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Who Participates? Longitudinal Retention in the MIDUS National Study of Health and Well-Being

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Abstract

Objectives—This article uses data from MIDUS (Midlife in the United States), a national study of Americans (N = 7,108), to investigate factors that predict longitudinal retention. With its extensive age range (25–75 at Time 1) and long-term design (9- to 10-year survey interval), MIDUS is useful for investigating common sociodemographic and health predictors of continuing participation.

Method—The authors conducted logistic regression analyses of baseline sociodemographic and health variables predicting retention. Select interaction terms examined the interplay between targeted variables.

Results—Consistent with prior research, higher retention rates were found among Whites, females, and married individuals as well as those with better health and more education. Interaction analyses further clarified that (a) health status better predicted retention among older compared to younger respondents and among women compared to men, (b) marital status better predicted retention among Whites compared to non-Whites and among women compared to men, and (c) economic status better predicted retention among those with poorer functional health status.

Discussion—The authors' analyses clarify that longitudinal retention varied depending on respondents' sociodemographic characteristics and their health status. The unique contribution of this article is that factors predicting nonparticipation can be offset by, or compensated for, other factors.

Keywords

aging; longitudinal retention; demographics; health

Who is likely to participate in the second wave of a large, national health study? Despite variation in samples, research design, and mode of assessment, prior studies have shown evidence of differentiated probabilities of response (or nonresponse) due to selective sociodemographic and health characteristics (Fitzgerald, Gottschalk, & Moffitt, 1998; Kapteyn, Michaud, Smith, & van Soest, 2006; Lindenberger et al., 1999). We draw on this work to examine predictors of longitudinal retention in the second wave of the MIDUS (Midlife in the United States) national survey. We highlight longitudinal retention rather than attrition because studies focused on attrition and/or nonresponse tend to be concerned with bias and related methodological adjustments (e.g., sample weights based on various assumptions about nonresponders compared to responders). The emphasis on retention, in contrast, addresses characteristics of the Time-2 respondents on whom subsequent longitudinal findings will be

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generated. Such information underscores the importance of which sociodemographic and health characteristics predict who stays in a longitudinal study over time.

The literature on survey response has examined many common sociodemographic and health variables to explain participation, but the direction and significance of these influences have been inconsistent. For example, men are sometimes found to be less likely to respond to a survey than women (Kalton, Lepkowski, Montanari, & Maligalig, 1990), whereas in other studies gender plays no significant role (Adams et al., 1990). The literature is also ambiguous about the effect of marital status and race on survey response; not being married is sometimes associated with nonresponse, just as response rates among minorities are sometimes lower than among others. Both marital status and race have been linked to health, suggesting that marital status and race may be confounded with health in studies of survey participation. Whether any of these variables are key predictors is likely influenced by whether other important variables are controlled for.

In fact, Mihelic and Crimmins (1997) suggested that such inconsistent results may be due to the lack of multivariate analyses or the omission of important variables (see also Groves, Singer, & Corning, 2000). They propose greater emphasis on control variables, that is, examine the effects of single variables, net of the influence of other factors as the solution. Groves et al. (2000) suggested a further alternative, which is to look at the interplay among key predictor variables—that is, how they modulate the effects of each other. So doing calls for enriched conceptualization of survey participation via a priori formulation of reasons for how one predictor variable might mitigate, or exacerbate, the influence of another on participation. Thus, rather than focus on single predictors of survey response, net of other factors, we emphasize the need to assess participation as a product of multiple interacting influences. Guided by this formulation, we first examine sociodemographic and health characteristics (variable by variable) that likely predict retention, and we then examine select interactions between sociodemographic and health predictor variables to probe the conditional relationships between them.

Sociodemographic and Health Predictors of Longitudinal Retention

Among major demographic variables, studies of cross-sectional and longitudinal survey response often find higher response rates among women than among men (Tolonen et al., 2006; Watson & Wooden, 2006). Although sometimes attributed to the fact that women are more frequently at home (and thus easier to contact), some evidence suggests that even once contacted, men may be more likely to discontinue survey participation (Lepkowski & Couper, 2002). A further common finding reported in cross-sectional surveys is that response rates tend to be lowest for both the youngest and oldest members of the population. The evidence from longitudinal surveys confirms that survey response rates tend to be relatively low among young people but show a more mixed picture among the oldest individuals (Tolonen et al., 2006). Studies that measure racial and/or ethnic identity generally find that minorities tend to have lower response probabilities (Goudy, 1985; Zabel, 1998). However, this relationship is probably due to lower rates of contact rather than higher rates of refusals (Lepkowski & Couper, 2002). Marital status is another variable showing relatively consistent findings, namely, single people are more likely than married people to attrite (see Lillard & Panis, 1998; Tolonen et al., 2006). Finally, there is repeated evidence that location affects participation in both longitudinal and cross-sectional surveys. Numerous studies (Fitzgerald et al., 1998; Kalton et al., 1990; Zabel, 1998) report higher survey nonresponse rates among individuals living in urban locations. Social isolation theory suggests that residents of large urban areas may be less available or harder to reach, whereas cooperation rates might be superior in smaller rural communities (Groves & Couper, 1998).

Other variables predicting survey response are those indicating socioeconomic status. Education is usually positively associated with survey response. According to Groves and Couper (1998), this effect is mainly due to those with higher educational attainment being better able to appreciate the utility of research and information gathering activities. Evidence from longitudinal studies largely concurs with this view (Fitzgerald et al., 1998; Kapteyn et al., 2006; Lepkowski & Couper, 2002). Income shows little consensus in the published research on survey response, perhaps due to the relatively high item nonresponse that occurs for income measures. Kalton et al. (1990) found more nonresponse among those with lower family income. Watson (2003) found small, but statistically significant, differences between European countries in the tendency for greater longitudinal attrition at the top (Southern countries and Ireland) or the bottom (remaining countries) of the income distribution. Other studies (e.g., Lepkowski & Couper, 2002; Zabel, 1998) have found no evidence of significant relationships between income and retention.

A smaller number of studies have examined the effects of respondent physical health characteristics on nonresponse and attrition, partially because these measures are not uniformly included in large surveys. Rather, they appear in more topic-specific studies (e.g., public health, epidemiology, and aging). Nonetheless, consistent findings are evident—primarily that "dropouts" tend to have poorer physical health than do respondents (Norris, 1985; Siegler & Botwinick, 1979; Streib, 1966). Powell et al. (1990) showed that, regardless of reason for nonresponse, attriters showed evidence of impaired physical health. Two important health behaviors also show relationships with survey participation: alcohol use has been linked with longitudinal attrition (de Graaf, Bijl, Smit, Ravelli, & Vollebergh, 2000; Winefield, Winefield, & Tiggemann, 1990), and smoking history is also a consistent significant predictor of survey participation (Badawi, Eaton, Myllyluoma, Weimer, & Gallo, 1999; de Graaf et al., 2000; Farmer, Locke, Liu, & Moscicki, 1994; Goudy, 1985; Vink et al., 2004), although evidence suggests that it predicts different kinds of nonresponse (mortality, refusal, unable to contact, etc.) at different ages. The latter finding illustrates the need to consider how particular predictors of participation interact with others, a key objective of this inquiry.

