies and self respondents. The coefficients were significantly different between spousal and nonspousal proxies ($p < .05$).

Table 3: Average Differences between Proxy Groups and Self Respondents in Numbers of Under-and Over-Reported Physician Visits in Survey Reports versus Claims

<i>Proxy Status and Relationship</i>	<i>Under-Reported Visits</i>	<i>Over-Reported Visits</i>
(A) Any proxy	−2.698*** (0.658)	0.054 (3.186)
(B) Spousal and nonspousal proxy groups		
Spousal	−0.803 ^b (1.150)	14.271 (8.908)
NonSpousal	−3.448***, ^b (0.731)	−7.817 (7.768)
(C) Detailed nonspousal proxy groups		
Spousal	−0.831 ^{a,b} (1.154)	14.612 ^a (9.034)
Daughters/daughters-in-Law	−3.273***, ^a (0.908)	−5.397 ^a (4.892)
Sons/sons-in-Law	−4.771***, ^b (1.390)	−17.051 (18.394)
Other relatives	−2.618** (1.115)	−1.295 (5.718)

Notes: The table reports regression coefficients and standard errors (in parentheses) from individual fixed-effect models for number of under-reported visits in survey responses versus claims data among under-reporters and number of over-reported visits among over-reporters, adjusting for all covariates shown in Table 1. Separate models are estimated for each outcome and proxy status/relationship specification (panels A, B, and C). The reference/omitted category in all models is self respondents.

Within each panel and outcome, ^a and ^b indicate coefficients are significantly different between spousal proxies and other proxy groups at $p < .1$ and $p < .05$, respectively.

** $p < .05$; *** $p < .01$.

All three subgroups within nonspousal proxies had less under-reporting than self respondents (panel C), with the largest difference for sons/sons-in-law, who had 5 fewer under-reported visits on average (29 percent relative to the average number of visits in the claims). The spousal proxy coefficient was significantly different from sons/sons-in-law ($p < .05$) and marginally different from daughters/daughters-in law ($p < .1$).

Unlike for under-reported visits, there were no significant differences overall by proxy status and groups for over-reported visits. Spousal proxies had a large (albeit insignificant) positive coefficient while nonspousal proxies had negative (but insignificant) coefficients; the spousal proxy coefficient was marginally different from daughters/daughters-in law ($p < .1$). The insignificant coefficients and group differences are likely due to the small sample for over-reported visits (2,712 observations).

DISCUSSION

To our knowledge, this is the first study to directly examine differences based on proxy status and proxy reporters' relationships with their target persons in the concordance between survey reports and claims-based measures of health services use among older adults. Spousal proxies did not significantly differ from self respondents in their discordance from claims data in reporting any hospitalizations and any outpatient surgery and the number of physician visits. This finding supports their use as proxies in health surveys of older adults.

At the same time, however, we found overall that nonspousal familial proxies had less discordance with the claims data in reporting these outcomes compared to self respondents and spousal proxies, with daughters/daughters-in-law and sons/sons-in-law appearing to have the least discordance. The reduction in error is meaningful, ranging between one-fifth and one-third of the claims-based means of these health service use measures in our sample.

These findings have important implications for health services research in that they suggest that all categories of proxy-reports are at least as concordant as self reports on these three measures of health services use in the past 2 years in the AHEAD cohort. Therefore, proxy-reports of health services use should not be excluded from analyses. In addition, when proxies are used, surveys should collect information on the relationship between proxy reporters and their target persons, and make that information available to survey

users. Survey users should use this information to conduct sensitivity analyses to evaluate reporting bias across proxy-reporter categories, so that adjustments for such differences could be made where indicated.

Because discordance in reporting any hospitalizations can result from both over- or under-reporting relative to claims, and because the analyses for physician visits mainly indicated differences in under-reporting visits, we explored in additional models the differences in under-reporting and over-reporting separately relative to concordance. We found that the results for any discordance reported above are mainly driven by differences between proxy groups in under-reporting but not over-reporting (see Tables S6 and S7 online). Nonspousal proxies, particularly daughters/daughters-in-law and sons/sons-in-law, do not under-report these outcomes as much as self respondents. Similar to overall discordance, there was no significant difference between spousal proxies and self respondents on either under- or over-reporting of these outcomes.

