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Longitudinal Predictors of Attitudes toward Aging among Women with Multiple Sclerosis

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Abstract

The purpose of the study was to explore the impact of change in functional limitation (FL), controlling for social support (SS), on attitudes toward aging using longitudinal survey data collected over a 7-year period. The 503 women with MS (age, M=57 years, SD= 10.25) were mostly Anglo (93%) and married (69%). First, growth models were specified to identify a suitable model for change in FL. A quadratic growth model best described change. Next, SS was considered a time-varying covariate of FL to assess both within- and between-individual effects of SS on FL over time. Within individuals, higher FL levels were associated with lower SS levels. Between individuals, level of but not change in FL was associated with average SS level. Finally, average SS and response level and change in FL were studied as predictors of attitudes toward aging, accounting for 38% of the variance. Women with higher FL and lower SS scores had more negative views of aging. Negative views of aging may have long-term consequences for health outcomes as well as the quality of their later years.

Multiple sclerosis (MS) is a chronic condition diagnosed in more than 2 million people world wide (Anderson, Ellenberg, Leventhal, Reingold, Rodriquez, Silberberg, 1992; Joy & Johnston, 2001). It is most commonly first diagnosed in women between the ages of 20 to 40 years, and over time, it results in varying levels of progressive mobility and sensory functional limitations affecting not only function but also appearance (Lolli, Rovero, Chelli, & Papini, 2006). The variations in MS related outcomes have been categorized based on disease progression and symptom severity. These include: relapsing remitting, secondary progressive, primary progressive, progressive relapsing, and benign. Clinical predictors of progression of disease are age at onset, gender, type and number of systems involved at onset, type of impairment severity, sequel of impairment events, and degree of disability (Bergamaschi, 2006). Despite the possibly progressive nature of this neurological disease most people live a relatively normal life span, with 50% of people living over 30 years after the diagnosis (O'Connor, 2002).

The effects of MS on the aging experience are relatively unexplored. This may be because of the complexity of combining an understanding of aging and disability as independent factors in a person's life. Indeed, many of the changes related to MS can also be attributed to aging in

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general making the separation of normal age-related change from disease related change elusive at best (Stern, 2005). Problems related to the pathophysiology of MS, such as incontinence, fatigue, weakness, cognitive impairment, and visual change, can be compounded by the reduced muscle strength and reduced cardiopulmonary reserve seen with increasing age. Moreover, the psychosocial issues that may accompany MS, such as the need to reassess driving ability with visual and muscular changes and the possibility of leaving or changing jobs due to increasing functional limitation, may also be issues common to older adults.

Noting that people with MS face many physiological and psychosocial issues related to change in function at a relatively early age, researchers have posited that they age at an accelerated pace (Campbell, Sheets, & Strong, 1999; Zarb, 1993). Researchers have demonstrated that people diagnosed with disabling conditions accumulated more vision, respiratory, and digestive disorders over a 5-year period than those aging without a disability (Campbell, Sheets & Strong, 1999).

“Accelerated aging” (Campbell, Sheets, & Strong, p. 114, 1999) in persons with disabling conditions, such as those with MS, may create a negative attitude towards aging. Individuals and societies create views and expectations of how people should age (Montepare, J. & Clements, 2001; Settersten, 1999). The development of a positive attitude toward aging is resultant of having appraised those views and the ability to fulfill those aging expectations in a way that is palatable. The impact of appraising a functional limitation as socially disabling through the stigmatizing images of the normal body type within society has long been reported. In the classic work of Goffman (1963), stigma due to disability is well documented with cultural accounts of discrimination and isolation of persons with disabilities. An interesting ethnographic study suggested that persons with disabilities in the United States were located in a liminal state-unable to participate in American cultural norms (Murphy, Scheer, Murphy, & Mack, 1988). Societal views of permanent functional limitations can become internalized and shape a person's identity as helpless, dependent, and cognitively impaired; a person to not worthy of social responsibility (Zola, 1993). Indeed, negative images of poor physical health have been associated with negative attitudes toward aging (Milligan, Prescott, Powell, & Furchtgott, 1989).

The implications of having a negative attitude toward aging are immense. A person's attitude towards the aging process may sway the quality of later years as well as long-term health related outcomes. Indeed, over time, negative attitudes toward aging may have deleterious effects on future health outcomes. Levy, Slade, and Kasl (2002) studied the effects of negative views of aging on health outcomes in a population of 433 participants over age 50 for 18 years. Those who had more positive views of aging at baseline had better functional health scores over time than those who had more negative views of aging at baseline. These results remained significant after controlling for baseline functional health, self-rated health, age, gender, race, and socioeconomics. This long-term association has been found in studies of disease specific mortality as well. Researchers found that baseline attitudes toward aging were significantly associated with respiratory mortality 23 years later (Levy & Myers, 2005). The research on negative images of aging provide growing evidence that the shared negative meanings of aging, once internalized, may directly impact long-term health outcomes.

Studies suggest that social support may act as a buffer between stressful situations and mental health outcomes, which is termed the `vulnerability hypothesis' (Cohen & Wills, 1985; Vilhjalmsson, 1993). Studies of how social support might impact attitudes toward aging were not found in the extant literature. Research has indicated that the adequacy of a social support system may influence the impact of age-related changes on the cardiovascular system, endocrine system, immune system, and other disease related changes (Uchino, Cacioppo, & Kiecolt-Glaser, 1996) and be a primary factor in adapting to functional change for persons with

MS (Fong, Finlayson & Peacock, 2006; Mohr, Dick, Russo, Likowsky, & Goodkin, 1999; Ritvo, Fisk, Archibald, Murray, & Field, 1996).

The way in which support systems are perceived to vary over time in relation to changes in functional limitation is a factor worth considering given the benefits it may have in moderating the impact of stressful situations on mental health. Fong and colleagues (2006) reported that a major concern about aging for persons with MS age 55 to 81 years was the characteristics of their support system and the response of their support providers. It was not the size but the ability of the support system to respond to their individual needs that kept them socially engaged and active despite increasing levels of functional limitation over time. Those aging with MS frequently engaged in efforts to negotiate with others to maintain access to the environment; however, over time and increasing age they debated if access was worth the effort expended to get the support needed. There were no known studies that explored how changes in functional limitation might impact change in social support over time.