Probing the Interplay Among Predictors of Retention: Where Are Interactions Plausible?

As illustrated above, most survey studies examine single-variable predictors of response (often controlling for others), with little attention given to how one predictor variable might modulate (exacerbate or ameliorate) the effects of another. For example, although better health status is a consistent predictor of retention, this effect is plausibly more strongly evident among older compared to younger respondents. Similarly, women tend to participate more than men, but this effect may vary depending on whether respondents are married or unmarried—for example, being married might increase participation among men. Men may also have participation rates comparable to women if they are in better health. The effects of socioeconomic status, indexed by education or income, on participation may vary depending on individuals' health status—that is, those with better health may be more likely to participate, even if they have lower educational or economic status (ameliorative effect). Alternatively, poor health status may exacerbate the likelihood of nonparticipation among those with lower socioeconomic standing. Similar effects might pertain to minority participation, in which health, marital, or economic status could enhance, or undermine, the likelihood of remaining in a longitudinal study. By investigating such interactions, we gain a more nuanced understanding of how the effects of one demographic or health variable might increase, or decrease, the extent to which another variable predicts retention.

In sum, the key aims of this investigation were to (a) examine longitudinal retention in MIDUS by comparing baseline measures of demographic and physical health variables between

participants and nonparticipants at the second wave of assessment (separately across the MIDUS random digit dialing [RDD], siblings, twin samples) and (b) investigate select interactions among demographic and health predictor variables as described above. Thus, a further question of interest is the consistency of predictors of longitudinal retention across distinct subsamples. The original MIDUS investigation included a national RDD probability sample as well as siblings of many of the respondents and a national twin sample. The inclusion of the sibling and twin subsamples introduces biological dependencies (Keppel, 1991; May, Masson, & Hunter, 1990) in the MIDUS data: those existing among main sample respondents and their siblings, or among twins.

Method

Sample

In 1995–1996, the MacArthur Midlife Research Network carried out a national survey of over 7,000 Americans aged 25 to 74. Referred to as MIDUS, the purpose of the study was to investigate the role of behavioral, psychological, and social factors in understanding age variation in physical and mental health. The survey was multimodal, employing an initial 30-min phone interview followed by a set (two) of self-administered questionnaires (SAQs), which were mailed to individuals after completing the phone interview.

Telephone numbers within the coterminous United States served as the sampling frame for the National RDD survey. In addition, oversampling was carried out in five cities (related to geographic-specific agendas), resulting in a baseline RDD sample of 4,244 individuals. The sibling sample was generated by randomly selecting 529 cases from the RDD sample who reported that they had one or more siblings. Using only siblings within a family that had the same biological mother and father, data were collected from a group of 950 siblings. For the twin sample, a two-part sampling design was employed. The first part involved screening a representative national sample of approximately 50,000 households for the presence of a twin (as part of ongoing national omnibus surveys). The second part involved contacting the twin households and attempting to recruit twins (also aged 25–74) to participate in the survey. Cooperating twins were asked to provide contact information for their co-twin. The twin sample ultimately consisted of 957 twin pairs (n = 1,914).

With support from the National Institute on Aging, a longitudinal follow-up of the original MIDUS began in 2004. The Time-2 data collection followed the original protocol. Advance letters with an accompanying brochure were sent to all Time-1 participants, reminding them of their past participation and informing them that an interviewer would be contacting them for the initial telephone survey in the next few weeks. Following successful completion of a 30-min phone interview, participants were mailed two SAQs. Monetary incentives were offered at both Time 1 and Time 2 to compensate for potential respondent burden in this multimode survey (US$20 for completion of MIDUS 1 surveys and up to US$60 for completion of MIDUS 2 surveys).

Of the original 7,108 participants completing the phone survey at MIDUS 1, 4,963 (70%) were successfully recontacted and completed the phone survey 9 to 10 years later at MIDUS 2.[1] This corresponds to an overall retention rate of 75% (adjusted for mortality). The retention rate for siblings (81%) and twins (81%) was somewhat higher than that observed for the RDD sample (69%). Of those who did not participate at MIDUS 2, 12% refused, 10% could not be contacted, and about 8% were too ill to be interviewed or deceased (as confirmed by the National Death Index).

[1]While the wave interval for MIDUS (Midlife in the United States) may be longer than other longitudinal studies, Matthews, Chatfield, and Brayne (2006) suggested that the factors influencing participation in short-term and long-term longitudinal studies are very similar.

Measures

Predictor variables were those prominent in published research on survey participation and retention, including 7 core demographic variables and 10 physical health variables from either the baseline telephone interview or the SAQ (see Table 1). The demographic variables represented baseline characteristics of age (continuous), gender (0 = *male*, 1 = *female*), marital status (0 = *not married*, 1 = *married*), race (0 = *minority*, 1 = *White*),[2] educational level (1 = *less than high school*, 2 = *high school graduate or equivalent*, 3 = *some college*, 4 = *college graduate or more*), personal income (continuous), and county size (1 = *21 largest MSAs* [metropolitan statistical areas], 2 = *MSA greater than 85,000 households*, 3 = *MSA greater than 20,000 households*, 4 = *remaining counties*). Among the health variables included were common measures such as subjective physical health rating (1 = *poor*, 2 = *fair*, 3 = *good*, 4 = *very good*, 5 = *excellent*), a count of the number of chronic conditions, a count of functional limitations (instrumental activities of daily living [IADL]), and body mass index (BMI; continuous). Two health behaviors, drinking (0 = *ever drink 3+ days/week*, 1 = *never drank 3 + days/week*) and smoking history (1 = *currently smoke*, 2 = *smoked in past*, 3 = *never smoked*), were also included as well as health insurance coverage (1 = *no coverage*, 2 = *government coverage*, 3 = *private coverage*), a count of the number of physician visits in the prior year, and a novel measure of alternative medicine/therapy use (respondents were asked to choose from among 13 listed medicines/therapies used in the prior year: 0 = *did not use any in prior year*, 1 = *used at least one in prior year*). The latter was viewed as a possible index of "topic interest" in matters related to a survey about health.

Most sociodemographic variables (except income) were obtained from the baseline phone interview, whereas most health questions (except subjective health, smoking, and drinking behaviors) were obtained from the SAQ. The latter was completed by 87% of the RDD respondents and 92% of the twin and sibling respondents. Thus, the present analysis is limited to those individuals with complete data across the predictors and who participated in both waves of the phone survey. Under these criteria, the sample sizes were as follows—RDD: n = 3,140; Twin: n = 1,520;[3] Sibling: n = 745.