We suspect that the lower levels of under-reporting among nonspousal proxy relatives, particularly daughters/daughters-in-law and sons/sons-in-law compared to spousal proxies and self respondents, may be due to their younger age and better cognitive status because most of the nonspousal proxy reporters come from a younger generation. However, we were unable to evaluate this hypothesis because age of nonspousal proxies was not measured. Future research should investigate the mechanisms for the reduced levels of under-reporting among nonspousal relatives.

As a sensitivity check, we estimated the model for discordance of any hospitalizations and any outpatient surgery using fixed-effect (conditional) logit models and found a similar pattern of results (Table S8 online). However, that model excludes individuals whose discordance outcome does not change over time, thus reducing the sample, and does not accommodate sampling probability weights. Therefore, we rely on and report only the main estimates from fixed-effect OLS. Similarly, we estimated a fixed-effect Poisson model (which has the same limitations as the fixed-effect logit model) for the numbers of over- and under-reported visits and found overall a similar pattern of results (Table S9 online). One noteworthy exception was that spousal proxies had significantly more over-reported visits than self respondents and nonspousal proxies. Another limitation of fixed-effect logit and Poisson models is that proxy-group effects cannot be derived on the original outcome scale (i.e., probability of discordance or counts of under- or over-reported visits) without assuming that individual fixed effects are null, making their results less meaningful and not fully comparable to OLS.

Understanding how these results generalize to survey reports of disease history is also of interest to health services researchers. Unlike the health service use questions which are measured at each interview for the past 2 years and can be mapped to claims over the same period, the survey asked at each interview whether the targeted person had ever been told by a doctor that she had certain health conditions. Therefore, mapping the survey and claims data requires a sufficient “look back” window in the Medicare claims which may extend beyond 1991, the first year of available data. Nonetheless, we explored how the concordance of disease history reports summed over 12 conditions (angina, arthritis, cancer, congestive heart failure, diabetes, glaucoma, heart attack, heart disease, hip fracture, hypertension, lung disease, and stroke) compared to claims data varied by proxy status and type (detailed results available upon request). We found no difference in overall concordant counts of diseases between self respondents and spousal and nonspousal proxies. These results suggest that use of a proxy is less of a concern when measuring disease history (especially for chronic diseases) than when measuring the use of health services.

This study had several strengths including the large sample, longitudinal data, detailed proxy respondent information, and inclusion of individual-level fixed effects to remove unobservable time-invariant confounders. It did, however, have two main limitations. First, only three measures of health services use were considered. Although the use of physicians and hospitals are the health services most frequently asked about in health surveys, and although outpatient surgery is relatively common among older adults, the AHEAD data did not allow us to compare other forms of health services use (e.g., emergency-department visits). Thus, the effects of proxy-reporting on other types of health services use remain unknown. Second, our estimates are prone to unobservable time-varying confounders, such as age-related changes in the physical and cognitive health of the target person which influence the need for and relationship of the target person to a proxy, and also correlate with reporting accuracy. While we adjusted for several time-dependent measures of physical health status and activity limitations, it was not possible to capture changes in cognitive health because the AHEAD does not collect comparable information on cognitive performance when proxy reporters are used. Accordingly, the observed differences among the proxies’ relationships to the target persons may not necessarily represent causal consequences and should be interpreted as associations.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Table S1. Descriptive Statistics of by Respondent Status.

Table S2. Coefficients of the Regression for Discordance between Survey Reports of Any Hospitalizations with Claims Data.

Table S3. Coefficients of the Regression for Discordance between Survey Reports of Any Outpatient Surgery with Claims Data.

Table S4. Coefficients of the Regression for Number of Under-Reported Visits Compared to Claims Data.

Table S5. Coefficients of the Regression for Number of Over-Reported Visits Compared to Claims Data.

Table S6. Differences in Probability of Under-Reporting in Survey Reports versus Claims between Proxy Groups and Self Respondents for Any Hospitalizations and Outpatient Surgery.

Table S7. Differences in Probability of Over-Reporting in Survey Reports versus Claims between Proxy Groups and Self Respondents for Any Hospitalizations and Outpatient Surgery.

Table S8. Odds Ratios of Proxy Status and Group Indicators Compared to Self Respondents from Fixed-Effect Logit Models for Probability of Discordance of Any Hospitalizations and Outpatient Surgery in Survey Reports versus Claims.

Table S9. Incidence-Rate Ratios of Proxy Status and Group Indicators Compared to Self Respondents from Fixed-Effect Poisson Models for Numbers of Under- and Over-Reported Physician Visits in Survey Reports versus Claims.