Further, social support, in the context of MS, is a dynamic process that changes with time. For instance, studies have indicated that over time social support changes; persons providing support to those with MS may prefer to provide support by themselves at first, but later as the disease progresses and coping resources dwindle, prefer to share responsibility for the provision of support with others who might be available, such as family or healthcare assistants (McKeown, Porter-Armstrong, & Baxter, 2004). In a study of 200 men and women with MS (Gulick, 1994), women perceived greater amounts of social support and duration of disease was not associated with amount of social support perceived. This study was limited, however, by a cross-sectional design used to infer relationships over time.

From this literature we posit a conceptual model that views functional limitation as having a shifting, variable trajectory among women with MS. The trajectory of functional limitations is thought to have a corresponding relationship with social support. As functional limitations increase, women may be required to expend further effort to maintain needed levels of social support but may be unable given functional decline, which diminishes their attitude toward aging. At the same time, women with MS who are able to maintain or reduce their degree of functional limitation may have the added benefit of maintaining a social network that promotes a better view of aging. For those whose functional limitations worsen overtime, a negative attitude toward aging may extend beyond the impact of chronological age. A woman's attitude towards the aging process may sway the quality of her later years as well as the long-term accumulation of health related problems. Over time, negative attitudes toward aging may be internalized with resultant deleterious effects on future health outcomes making it imperative to consider this outcome variable. This process of increasing functional decline with decreasing social support could create a spiraling downward effect as attitude toward aging worsens.

Specifically, it is our position that there is a significant relationship between social support, functional limitation and attitude toward aging. We hypothesize that women with high levels of functional limitation, regardless of their age, will correspondingly have lower levels of social support due to the effort needed to maintain that support over time. We also hypothesize that the level and change in perceived functional limitation over time will be associated with the amount of perceived social support regardless of age. Additionally, functional limitation will be associated with attitude toward aging among women with MS beyond the effects of advancing chronological age and social support. It is our purpose to explore the following research questions:

- What is the within-individual effect of social support on functional limitation over the seven-year period after adjusting for the effect of chronological age?

- What is the between-individual effect of social support on functional limitation after adjusting for the effect of chronological age?
- Does the level and change rate in functional limitation trajectories predict attitude toward aging 7 years later after controlling for the effects of social support and chronological age?

Methods

Data Collection Procedures

Data collection procedures for this on-going longitudinal study of the health promotion behaviors of persons with MS are described in detail elsewhere (Stuifbergen, Blozis, Harrison & Becker, 2006). The study began in 1996/1997 after the local institutional review board approved a cross-sectional study of persons with MS. Participants were recruited through the National MS Society and newspapers. Then in 1999, the longitudinal study was initiated; 621 of the 749 participants who remained eligible from the 1996/1997 cross sectional study consented to continue into the longitudinal study. Those who chose to remain in the study were significantly younger with fewer functional limitations and greater social support than those in the original cross sectional study. Data collection was done by mailing study materials to the participants with a stamped self-addressed return envelope yearly, although not all variables used in this analysis were included at each year. As of the end of the 2005 data collection period (Year 7), 533 participants remained in the study (women =503, men=30). Eighty-eight participants were lost due to death (n=31), institutionalization (n=8), misdiagnosis (n=11), refusal to continue (n=18), inability to continue due to illness (n=14) and lack of address (n=6). The response rates for participants from Year 1 through Year 7 were .84, .90, .90, .87, .85, .87, .83, respectively. Each participant received no more than a $30.00 gift certificate per year along with a hand-written thank you note for participation.

Sample

For this longitudinal analysis, data from 503 women with MS were included. At beginning of the longitudinal study in 1999, the women (age Mean = 49 years, Range = 28 to 80 years) were mostly Anglo (93%). The majority were married (69%), while 13% were divorced, 6% widowed, 6% never married, 4% lived with a significant other and 2% were separated. A total of 49% were college educated, 34% reported a high school diploma, and 5% reported no degree. In regard to the type of MS the women self-reported, the majority indicated that they had relapsing remitting MS (42%) while 17% had secondary progressive, 16% had primary progressive MS, 11% had progressive relapsing MS, 11% had benign MS and 4% did not know what type of MS they had. The average number of years since diagnosis was 10 years.

Procedures

Questionnaire booklets containing a variety of self-report instruments were sent to participants enrolled in the longitudinal study from 1999 to present unless they withdrew. For the analyses discussed here measures of demographic and illness related variables, functional limitations, social support, and attitude toward aging were used.

Measures

Demographics

A background information sheet was used to collect demographic profiles and disease characteristics for the sample. The demographics included age, race/ethnicity, marital status, education, employment, length of diagnosis and type of MS.

Functional Limitations

Functional limitations related to MS were measured annually with the Incapacity Status Scale (ISS), modified for self-report (Kurtzke, 1981). Construct validity has been reported (Kurtzke, 1981). This scale provides an assessment of the degree of limitation in 16 personal functions, such as climbing stairs, bowel and bladder function, transferring, and dressing. Each is rated on a 5-point scale, with 0 indicating normal or unimpaired functioning and 4 indicating a complete inability to perform the activity. In the current study reported here, the Cronbach's alpha at Year 1 was .87. Scores can range from 0 to 64. Scores on this scale were significantly associated with scores on the MS Functional composite scores for a sub-sample of persons in this study (Stuifbergen, et al., 2006). The ISS scores were associated with ambulation ($r=-0.49$) and upper extremity coordination and control ($r=-.57$). Test-retest reliability has also been demonstrated; Pearson product moment correlations between measures spanning 8 months have been reported at 0.91 ($p<.001$) (Stuifbergen, Becker, Blozis, Timmerman, & Kulberg, 2003).