Results

For each of the three samples, hierarchical logistic regression analyses were performed using retention status at Time 2 as the binary dependent variable (0 = *attrited*, 1 = *retained*). Seven demographic variables were entered in the first step, followed by a set of 10 physical health variables.

Single-Variable Predictors of Retention

Sociodemographic factors—Table 2 contains the results of the logistic regression models for each of the three subsamples. Significant odds ratios (ORs) are marked with superscript "a," and results are described for the full regression model. For the RDD sample, all demographic variables except income were significant predictors of retention. Race had the highest OR, indicating that those retained at Time 2 tended to be nonminorities. Longitudinal respondents were also much more likely to be married than not and were more likely to be female than male. Education had a significant effect on retention such that Time-2 respondents tended to be better educated than nonrespondents. County size was also significant such that individuals living in smaller size counties were more likely to participate at Time 2 than those

[2]Because of small cell counts, which would be particularly troublesome in interaction analysis, all 574 non-White minorities were combined into one category.

[3]Twins were included in the present analysis whether or not their pairings remained "intact" at Time 2; most pairings (85%) did remain intact.

from more urban areas. For the RDD sample, age was a significant predictor with an OR indicating that retention improved with an increase in age.

Findings for the twin sample revealed the same patterns for race, education, and marital status. That is, longitudinal twin participants tended to be nonminority, better educated, and married. Personal income was also a significant linear predictor, such that Time-2 twin participants had higher incomes than nonparticipants did. Similarly, for the sibling sample, race, gender, marital status, and education proved to be significant predictors of retention. That is, sibling respondents at Time 2 tended to be nonminority, female, married, and better educated, compared to nonrespondents.

Summary—All demographic variables showed effects on retention consistent with findings from prior research. Three such variables showed convergence across the three subsamples: Those more likely to participate at Time 1 were White, married, and had higher levels of education. Women were also more likely to participate, as shown in the RDD and sibling samples. The remaining demographic variables (age, income, county size) were less consistent across the samples. Age significantly predicted retention only in the RDD sample, indicating that retention increased with age. County size was also significant in the RDD sample, such that individuals living in rural areas had better retention rates than those living in urban areas. Finally, income was a significant predictor only in the twin sample.

Physical health predictors—Five health variables were significant predictors of retention in the RDD sample. Time-2 respondents tended to have better subjective physical health, fewer functional limitations, and, contrary to prediction, slightly higher BMI. Time-2 respondents were also more likely than nonrespondents to have private health insurance and have used alternative therapies in the past year. Similarly, the twin sample showed greater longitudinal retention among those with better subjective health, higher BMI, and having used alternative therapies in the past year. In addition, smoking status was a significant predictor of retention in the twin sample, with nonsmokers and past smokers having higher retention rates than current smokers. For the sibling sample, two of the above health variables were significant predictors of participation: having fewer functional limitations and using alternative therapies during the past year. In addition, drinking status was also significant, with Time-2 siblings more likely to report having had three or more drinks in a week at some point during their life compared to nonparticipating siblings.

Summary—Subjective health, functional health (IADL), and BMI were significant predictors of longitudinal participation in the above samples. Among the RDD and twin samples, those with better subjective health and higher body mass indices were more likely to participate at Time 2. Among the RDD and sibling samples, those with fewer functional health limitations were more likely to participate at Time 2. Health insurance coverage, smoking history, and drinking history were varied in their effects across the samples. In the RDD sample, those with private health insurance were more likely to participate than those with government-sponsored insurance, or no coverage at all. Among twins, nonsmokers were more likely to participate than past or current smokers were. Finally, among siblings, drinking status was significant, indicating that those who reported having had three or more drinks per week at some point in their lives were also more likely to be retained at Time 2.

Interaction Effects Among Predictor Variables

Further analyses were guided by a priori formulations of likely two-way interactions. We also created interaction terms between demographic variables and health variables that demonstrated a statistically significant relationship to retention. Each interaction term was entered on the third step in separate logistic regression runs. Significant interactions were

graphed by generating predicted retention probabilities from the logistic regression model and then plotting predicted probabilities for each data point. Interaction patterns were investigated only for the RDD and twin samples, as the sibling sample was of insufficient size to produce stable findings. Table 3 summarizes the significant interaction results for each sample. As described below, four categories of significant interactions were obtained.

Age with health—Age interacted with subjective health and functional health (IADL) in predicting longitudinal participation among RDD respondents. As shown in Figure 1, retention rates rose sharply for all age groups as subjective health ratings increased from "poor" to "excellent." However, the oldest respondents had a significantly steeper slope than the young or middle groups. While old individuals in poor health had the lowest retention probability of any group (44%), old individuals with excellent physical health had the highest retention probabilities (83%). Age interacted with IADL in a similar manner (not shown). Although fewer functional limitations predicted higher probabilities of retention, this effect was most strongly evident among older respondents (77%) compared to similar-aged respondents with greater functional limitations (55%). That is, as functional limitations increased, old individuals experienced a steeper decline in retention.

Age also interacted with race and alternative therapies (not shown). For Whites, all age groups had similar retention probabilities (around 72%), whereas among non-Whites, there was a marked difference depending on age: The youngest adults had the lowest retention probability (52%), whereas oldest had the highest retention (65%). Put another way, minority respondents had lower retention rates than Whites, but this effect was less prominent among older respondents. Among twins, age interacted with use of alternative therapies. That is, retention probabilities did not differ by use of alternative therapies among young twins, but for both middle- and old-age twins, those showing higher retention probabilities were more likely to be users of alternative therapies.

Gender with marital status and health—Overall, women had higher retention rates than men in each sample, but this effect was moderated by marital status, physical health, and BMI. Women had higher participation rates than married men, whereas among unmarried individuals, men and women had the same retention probability (65%). Figure 2 shows that men and women who reported "excellent" physical health had the same retention rate (around 80%), but men with poor physical health had a retention rate notably lower (near 40%) compared to women with poor health status (58%). Gender also interacted significantly with BMI, which clarified the previous finding that higher BMI (typically a health-risk factor) predicted higher retention. Using categories based on World Health Organization definitions, minimal gender differences in response rates were found among those who are classified as overweight or obese. However, among individuals classified as "underweight," men had notably lower retention rates (50%) than women (73%). Indeed, the female BMI rate varied little with retention rate, whereas for men, it accounted for notably lower retention but only among those classified as underweight.

Income with health—While nonsmokers had better retention probabilities than either current or past smokers, significant interactions existed between income and smoking status (not shown). As quartiles of income decline, smoking status has an ever-greater influence on retention. That is, in the highest quartile of income, retention rates differ little between nonsmokers, past smokers, and current smokers. However, in the lowest quartile of income, smoking is associated with steep drops in retention (57%), compared to past smokers (65%), especially nonsmokers (69%).