Social Support

The Personal Resource Questionnaire (PRQ-2000) was used to measure social support (Weinert, 2003). The Likert-type scale is scored from 1 (strongly disagree) to 7 (highly agree), with higher scores indicating higher perceived levels of social support. Content, construct, and criteria-related validity were well established with the PRQ85, the 25-item version of the scale (Weinert & Brandt, 1987). The PRQ-85 has been used in multiple survey studies with various groups (e.g. Hunter, 1998; Schachman, Lee, & Lederma, 2004; and Smith & Weinart, 2000) including those with MS (Stuifbergen et al, 2006). The PRQ-2000 is a revised, more parsimonious, version of the PRQ85 (Weinart, 2000). It is a 3-factor, 15-item scale. Construct and content validity has also been documented with the PRQ-2000 (Weinert, 2003). The Cronbach's alpha for the PRQ-2000 in this study at Year 1 was .89. The 25 items constituting the PRQ-85 were measured annually from Year 1 to Year 7 except for Year 6 when the measure was excluded from the questionnaire battery, but consistent with the Weinart's recommendation, only the 15 items constituting the PRQ-2000 were used for this study.

Attitude toward Aging

Attitude toward aging was measured using the Attitude Toward Own Aging subscale of the Philadelphia Geriatric Center Morale Scale (PGCMS; Lawton, 1975; Liang & Bollen, 1983). This five-item subscale is scored from 5 to 11 with higher scores indicating a more positive attitude toward aging. Each woman was asked to indicate their agreement on the following items: 1. Things keep getting worse as I get older. 2. I have as much pep as I did last year. 3. As I get older, I am less useful. 4. I am as happy now as I was when I was younger. 5. As I get older things are better/worse/or the same as I thought they should be. Internal consistency reliability was reported as .68 and construct validity of the subscale has been supported using data from the National Senior Citizens Survey (Kim & Moen, 2002; Liang & Bollen, 1983). The subscale has been used in previous survey research (Levy et al., 2002). Cronbach's alpha for the Attitude Toward Own Aging subscale in this study at Year 7, the only time the subscale was used to date, was .71.

Data Analyses

In light of the research questions and given that SS scores were available for all years but Year 6, measures of FL were also considered for only Years 1–5 and 7. First, means and standard deviations for these years were examined along with the associations between variables. Next, to answer the three research questions, it was necessary to first test different growth models for comparison to understand which model best explained the FL data for interpretation. The best fitting model was then extended to allow for the study of how the level and change in measures of FL over a seven-year period, adjusting for the effects of measures of SS, were predictive of attitudes toward aging (*AGING*) measured in the final year of the study. This general analytic approach has been successfully applied in many areas of research (Cornman, Lynch, Goldman, Terracciano, McCrae, Brant, & Costa, 2005; Weinstein, & Lin, 2004). FL scores were studied as a function of time, with the regression coefficients specified as unique to the individual to allow between-individual variation in change characteristics. The corresponding fixed-effects represented change at the population level.

Three models were fitted to assess the form of change in FL. The first assumed no change over time but allowed individual differences in the response level by including a random intercept. The second assumed linear change with allowance for individual differences in both the level and change rate. The third included a quadratic time effect in addition to a linear effect to allow for a nonlinear rate of change, with all coefficients allowed to vary between individuals. For each model, the time-specific errors were assumed to be identically distributed across individuals as normal with means equal to zero and to be independent between occasions with constant variance. Between individuals the random coefficients were assumed to be normal and independent. Next, time-varying SS scores were centered about the individual's mean score and included as time-varying predictors of FL; the individual mean SS score was included as a predictor of the individual-level intercept relating to the model for FL. This treatment of the time-varying measures of SS resulted in an estimated within- and between-individual effect of SS on FL. Characteristics of change in FL scores were also considered a function of the individual's age. Finally, *AGING* was regressed on the level and change in FL, adjusting for the effects of SS and the individual's age (*AGE*).

Missing Data—A total of 134 individuals were missing data on the FL measure for at least one occasion beginning in the second year (n=47 in Year 2, n=64 in Year 3, n=84 in Year 4, n=105 in Year 5 and n=131 in Year 7; counts are not mutually exclusive). Similar patterns of missing data were observed for SS measures. Further, 142 individuals were missing measures of *AGING*. A major source of the missing data was due to 81 individuals dropping from the larger study (n=26 in Year 2, n=19 in Year 3, n=20 in Year 4, n=2 in Year 5, and n=14 in Year 7). Valid inference from a latent curve model depends on the assumption that missing data are missing at random (Willett & Singer, 2003). Given that the processes giving rise to the missing data were unknown, different methods were considered to address the missing data process, in particular, subject drop-out (16% of the sample). Given the low numbers of individuals having missing data patterns not due to drop-out, missing data not due to drop-out were assumed to be missing at random.

Based on the growth model that best described change in FL scores, the model was studied under three different assumptions about the missing data due to drop-out: the missing data were missing completely at random, missing at random, and missing not at random (Diggle & Kenward, 1994; Molenberghs & Kenward, 2007). Under a selection model, a growth model for the FL scores was considered simultaneously with a model for the logit of the probability that an individual had dropped from the study as a function of the FL scores. Assuming missing data were missing completely at random, the logit of the probability of drop-out did not depend on the FL scores. Assuming missing data were missing at random, the logit of the probability of drop-out at a given occasion (beginning in Year 2) was considered a function of the FL score in the previous year. Assuming missing data were missing not at random, the logit of the probability of drop-out at a given occasion was considered a function of the FL score at the previous and current years (cf: Diggle & Kenward, 1994):

$$\text{logit}\,[\,\mathrm{P}\,(\mathrm{d_t}=1)]=\gamma_0+\gamma_1 FL_t+\gamma_2 FL_{t-1}$$

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where d_t is an indicator variable that is equal to 1 if the individual had dropped from the study by year *t* and equal to 0 otherwise, $P(d_t = 1)$ is the probability of drop-out at occasion *t*, FL_t is the response at the corresponding time *t*, and FL_{t-1} is the response at the previous occasion. The coefficients γ_0, γ_1 and γ_2 are the regression coefficients, where γ_0 is the intercept, γ_1 is the effect of the current response, and γ_2 is the effect of the previous response. In addition to these models, a pattern-mixture random-effects model was considered (e.g., see Hedeker & Gibbons, 1997). An indicator variable denoting whether an individual ever dropped from the study was included as a moderator of the random coefficients describing change in FL scores. Finally, a sensitivity analysis was conducted in which parameter estimates relating to the growth model for the FL scores were compared across the different assumptions about the drop-out process. Analyses were conducted using SAS PROC IML. This approach was also carried out on the SS scores to assess the effects of drop-out for measures of social support.