The twin sample showed a significant interaction of income and functional limitations (IADL). As illustrated in Figure 3, greater functional limitations (high IADL scores) dramatically

reduced the retention rates among those in the bottom quartiles of income compared to other groups. That is, twins in the lowest income quartile with the poorest functioning had retention probabilities of 55%, compared to 75% to 87% for the three upper income quartiles.

The twin sample also showed a significant income interaction with marital status (not shown). Among married twins, there was little variation in retention probabilities with regard to income quartiles, which ranged from 80% for the lowest quartile to 88% for the highest quartile. Being unmarried had a differential effect on retention, depending on income quartiles. Unmarried individuals in the highest income quartile actually had a higher retention rate than married individuals, whereas the retention rate dropped sharply among those in the lowest quartile, from 80% for married individuals to 55% for unmarried individuals.

Race with marital status and health—Overall, Whites had higher retention rates than non-Whites, but this effect was moderated by several other variables. For instance, race interacted with marital status, such that the difference in retention rates between Whites and non-Whites was greater among respondents who were married compared to those who were not. In addition, race interacted with functional limitations (IADL) and health insurance coverage. Figure 4 shows that for Whites, functional health has a strong influence on longitudinal participation, such that those with fewer limitations had retention rates of about 78% compared to those with more limitations (59%), whereas for non-Whites, functional health status had limited bearing on retention rates (note that, on average, non-Whites had significantly more functional limitations than Whites). Similar effects occurred between race and health insurance coverage (not shown), where the difference between no coverage and private coverage had notable effects on rates of retention of Whites, whereas for non-Whites, insurance coverage did not strongly differentiate between those who participated and those who did not.

Supplemental Analyses

Including health assessments to predict longitudinal retention necessitated use of materials in the SAQ of the MIDUS 2 data. This, in turn, resulted in a loss of sample size; that is, only cases with complete data for the phone and SAQ surveys were included. It also meant that nonrespondents to the Time-1 SAQ were removed from regression analysis. To investigate whether respondents who completed both phone and SAQ assessments were different from those who dropped out, or completed only the phone interviews, separate logistic regression analyses were conducted on each sample using only phone variables. Comparison of the phone-only results with the phone/SAQ results showed that there were no differences between the two sets of analyses in all cases but one.

Discussion

Data from MIDUS are publicly available (see http://www.icpsr.umich.edu/NACDA/) and have been extensively used by scientists from diverse scientific fields, with close to 300 publications generated to date from the baseline study. The new longitudinal data are likely to be widely used—MIDUS is the most frequently downloaded study at the National Archive for Computerized Data on Aging (NACDA) Web site. Such extensive utilization makes it important to document the nature of the samples on which new findings will be generated. Some investigators will choose to use weighted samples in carrying out their analyses, but others will not, given disciplinary differences in such practices. Our objective therefore was to clarify the sociodemographic and health characteristics of those sample members who remained in the study at the second wave. The findings show that longitudinal retention did vary depending on respondents' sociodemographic characteristics and health status. First, we

summarize the results with a focus on convergence with the prior literature and then move on to the novel features of our investigation—namely, the interplay among predictor variables.

Many findings converge with what has been observed in other studies, but other results draw attention to largely neglected questions of the interplay among variables in accounting for who stays with a major longitudinal investigation involving a long-term (9–10 years) follow-up.

Three demographic variables were, as predicted, significant positive predictors of retention across all three samples (RDD, twins, and siblings). Those who were White, married, and have higher levels of education were more likely to participate at Time 2 compared to non-Whites, the unmarried, and those with less education. Consistent with prior research (Fitzgerald et al., 1998; Lepkowski & Couper, 2002; Lillard & Panis, 1998; Zabel, 1998), gender was also important in predicting retention: women from all but the twin sample were more likely than men to participate at Time 2.

Other demographic variables showed sample-specific findings. Age showed significant effects in the RDD sample, such that older individuals had higher retention rates than younger individuals. Yet among siblings, the reverse relationship (though nonsignificant) held such that younger individuals had higher retention than older individuals did. Such ambiguous results find support in Watson and Wooden (2006), who show (in cross-sectional surveys) that response rates tended to be lowest for the youngest and oldest members of a population. County size was also a significant predictor in the RDD sample, with those from smaller size counties being more likely to participate than those living in larger urban counties—a finding consistent with the published literature (Groves & Couper, 1998). Finally, personal income showed a significant positive effect on retention, but only among members of the twin sample, underscoring the inconsistency of income as a predictor of participation or retention (Lepkowski & Couper, 2002; Zabel, 1998).

Physical health variables were less strong predictors of retention and explained less variance overall than the sociodemographic variables. Among the RDD sample, two health variables predicted retention in the manner described by the literature (Norris, 1985; Powell et al., 1990): those with better subjective health ratings and lower functional limitations were more likely to participate at Time 2. These effects were replicated in other samples as well—better subjective health predicted retention among twins, whereas fewer functional limitations predicted retention among siblings. Another health variable, BMI, showed an interesting pattern, namely, those with higher BMI (i.e., those likely to be overweight or obese) were more likely to participate at follow-up, both among RDD and twin respondents (an unexpected effect subsequently clarified by interaction analyses).

The use of alternative therapies emerged as a novel predictor of retention and was the only significant health variable present across all three samples. One possible interpretation is that use of alternative therapies serves as a general indicator of personal interest in health issues or lifestyle choices. There is some evidence that heightened involvement in an issue can increase survey-response probabilities (Groves, Presser, & Dipko, 2004). Another possible explanation of this variable's influence could be a strong spiritual or religious characteristic; among the 15 specific therapies listed, "prayer or other spiritual practices" was the most popular by far (30% of eligible respondents chose it). Although neglected in research on retention, this variable warrants further exploration in predicting participation in future longitudinal studies.

The key objective of the present investigation was to examine targeted interactions among predictor variables to clarify if sociodemographic factors that undermine retention (e.g., being male or having lower socioeconomic standing) might be offset by other variables (e.g., being married, having better health status), thereby illustrating possible ameliorative effects. Alternatively, sociodemographic and health variables can combine such that the joint effect of

both decreases the likelihood of participation than either alone, thus illustrating exacerbation or compounding effects. The obtained interactions, which were examined only in the RDD and twin samples, illustrated both types of influence.

For example, with regard to interactions of age with health status, we found that the longitudinal retention of older respondents (RDD sample) was strongly linked to subjective health ratings and functional limitations. Those in poor health had, in fact, the lowest response rates across all age groups, thereby demonstrating the compounding effects of being old and ill. Nonetheless, the highest retention rates by age occurred among older persons in good health, thereby showing that the age-related risk of attrition can be offset by having high subjective health and few functional limitations. Similarly, we also found that being older ameliorated the risk of nonparticipation among minority respondents (RDD sample). That is, older non-Whites had retention rates comparable to older Whites. Alternatively, being young clearly compounded the likelihood of nonresponse observed among minority respondents. Finally, among the twin sample, age interacted with use of alternative therapies to show that among both middle- and older aged twins, likelihood of participating at Time 2 was enhanced in those who use such therapies.

Although gender is a strong individual predictor of who participates longitudinally, our findings underscored that this interacts with both marital status and health. The obtained interaction between gender and marital status (RDD sample) showed that marital status affected the participation rates of women more than those of men. That is, being married enhanced the retention rates among women compared to men, whereas among unmarried respondents, there was no gender difference in longitudinal participation. Gender also interacted with health status (RDD sample), showing that among those reporting poor subjective health, men had notably lower retention rates than women. Alternatively, among those in “excellent” physical health, male and female response probabilities were the same (79%–80%). Good health, it seems, offsets the negative effect of being male on retention rates. Men also showed differential retention rates compared to women, depending on BMI. Here the findings showed the compounding of nonresponse among men who are also underweight. Interestingly, the greater health risks associated with being overweight or obese did not translate to lower response rates for men or women. It is difficult to know what accounts for the latter findings, but one possibility is that those who are overweight or obese may have some awareness of their greater health risks, which translates to greater interest in surveys about health.

Based on the results of prior literature, we had anticipated that good health status might offset the negative effect that low socioeconomic status has on longitudinal retention. Several interactions of income with health status were obtained, but all illustrated the compounding of negative effects of low income and poor health on participation rates. In the RDD sample, income interacted with smoking status to show that among nonsmokers or past smokers, retention rates varied little depending on income. However, among current smokers, there was a clear economic gradient in participation, with the lowest rates occurring for those who were both poor and who smoked. Among members of the twin sample, income also interacted with functional limitations. Although those in the top quartile of income had higher retention rates than all other income groups, the differential effect of income on retention became far more dramatic among those with high levels of functional limitations. Finally, income interacted with marital status in the twin sample and showed that retention probabilities varied little by income among those who were married. Among the unmarried, however, there was a strong income gradient to participation, with the lowest rates occurring for those who were poor and not married.

Other obtained interactions pertained to factors that modulate the effects of racial status on retention (RDD sample). Limitations in physical function tended to affect Whites more than

minorities. That is, rates of retention went steadily down among Whites with ever-greater functional limitations, whereas among minorities retention rates were consistently low regardless of levels of functional limitation. Being a minority also reversed the positive effect that being married typically has on retention rates; although being unmarried lowered retention rates among Whites, it increases rates of participation among non-Whites. Stated otherwise, the lowest retention was observed among non-Whites who were married. It is worth noting that at baseline and at longitudinal follow-up, Whites and minorities had different marriage rates (i.e., about 75% of Whites were married, whereas slightly more than half of minorities (56%) were). These differences correspond to data from the 1995 and 2005 Current Population Survey—that is, it is more common for minorities than Whites to be unmarried. Race also interacted with having health insurance and showed a beneficial effect only for Whites. Among minority respondents, retention rates were consistently low regardless of insurance coverage. These overall patterns strongly suggest that minority status often overrides other sociodemographic and health factors in accounting for low response rates.

Taken as a whole, the obtained interactions underscore that the interplay of key variables in predicting longitudinal retention is crucial to accurately understand retention and survey response. Such findings have scientific as well as practical relevance. On the scientific side, considerable research (cited herein) has focused on “risk factors” that contribute to nonresponse in cross-sectional studies or attrition in longitudinal studies. Limited attention has been given to how certain factors can offset, or compound, the effects of other factors on risk of nonparticipation. Indeed, few of the studies cited herein examined interactions among key predictors. Examining survey participation using single predictors obscures how these predictors are related to retention. Perhaps one reason for the conflicting or inconsistent results in attrition studies (see Mihelic & Crimmins, 1997) is failure to take into account moderating variables. That is, the effects of individual demographic characteristics cannot be clearly understood without knowing how they interact among themselves as well as with important variables like health and well-being.

These matters also bear on other substantive scientific agendas. For example, numerous investigations address social inequalities in health using the baseline MIDUS data (Almeida, Neupert, Banks, & Serido, 2005; Grzywacz, Almeida, Neupert, & Ettner, 2004; Hu, Adler, Goldman, Weinstein, & Seeman, 2005; Neupert, Miller, & Lachman, 2006; Ryff & Singer, 2005, etc.). These will now likely to be continued with the longitudinal data. In carrying out such queries, it is important to remember that some subgroups of respondents (e.g., young racial minorities, men in poor health, low income respondents in poor health) are disproportionately missing due to the compounded effects of select sociodemographic and health factors on retention. As is the case in many longitudinal studies, the extent to which selective retention/attrition significantly biases research will largely depend on the specific research questions being posed. Nonetheless, interaction analyses such as those adopted here to examine longitudinal participation are consistent with the larger objective of MIDUS as a whole, which is to probe the interplay of factors contributing to diverse health outcomes.

The practical implications of the results pertain to the task of continuing longitudinal studies. After the first wave of a longitudinal study such as MIDUS, survey researchers, and interviewers have a wealth of information about participants that can be used to target recruitment. Sociodemographic information can be preloaded onto a computer-assisted personal interviewer’s screen, allowing “tailoring” of recruitment scripts to maximally appeal to specific cases (Groves et al., 2000). For example, given what is known about the effect of education level on participation (i.e., that cases with lower levels of education are harder to retain), an interviewer can emphasize extrinsic benefits such as monetary incentives, which may be more persuasive in gaining cooperation than appealing to more intrinsic motivations (such as making a contribution to research and science). Furthermore, by proactively

identifying which cases are likely to be difficult to recruit versus those that are easy to recruit, field staff can be assigned accordingly; more experienced interviewers can be assigned to the "hard" cases, thereby achieving efficiencies in time and cost.

Limitations and Future Directions

Given the above observations, we note that both Time-1 and Time-2 MIDUS data sets contain poststratification weights based on the Current Population Survey, to improve the extent to which the sample is nationally representative (i.e., its external validity). These weights do not explicitly address bias in longitudinal retention. Researchers interested in change in health and well-being across the 9- to 10-year interval thus need to know whether findings represent actual gains or losses, or constitute artifacts of selective longitudinal participation, which could adversely affect internal validity. By examining retention (as opposed to attrition), the current study provides a beginning understanding of what sociodemographic and health groups remain part of the inquiry. Clearly, attrition has been selective and indeed has been disproportionately so among those defined by the interplay of select predictor variables. These constitute caveats in longitudinal findings that need to be kept in mind among users of the data, in addition to possible weighting or other methodological adjustments.