As noted above, some data were missing on the SS measure. Given that SS scores are considered as time-varying predictors of FL scores to assess the within-person effect and the mean of SS across years is used to assess the between-person effect, multiple imputation (MI) using a Markov Chain Monte Carlo method was implemented using SAS PROC MI to generate 10 complete data sets using variables in the data model in addition to other variables available from the larger longitudinal study. An advantage of MI is that variables included in the data model, as well as auxiliary variables, may be used to provide information about the missing data (Allison, 2002; Molenberghs & Kenward, 2007; Schafer, 1997). Auxiliary variables included other self-report measures, such as indicators of social functioning and health behaviors. MI was done treating the nesting of data within individuals.

Maximum likelihood (ML) estimation with robust standard errors were obtained using Mplus version 5 (Muthén & Muthén, 1998–2007). Various indices, where appropriate, were used to assess overall model fit. The χ^2 value and corresponding degrees of freedom (*df*) were computed along with the deviance value (−2 times the log-likelihood, $-2lnL$). Other indicators of model fit were the Akaike Information Criterion (*AIC*) and the root mean square error of approximation (*RMSEA*). The AIC is a relative fit index based on the deviance value for a given model that penalizes a model based on its number of parameters. Smaller values of the *AIC* among competing models are preferred. The *RMSEA* provides an index of close fit (Browne & Cudeck, 1992; Steiger, 1990; Steiger & Lind, 1980) with values less than .05 suggesting a close fit to the data (Browne, 1990). Statistical tests were carried out using a significance level of .05.

Results

The means and standard deviations of each variable at Years 1–5 and 7 are found in Table 1. In Table 2 the correlations between the variables with 95% confidence intervals are given for each occasion. The estimated confidence intervals did not include 0 as interior points. *SS* and *FL* were negatively correlated at all time points, while *SS* and *AGING* were positively correlated at Year 7. *FL* and *AGING* were negatively correlated at Year 7.

Indices of model fit for the growth models relating to FL scores are given in Table 3. The AIC was lowest under the quadratic growth model. The RMSEA was equal to .047 and to .023 under the linear and quadratic growth models, respectively. The quadratic growth model was studied further. The fixed effects relating to the linear and quadratic time effects were not statistically significant. Deviance tests were also performed, suggesting that the variances of the three random coefficients were important in characterizing individual differences in responses. These results suggest that while the typical response shows no change over time, individuals vary with regard to change, with some individual curves increasing and some decreasing over time. Based on these results, the quadratic model was considered most suitable.

Hence, interpretations of the research questions are based upon this model. Although not reported, these analyses were performed on the original raw data using full information maximum likelihood as well as on the imputed datasets using MI. Parameter estimates and standard errors did not differ appreciably between approaches.

The assumptions of homogeneity of variance and independence between occasions for the time-specific errors was evaluated by fitting two additional models that allowed either heterogeneity of variance across time or autocorrelation between adjacent time points (allowing for a different correlation between scores at Years 5 and 7). Across models there were no practical differences in the RMSEA values. Additionally, the AIC was lowest under the model that assumed independence and constant variance across time. Deviance tests (for heterogeneity of variance, χ^2=7.8 (5 *df*), *p*=.17; for autocorrelation between adjacent time points, χ^2=3.7 (2 *df*), *p*=.15) also supported the simpler error structure. Thus, the assumption of independence and constant error variance was judged to be tenable. The assumption of normality for the time-specific errors was evaluated using SAS PROC MIXED to obtain Studentized conditional residuals. Based on the analysis, the residuals were generally symmetric with only a few cases with values as extreme as −4.5 and 4.6. While these results suggest that the distribution of the residuals is not a great departure from normal, they do reinforce the value in obtaining ML estimates with robust standard errors.

Age was included as a predictor of the characteristics of change in FL. Although Age was a reliable predictor of the intercept relating to growth in FL, statistically there was no evidence that it was related to either the linear or quadratic change rate. Thus, in the following analyses, the effects of the individual's age on the linear and quadratic change rates in FL were excluded from the growth model for FL.

The quadratic growth model for change in FL scores was extended to include a model for the logit of the probability that an individual dropped from the study. Deviance tests were used to compare the log-likelihoods of models that assumed missing data were missing completely at random, missing at random, and missing not at random. The difference in deviances between models based on the first two assumptions was statistically significant (χ^2 (1 *df*) = 15.5, *p*<.001), suggesting that the assumption that missing data were missing completely at random was not tenable. Next, the difference in deviances between models based on the last two assumptions was not statistically significant (χ^2 (1 *df*) = 0.138, *p*=.71), suggesting that the assumption that the missing data were missing at random was reasonable. Finally, a comparison of parameter estimates relating to growth in FL scores under the different selection models and the pattern-mixture random-effects model did not differ appreciably across assumptions about drop-out. Similar results were obtained for tests and comparisons relating to models for the SS scores. Based on these results, missing data for both FL and SS scores were henceforth assumed to be missing at random and all analyses based on MI.

The first and second research questions were evaluated under a conditional FL growth model using the imputed datasets. Estimates of the fixed effects and their corresponding standard errors, in addition to estimates of the variances and covariances of the random growth coefficients, are summarized in Table 4. FL responses showed on average no change over time after adjusting for the time-varying effects of SS. The estimated 95% CIs for the linear (−.054, .40) and quadratic (−.026, .048) time effects included 0. Deviance tests for the variances corresponding to each of the three random coefficients suggested individual differences in each feature. Thus, while the results suggest no change at the population level, individual FL scores after adjusting for SS varied in form with some curves changing in a nonlinear manner. Correlations between the FL response level at the start of the study and the linear (*r* = .01) and quadratic (*r* = −.01) change rates were close to zero. The correlation between the linear and quadratic change rates was strong and negative (*r* = −.80) suggesting that individuals whose

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linear change rates at the start of the study were positive tended to also have negative rates of acceleration. While the two coefficients were highly correlated, a deviance test indicated that both random coefficients were important in characterizing change in FL scores.