Much work remains in the development of a general theory of survey participation. One promising approach to such development can be found in a recent experiment conducted by Tourangeau and Ye (2009), which adopted Kahneman and Tverky's "prospect theory." Noted for their research on heuristics and human decision making, Kahneman and Tversky (1979) proposed two tenets of prospect theory that are potentially relevant to the study of survey participation. First, humans tend to frame alternative courses of action in terms of gains or losses from current positions rather than from final positions. Second, people tend to be more sensitive to losses than to gains of the same magnitude. By framing a follow-up survey request in terms of potential gains or losses, Tourangeau and Ye found that 88% of those who received the "loss" framing completed the second interview compared to 78% of those who received the "gain" framing. While the framing effect operated robustly across different sociodemographic subgroups, it may be fruitful to examine whether the framing effect varies across demographic, health, and psychosocial variables, such as those examined in this investigation.

Nonetheless, framing likely accounts for only a portion of the variance in survey response. Also important are the role survey design or field characteristics (e.g., monetary incentives, survey mode, use of prenotification letters, etc.) play in predicting participation. Both of these influences (framing and field characteristics) may also interact with respondent characteristics, such as those examined in this investigation. Groves et al. (2000), for example, found that the lack of a monetary incentive adversely affects participation but only among those with low community involvement. A comprehensive theory of survey participation demands the exploration of such combinations of individual characteristics in concert with the aspects of survey design and administration. The findings from this study reach toward this goal.

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References

Adams MME, Scherr PA, Branch LG, Herbert LE, Cook NR, Lane AM, et al. A comparison of elderly participants in a community survey with nonparticipants. Public Health Reports 1990;105:617–622. [PubMed: 2124361]

Almeida DM, Neupert SD, Banks SR, Serido J. Do daily stress processes account for socioeconomic health disparities. Journal of Gerontology: Social Sciences 2005;60B(Special Issue II):34–39.

Badawi MA, Eaton WW, Myllyluoma J, Weimer LG, Gallo J. Psychopathology and attrition in the Baltimore ECA 15-year follow-up 1981–1996. Social Psychiatry and Psychiatric Epidemiology 1999;34:91–98. [PubMed: 10189815]

de Graaf R, Bijl VR, Smit F, Ravelli A, Vollebergh AM. Psychiatric and sociodemographic predictors of attrition in a longitudinal study. American Journal of Epidemiology 2000;152:1039–1047. [PubMed: 11117613]

Farmer ME, Locke BZ, Liu IY, Moscicki EK. Depressive symptoms and attrition: The NHANES I epidemiologic follow-up study. International Journal of Methods in Psychiatric Research 1994;4:19–27.

Fitzgerald J, Gottschalk P, Moffitt R. An analysis of sample attrition in panel data: The Michigan Panel Study of Income Dynamics. Journal of Human Resources 1998;33:251–299.

Goudy WJ. Effects of sample attrition and data analysis in the Retirement History Study. Experimental Aging Research 1985;11:161–167. [PubMed: 3908120]

Groves, RM.; Couper, MP. Nonresponse in household interview surveys. New York: John Wiley; 1998.

Groves RM, Presser S, Dipko S. The role of topic interest in survey participation decisions. Public Opinion Quarterly 2004;68:2–31.

Groves RM, Singer E, Corning A. Leverage-saliency theory of survey participation. Public Opinion Quarterly 2000;64:299–308. [PubMed: 11114270]

Grzywacz JG, Almeida DM, Neupert SD, Ettner SL. Socioeconomic status and health: A micro-level analysis of exposure and vulnerability to daily stressors. Journal of Health & Social Behavior 2004;45:1–16. [PubMed: 15179904]

Hu P, Adler NE, Goldman N, Weinstein M, Seeman T. Relationship of subjective assessment of socioeconomic status with measures of health in older Taiwanese persons. Journal of the American Geriatrics Society 2005;53:483–488. [PubMed: 15743294]

Kahneman D, Tversky A. Prospect theory: An analysis of decisions under risk. Econometrica 1979;47:263–291.

Kalton, G.; Lepkowski, J.; Montanari, GE.; Maligalig, D. Proceedings of the American Statistical Association. Survey Research Methods Section; 1990. Characteristics of second wave nonrespondents in a panel survey; p. 462-467.

Kapteyn, A.; Michaud, P.; Smith, J.; van Soest, A. Effects of attrition and non-response in the Health and Retirement Study. Discussion paper from the Institute for the Study of Labor (IZA); Bonn, Germany. 2006 Aug.

Keppel, G. Design and analysis: A researcher's handbook. 3. Englewood Cliffs, NJ: Prentice-Hall; 1991.

Lepkowski, JM.; Couper, MP. Nonresponse in the second wave of longitudinal household surveys. In: Grove, RM.; Dillman, DA.; Eltinge, JL.; Little, RJ., editors. Survey nonresponse. New York: John Wiley; 2002. p. 259-272.

Lillard LA, Panis CWA. Panel attrition from the Panel Study of Income Dynamics: Household income, marital status, and mortality. Journal of Human Resources 1998;33:437–457.

Lindenberger, U.; Gilberg, R.; Little, TD.; Nuthmann, R.; Potter, U.; Baltes, PB. Sample selectivity and generalizability of the results of the Berlin Aging Study. In: Baltes, PB.; Mater, KU., editors. The Berlin Aging Study. Cambridge, UK: Cambridge University Press; 1999. p. 56-82.

Matthews FE, Chatfield M, Brayne C. An investigation of whether factors associated with short-term attrition change or persist over ten years: Data from the Medical Research Council Cognitive Function and Aging Study. BMC Public Health 2006;6:185. [PubMed: 16848886]

May, RB.; Masson, MEJ.; Hunter, MA. Application of statistics in behavioral research. New York: Harper & Row; 1990.

Mihelic AH, Crimmins EM. Loss to follow-up in a sample of Americans 70 years of age and older: The LSOA 1984–1990. Journal of Gerontology 1997;52B:S37–S48.

Neupert SD, Miller LS, Lachman ME. Physiological reactivity to cognitive stressors: Variations by age and socioeconomic status. International Journal of Aging & Human Development 2006;62:221–235. [PubMed: 16625938]

Norris FH. Characteristics of older nonrespondents over five waves of a panel study. Journal of Gerontology 1985;40:627–636. [PubMed: 3161935]

Powell DA, Furchtgott E, Henderson M, Prescott L, Mitchell A, Hartis P, et al. Some determinants of attrition in prospective studies on aging. Experimental Aging Research 1990;16:17–24. [PubMed: 2265661]

Ryff CD, Singer B. Social environments and the genetics of aging: Advancing knowledge of protective health mechanisms. Journal of Gerontology 2005;60B(Special Issue 1):12–23.

Siegler IC, Botwinick J. A long-term longitudinal study of intellectual ability of older adults: The matter of selective subject attrition. Journal of Gerontology 1979;34:242–245. [PubMed: 438478]

Streib G. Participants and dropouts in a longitudinal study. Journal of Gerontology 1966;21:200–209. [PubMed: 5930514]

Tolonen H, Helakorpi S, Talala K, Helasoja V, Martelin T, Prattala R. 25-year trends and sociodemographic differences in response rates: Finnish adult health behaviour survey. European Journal of Epidemiology 2006;21:409–415. [PubMed: 16804763]

Tourangeau R, Ye C. The framing of the survey request and panel attrition. Public Opinion Quarterly 2009;73:338–348.

Vink JM, Willemsen G, Stubbe JH, Middeldorp CM, Ligthart RSL, Baas KD, et al. Estimating nonresponse bias in family studies: Application to mental health and lifestyle. European Journal of Epidemiology 2004;19:623–630. [PubMed: 15461193]

Watson D. Sample attrition between Waves 1 and 5 in the European Community Household Panel. European Sociological Review 2003;19:361–378.

Watson, N.; Wooden, M. Identifying factors affecting longitudinal survey response. Paper presented at the Methodology of Longitudinal Surveys Conference; Colchester: University of Essex; 2006 Jul 12–14.

Winefield AH, Winefield HR, Tiggemann M. Sample attrition bias in a longitudinal study of young people. Australian Journal of Psychology 1990;42:75–85.

Zabel JE. An analysis of attrition in the PSID and the SIPP with an application to a model of labor market behavior. Journal of Human Resources 1998;33:479–506.

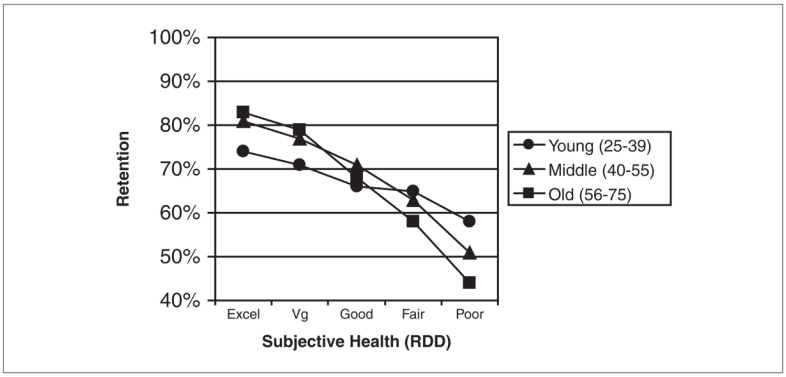

Figure 1. Interaction of age with health
Note: RDD = random digit dialing.

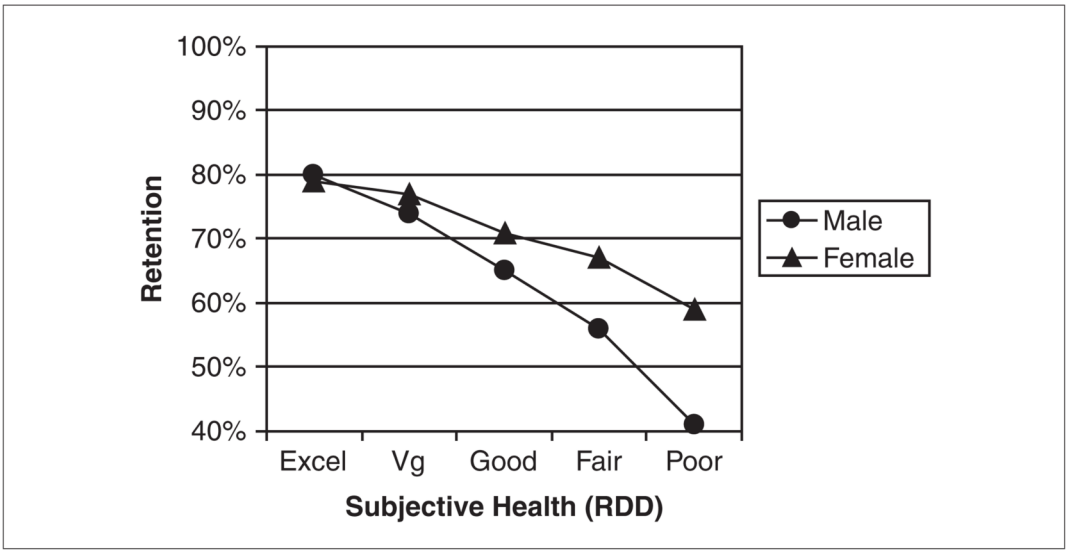

Figure 2. Interaction of gender with health
Note: RDD = random digit dialing.

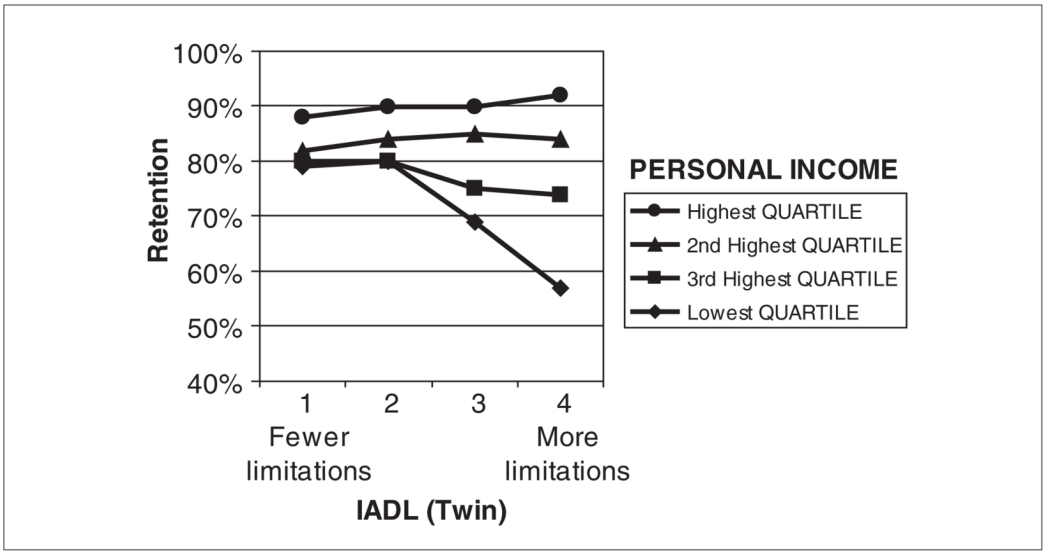

Figure 3. Interaction of income with health
Note: IADL = instrumental activities of daily living.