In response to the first research question, it was hypothesized that women with high levels of functional limitation will correspondingly have lower levels of social support controlling for chronological age due to the effort needed to maintain that support over time. The estimated 95% CI for the within-person effect (−.068, −.024) did not include 0, suggesting that higher levels of social support were related to lower levels of functional limitation within individuals. In response to the second research question, it was hypothesized that the level and change in perceived functional limitation over time would be associated with the overall level of perceived social support controlling for age. The estimated 95% CI for the between-individual effect of SS (−.267, −.149) did not include 0, suggesting that higher mean levels of social support were related to lower levels of functional limitations at the start of the study while adjusting for the effect of the individual's age. The MLE's of the effects of mean SS on the linear and quadratic slopes (excluded from the results provided in Table 4) were very close to 0, suggesting mean social support was not related to change in FL. Additionally, older individuals had relatively high FL scores in Year 1, adjusting for the effect of mean SS (95% CI: .178, .330).

In response to the final research question, it was hypothesized that functional limitation would be associated with attitude toward aging among women with MS beyond the effects of advancing chronological age and social support. To examine this, the regression of *AGING* on the level and change coefficients in the growth model for FL scores adjusting for the effects of SS and the individual's age was incorporated into the model, with the full model depicted in Figure 1. Given the high correlation between the linear and quadratic rates, two sets of models were estimated. The first was based on the time of measurement centered at the start of the study, as was done for all previous analyses; the second was based on centering time at the midpoint of the study. Between models, the correlation between the linear and quadratic change rates was reduced in magnitude from −.78 to .23 with time centered at the study's start and the study's mid-point, respectively. In both analyses, *AGE* was not related to *AGING*, and so the regression path was dropped.

MLEs are presented in Table 5 for models with time centered at the start of the longitudinal study and in Table 6 for models with time centered at the midpoint (Year 4) of the study. While the estimated effect of FL level on *AGING* was statistically significant, the estimated standard errors of the effects of the linear change rate in Year 1 and the quadratic change rate on *AGING* were large relative to their corresponding MLE's. These two latter effects were subsequently dropped from the model and the results given in Table 5. Based on these results, FL level in Year 1 has a negative effect on *AGING* in Year 7 (95% CI: .073, .029), suggesting a tendency for individuals with initially low levels of functional limitation to have high *AGING* scores seven years later. With time centered to the mid-point of the study, the estimated effect of FL level and the linear change rate in Year 4 were both statistically significant, while the estimated 95% CI for the quadratic effect of time on *AGING* included zero, so the effect was dropped from the model with the results given in Table 6. FL level (95% CI: −.066, −.022) and the linear change rate (95% CI: −.89, −.27) in Year 4 were negatively related to *AGING* in Year 7, suggesting that individuals with lower levels of and decreases in functional limitation in the 4th year to also have higher *AGING* scores three years later. Mean SS scores were positively related to *AGING* in Year 7, suggesting that individuals with overall high levels of social support to also have higher *AGING* scores at the end of the study. Finally, to approximate the proportion of variance in *AGING* scores accounted for by characteristics of change in FL scores and SS scores, the estimated variance of 3.150 for *AGING* scores was considered relative to the change in the variance when predictors of *AGING* were studied.

Given time centered at the start of the study and only the intercept of the FL growth model and mean SS as predictors, the residual variance of *AGING* was 1.97, representing a 38% reduction in the variance. Given time centered at the study's mid-point and the intercept and linear time effect at Year 4 and mean SS as predictors, the residual variance was 2.19, representing a 30% reduction in the variance.

Discussion

Overall, the purpose of this study was to explore how the trajectories of functional limitations controlling for the effects of social support predict women's attitude toward aging. Specifically, three research questions were explored. We investigated the within and between effects of social support on functional limitation over the seven-year period, the relationship between social support and functional limitation after adjusting for the effect of chronological age and the ability to predict attitude toward aging by studying the perceived level of functional limitations and its changes, adjusted for differences due to an individual's age and social support. Longitudinal data from women with MS was used to study trajectories and predict attitude towards aging. The data were used to understand both average and individual change in measures of functional limitation, adjusting for social support, over the 7-year period. In other words, models of population and individual level change characteristics based on longitudinal measures of functional limitation and social support were developed. These characteristics were then studied as predictors of attitudes toward aging. The final model is displayed in Figure 1.

Using the most appropriate growth model, the quadratic model where results are based on the assumption that missing data are missing at random, the trajectories of increasing degrees of functional limitation with lower average levels of social support over time predicted a more negative attitude toward aging. Controlling for the effects of social support over time, the functional limitation trajectory was on average stable over time. At the individual level, however, individuals varied in their functional limitation trajectories, with some individuals improving and others worsening over time, even after controlling for the effects of social support.

From this analysis it is evident that these women's perceptions of their functional limitations and social support, along with the change in perceptions of functional limitations, were predictive of an attitude toward aging. Functional limitations had an impact on attitudes toward aging even after controlling for the levels of social support. This is consistent with our supposition that over time functional limitations may become internalized and shape women's age related identity (Zola, 1993). This study also demonstrates that perceptions of aging may be influenced not only by level of function, but also by how fast function declines when examining individual trajectories over a given period of time. Hence, this may indicate that with faster declines in functioning, women may have less time to adjust to their changing bodies making their attitude toward age worse. This has implications for the quality of later years for those aging with changing trajectories of functional limitations and should be explored further.

As evident from this study, longitudinally perceived social support is inversely related to functional limitations while adjusting for the effects of chronological age. Hence, it is evident that increasing functional limitation, and not advancing age, had an association with decreasing social support. If only the mean levels of social support and functional limitations were examined it might be posited from this association that social support had a one-way protective influence on functional decline. This would indicate that variations in functional limitations might be explained by the amount of perceived social support. Studies have indicated that social support has a positive affect on health with aging (Pinquart, 2001; Uchino, et al., 1996). It is important, however, to compare group levels and individual change because it is the varying trajectories of functional limitations that do not necessarily fit existing social support theories (Krause, 1999). Among the women with MS, those with high levels of functional limitations had lower levels of social support over the period of seven years but change in functional limitations had no relationship with mean social support. Women may be able to gain social support at levels of higher function but social support did not subsequently affect change in function. This may indicate that social support is more complex than previously suggested when in the context of disability. It may require an effort on the part of women to gather and maintain social support, which may be difficult in the context of high levels of functional limitation along with accelerated decline. This is consistent with Fong and colleagues (2006) finding that over time people with MS debate if access to social support is worth the effort expended to get the type needed. Social support may require a level of reciprocity that those in states of accelerated decline cannot match, which puts them at risk for worse mental health over time.

The relationship between social support and functional limitations remained while adjusting for the effect of chronological age. Moreover, when the variables were used to predict attitudes toward aging, chronological age was dropped from the model because it was not a significant predictor. This indicates that the relationship between functional limitation and social support was not age dependent. Age could have eliminated the association due to the biological, age-related changes that compound functional decline. Further, women with MS at younger ages could have had exposure to opportunities for greater amounts of social support given their developmental stage of life. Regardless, the relationship between social support and functional limitation remained despite controlling for chronological age and it was not in the final model predicting attitude toward aging. Hence, chronological age does not explain the findings of this study.

It should also be noted that higher mean levels of social support predicted more positive attitudes toward aging. Women with MS with higher levels of social support had higher levels of positive attitudes toward aging seven years later. This offers support for the buffer hypothesis, in that social support may influence mental health outcomes in the context of stressful situations, such as what may be experienced with MS. However, given the findings that those with higher levels of functional limitations and accelerated decline had correspondingly lower levels of social support over the same period, it is possible that those who are able to maintain or improve their function may be at an advantage in securing adequate levels of social support, which impacts their long-term attitude toward aging.

Women with MS in this study, after controlling for social support, had varying patterns of change in functional limitation trajectories. Increasing functional limitations could leave women with a negative attitude toward aging because exacerbations of illness frequently leave new limitations that require new levels of support. The variations in trajectories make it difficult to plan supportive interventions based solely upon group indicators of change. Interventions may be needed to target women with MS who have more severe functional limitations and are at risk for exacerbation. Interventions designed for those at high risk due to higher levels of functional limitations may be most beneficial for improving attitudes toward aging and possibly long term health, and measurement outcomes might consider group as well as individual change indicators. It may be beneficial to assess the availability of, and provide if necessary, increased levels of support that do not require reciprocity during times of functional decline.

This longitudinal data set provided the opportunity to model trajectories of functional limitation and social support in ways not possible with cross-sectional data. Despite this, there was a limitation in our data set due to missing data. It was possible that missing responses were not a random occurrence. For example, it was possible that women did not provide responses for a common reason, such as worsening function. If this was the case then the data were not missing at random. To address this issue we took the added step of testing change in measures of both functional limitation and social support under different assumptions about missing data. After careful examination, we believe it was reasonable to assume that the missing data were missing at random. Ultimately, however, these statistical models are best approximations and can never fully capture the absolute truth of experience.

The results of this study should be interpreted with caution. The results are based upon self-report data of how much functional limitation the women have and of how much social support the women receive. The sample is largely Anglo and the influence of race and ethnicity could not be explored. Future studies are needed to explore these relationships within the context of ethnicity and race. It must also be mentioned that there is no information from this study to indicate what an abnormal attitude toward aging might be or that an abnormal attitude toward aging even exists. There is no objective cut-off point to determine when a person has the wrong attitude about their aging experience. It is also possible that mood changes, such as depression, which may be associated with living with or the actual disease processes of MS, may also impact attitudes toward aging. Cognitive changes with age and with MS may also impact the variables in this study but were not measured. Further, given that this is not a random sample and the original cross-sectional sample fared worse in terms of functional limitations these findings may not be representative of women with MS in general.

Conclusion

Data from a longitudinal study conducted over a seven-year period was used to explore individual change in functional limitations, after controlling for social support, as well as average social support levels across time as predictors of attitudes toward aging in women with MS. Together, these accounted for a significant amount of variance in attitudes toward aging, with lower functional limitation levels and decreasing functional limitations predicting a more positive view of aging, and higher average social support levels also predicting a more positive view of aging. Findings provide initial evidence that mean levels of perceived social support is inversely associated with perceived level of functional limitations but social support is not associated with change rates in functional limitations. Both variables may have an influence on the attitude toward aging of women with MS, but studies are needed to examine these relationships further. For instance, as this longitudinal study progresses it will be necessary to clarify if negative attitudes toward aging will cause a spiraling downward affect on health indicators over time in the context of low levels of social support for women with higher levels of functional limitation. There is evidence that negative views of aging may have long-term consequences for health related outcomes as well as the quality of their later years and thus, cannot be ignored.

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References

Allison, PD. Missing data. Sage Publications, Inc.; Thousand Oaks, CA: 2002.

Anderson DW, Ellenberg JH, Leventhal CM, Reingold SC, Rodriquez M, Silberberg DH. Revised estimate of the prevalence of multiple sclerosis in the United States. Annals of Neurology 1992;31:333–336. [PubMed: 1637140]

Bem S. Gender schema theory: A cognitive account of sex typing. Psychological Review 1981;88:354–364.

Bentler PM, Bonnett DG. Significance tests and goodness of fit in the analysis of covariance structures. Psychological Bulletin 1980;88:588–606.

Bergamaschi R. Prognosis of multiple sclerosis: Clinical factors predicting the late evolution for an early treatment decision. Expert Reviews in Neurotherapeutics 2006;6:357–364.

Browne, MW. MUTMUM PC: User's guide. Ohio State University, Department of Psychology; Columbus: 1990.