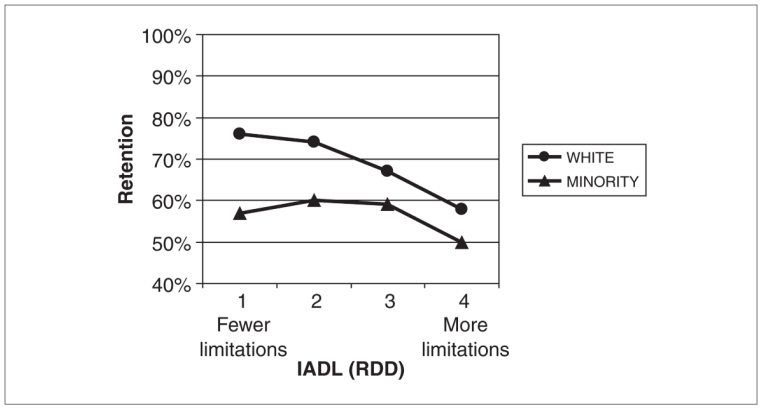

Figure 4. Interaction of race with health

Note: IADL = instrumental activities of daily living; RDD = random digit dialing.

Table 1

Time-1 (Baseline) Characteristics by Sample

	RDD (*n* = 4,244)	Twin (*n* = 1,914)	Sibling (*n* = 950)
Demographics			
Age—*M* (*SD*)	46.4 (13.3)	44.9 (12.0)	49.4 (12.6)
Female	49.2%	55.4%	52.8%
Education (college graduate or more)	31.4%	27.0%	34.8%
Race/ethnicity (White)	74.3%	84.8%	86.9%
Married	66.6%	77.0%	76.5%
County size (live in 21 largest MSAs)	45.1%	28.6%	28.7%
Personal income (*M*)[a]	US$27,100	US$25,800	US$27,200
Health			
Subjective physical health (range: 1–5)	3.5 (1.0)	3.6 (0.9)	3.6 (0.9)
Body mass index (range: 9.4–64.0)[a]	26.7 (5.3)	26.5 (5.1)	26.9 (5.1)
Instrumental activities of daily living (range: 1.0–4.0)[a]	1.6 (0.8)	1.5 (0.7)	1.6 (0.8)
Alternative therapy use (at least one)[a]	45.3%	46.2%	49.5%
Health insurance coverage (private)[a]	59.9%	67.5%	62.8%
Currently smoking cigarettes	23.7%	23.2%	18.8%
Ever drank 3+ days/week	44.0%	39.0%	41.8%
No. of physician visits—12 months[a]	3.2 (5.7)	2.7 (3.8)	3.1 (5.3)
No. of chronic conditions[a]	2.5 (2.6)	2.2 (2.3)	2.4 (2.3)
No. of times exercise vigorously/month[a]	5.9 (5.2)	6.2 (5.1)	6.1 (5.2)

Note: RDD = random digit dialing; MSA = metropolitan statistical area.

[a]Items from self-administered questionnaire, all other variables from phone survey.

Table 2

Full Logistic Regression Model Predicting Retention at Time 2

	Odds ratio (95% CI)		
	RDD (*n* = 3,140)	**Twin (*n* = 1,520)**	**Sibling (*n* = 745)**
Demographics			
Age	1.16**,a (1.04–1.29)	1.18 (0.98–1.43)	0.89 (0.66–1.19)
Education	1.29***,a (1.18–1.42)	1.21*,a (1.03–1.42)	1.27*,a (1.00–1.59)
Gender	1.47***,a (1.21–1.77)	1.35 (0.98–1.86)	1.68*,a (1.05–2.70)
Race	1.72***,a (1.34–2.20)	3.64***,a (2.25–5.88)	2.55*,a (1.10–5.89)
Income	1.00 (0.92–1.10)	1.31***,a (1.12–1.55)	.812 (0.65–1.25)
Marital status	1.53***,a (1.28–1.83)	1.56**,a (1.13–2.15)	2.22***,a (1.41–3.51)
County size	1.10*,a (1.02–1.19)	0.93 (0.82–1.06)	1.03 (0.85–1.25)
Health			
Physical health	1.23***,a (1.11–1.36)	1.20*,a (1.00–1.43)	0.96 (0.74–1.24)
No. of chronic conditions	1.03 (0.98–1.06)	1.04 (0.97–1.11)	0.98 (0.89–1.09)
Body mass index	1.02*,a (1.00–1.03)	1.03*,a (1.00–1.06)	1.04 (0.99–1.09)
IADL	0.80**,a (0.70–0.91)	0.80 (0.63–1.02)	0.55***,a (0.40–0.76)
Smoking history	1.06 (0.95–1.18)	1.26*,a (1.06–1.50)	1.26 (0.97–1.65)
Drinking history	0.89 (0.74–1.06)	1.11 (0.82–1.48)	0.61*,a (0.38–0.95)
Vigorous exercise	1.00 (0.98–1.01)	0.99 (0.96–1.02)	1.00 (0.96–1.05)
No. of physician visits	1.01 (0.99–1.02)	0.98 (0.95–1.02)	0.98 (0.94–1.01)
Health insurance	1.17*,a (1.03–1.33)	1.00 (0.81–1.25)	1.33 (0.95–1.86)
Alternative therapy use	1.49***,a (1.26–1.77)	1.33*,a (1.00–1.76)	1.77**,a (1.61–2.71)
R^2	.10	.12	.18

Note: RDD = random digit dialing; IADL = instrumental activities of daily living; CI = confidence interval.

[a]Significant odds ratios.

*$p < .05$.

** $p < .01$.

*** $p < .001$.

Table 3

Significant Retention Interactions Among Demographic and Health Variables—OR

	RDD	Twin
Interactions	**OR (95% CI)**	**OR (95% CI)**
Age × Race	0.72* (0.52–0.98)	
Age × Physical health	1.15** (1.04–1.29)	
Age × IADL	0.88* (0.77–0.99)	
Age × Alternative therapies		1.50* (1.04–2.16)
Gender × Marital status	1.52* (1.07–2.17)	
Gender × Physical health	0.82* (0.69–0.96)	
Gender × BMI	0.95** (0.92–0.98)	
Income × BMI	1.02** (1.00–1.03)	
Income × IADL		1.01* (1.01–1.01)
Income × Smoking history	0.99* (0.99–0.99)	
Race × Marital status	2.26** (1.39–3.68)	
Race × IADL	0.73* (0.55–0.96)	
Race × Health insurance	1.42* (1.02–1.99)	
Marital × Income		0.61** (0.43–0.88)
County size × Alternative therapies		1.38* (1.07–1.78)

Note: OR = odds ratio; RDD = random digit dialing; CI = confidence interval; IADL = instrumental activities of daily living; BMI = body mass index.

* $p < .05$.

** $p < .01$.