Browne MW, Cudeck R. Alternative ways of assessing model fit. Sociological Methods and Research 1992;21:230–258.

Campbell ML, Sheets D, Strong PS. Secondary health conditions among middle-aged individuals with chronic physical disabilities: Implications for unmet needs for services. Assistive Technology 1999;11:105–122. [PubMed: 11010061]

Cohen S, Wills T. Stress, social support and the buffering hypothesis. Psychological Bulletin 1985;98:310–357. [PubMed: 3901065]

Cornman JC, Lynch SM, Goldman N, Weinstein M, Lin HS. Stability and change in the perceived social support of older Taiwanese adults. Journal of Gerontology, Series B, Psychological Sciences & Social Sciences 2004;59:S350–7.

Cummings SM, Kropf NP, DeWeaver KL. Knowledge of and attitudes toward aging among non-elders: Gender and race differences. Journal of Women & Aging 2000;12:77–91. [PubMed: 10986852]

Diggle PJ, Kenward MG. Informative drop-out in longitudinal data analysis (with discussion). Applied Statistics 1994;43:49–93.

Fong T, Finlayson M, Peacock N. The social experience of aging with a chronic illness: Perspectives of older adults with multiple sclerosis. Disability and Rehabilitation 2006;28:695–705. [PubMed: 16809212]

Goffman, E. Stigma: Notes on the management of spoiled identity. Simon & Schuster; NY: 1963.

Gulick EE. Social support among persons with multiple sclerosis. Research in Nursing & Health 1994;17:195–206. [PubMed: 8184131]

Harris MB. Growing old gracefully: Age concealment and gender. Journal of Gerontology 1994;49:P149–58. [PubMed: 8014395]

Hunter AG. Some psychosocial aspects of nonlethal chondrodysplasias: V. Assessment of personal social support using the personal resource questionnaire. American Journal of Medical Genetics 1998;78:22–24. [PubMed: 9637418]

Joy, JE.; Johnston, RB. Multiple sclerosis: Current status and strategies for the future. National Academy Press; Washington, DC: 2001.

Kelman H, Thomas C, Tanaka J. Longitudinal patterns of formal and informal social support in an urban elderly population. Social Science & Medicine 1994;38:905–914. [PubMed: 8202739]

Kim JE, Moen P. Retirement transitions, gender, and psychological well being: A life course ecological model. Journal of Gerontology 2002;57B:212–222.

Krause N. Assessing change in social support during late life. Research on Aging 1999;21:539–569.

Kurtzke JF. A proposal for a uniform minimal record of disability in multiple sclerosis. Acta Neurological Scandinavica 1981;64(Suppl 87):110–129.

Lawton J. The Philadelphia Geriatric Center Morale Scale: A revision. Journal of Gerontology 1975;30:85–9. [PubMed: 1109399]

Laird NM. Missing data in longitudinal studies. Statistics in Medicine 1988;7:305–315. [PubMed: 3353609]

Levy B, Myers L. Relationship between respiratory mortality and self-perceptions of aging. Psychology and Health 2005;20:553–564.

Levy BR, Slade MD, Kasl SV. Longitudinal benefit of positive self-perceptions of aging on functional health. Journal of Gerontology 2002;57B:409–417.

Liang J, Bollen K. The structure of the Philadelphia Geriatric Center Morale Scale: A reinterpretation. Journal of Gerontology 1983;38:181–189. [PubMed: 6827034]

Little RJA. Modeling the Drop-Out Mechanism in Longitudinal Studies. Journal of the American Statistical Association 1995;90:1112–1121.

Lolli F, Rovero P, Chelli M, Papini AM. Toward biomarkers in multiple sclerosis: new advances. Expert Review in Neurotherapeutics 2006;6:781–794.

McKeown LP, Prter-Armstrong AP, Baxter GD. Caregivers of people with multiple sclerosis: Experiences of support. Multiple Sclerosis 2004;10:219–230. [PubMed: 15124770]

Milligan W, Prescott L, Powell D, Furchtgott E. Attitudes towards aging and physical health. Experimental Aging Research 1989;15:33–41. [PubMed: 2583214]

Mohr D, Dick L, Russo D, Likosky W, Goodkin D. The psychosocial impact of multiple sclerosis: Exploring the patient's perspective. Health Psychology 1999;18:376–382. [PubMed: 10431939]

Molenberghs, G.; Kenward, MG. Missing data in clinical studies. John Wiley & Sons, Ltd.; West Sussex, England: 2007.

Montepare JM, Clements AE. Age schemas: Guides to processing information about the self. Journal of Adult Development 2001;8:99–108.

Murphy, R. The body silent. Holt Science; New York, NY: 1987.

Murphy R, Scheer J, Murphy Y, Mack R. Physical disability and social liminality: A study in the rituals of adversity. Social Science & Medicine 1988;26:235–42. [PubMed: 2964721]

Muthén, LK.; Muthén, BO. Mplus User's Guide. Vol. 5th ed. Muthén & Muthén; Los Angeles, CA: 19982007.

O'Connor P. Canadian multiple sclerosis working group. Key issues in the diagnosis and treatment of multiple sclerosis: An overview. Neurology 2002;59:S1–33. [PubMed: 12448786]

Pinquart M. Correlates of subjective health in older adults: A meta-analysis. Psychology and Aging 2001;16:414–26. [PubMed: 11554520]

Raudenbush, SW.; Bryk, AS. Hierarchical Linear Models: Applications and Data Analysis Methods. Vol. 2nd ed. Sage; Thousand Oaks, CA: 2002.

Ritvo PG, Fisk JD, Archibald CJ, Murray TJ, Field C. Psychosocial and neurological predictors of mental health in multiple sclerosis patients. Journal of Clinical Epidemiology 1996;49:467–472. [PubMed: 8621999]

Schachman KA, Lee RK, Lederma RP. Baby boot camp: Facilitating maternal role adaptation among military wives. Nursing Research 2004;53:107–115. [PubMed: 15084995]

Schafer, JL. Analysis of incomplete multivariate data. Chapman & Hall; London: 1997.

Settersten, RA. Lives in Time and Place: The Problems and Promises of Developmental Science. Baywood Publishing Company, Inc.; Amityville, NY: 1999.

Singer, JD.; Willett, JB. Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence. Oxford University Press; New York: 2003.

Smith L, Weinert C. Telecommunication support for rural women with diabetes. Diabetes Educator 2000;26:645–655. [PubMed: 11140073]

Snijders, T.; Bosker, R. Multilevel analysis: An introduction to basic and advanced multilevel modeling. Sage; Thousand Oaks, CA: 1999.

Steiger JH. Structural model evaluation and modification: An interval estimation approach. Multivariate Behavioral Research 1990;25:173–180.

Steiger, JH.; Lind, JM. Statistically based tests for the number of common factors. Paper presented at the meeting of the Psychometric Society; Iowa City. 1980.

Stern M. Aging with multiple sclerosis. Physical Medicine and Rehabilitation Clinics of North America 2005;16:219–234. [PubMed: 15561552]

Stuifbergen A, Becker H, Blozis S, Timmerman G, Kulberg V. A randomized clinical trial of a wellness intervention for women with multiple sclerosis. Archives of Physical Medicine & Rehabilitation 2003;94:467–476. [PubMed: 12690582]

Stuifbergen A, Blozis S, Harrison TC, Becker H. Exercise, functional limitations, and quality of life: A longitudinal study of persons with multiple sclerosis. Archives of Physical Medicine & Rehabilitation 2006;87:935–943. [PubMed: 16813781]

Terracciano A, McCrae RR, Brant LJ, Costa PT. Hierarchical linear modelings analysis of the NEO-PI-R Scales in the Baltimore Longitudinal Study of Aging. Psychology and Aging 2005;20:493–506. [PubMed: 16248708]

Uchino BN, Cacioppo JT, Kiecolt-Glaser JK. The relationship between social support and physiological processes: A review with emphasis on underlying mechanisms and implications for health. Psychological Bulletin 1996;119:488–531. [PubMed: 8668748]

Vilhjalmsson R. Life stress, social support and clinical depression: A reanalysis of the literature. Social Science & Medicine 1993;37:331–342. [PubMed: 8356482]

Verbrugge LM, Jette AM. The Disablement Process. Social Science & Medicine 1994;38:1–14. [PubMed: 8146699]

Weinert, C. Measuring social support: PRQ2000. In: Strickland, O.; DiIorio, C., editors. Measurement of nursing outcomes: Vol. 3. Self care and coping. Springer; New York: 2003. p. 161-72.

Weinert C, Brandt PA. Measuring social support with the personal resource questionnaire. Western Journal of Nursing Research 1987;9:589–602. [PubMed: 3433744]

Zarb, G. Ageing with a disability. In: Johnson, J.; Slater, R., editors. Ageing and Later Life. Sage Publications; London: 1993. p. 54-59.

Zola IK. Self, identity and the naming question: reflections on the language of disability. Social Science & Medicine 1993;36:167–173. [PubMed: 8421793]

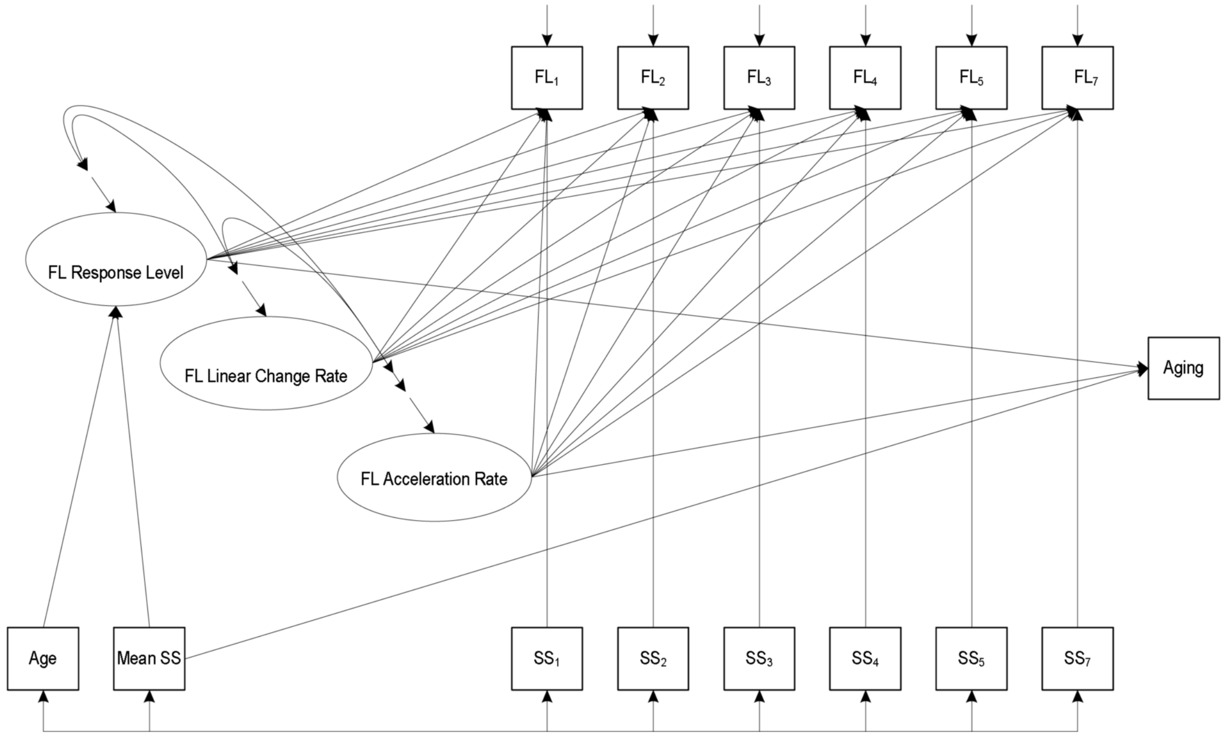

Figure 1.
Structural model displaying relationships between variables.

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Table 1

Means, Standard Deviations and Score Range for Variables by Year

Year		Social Support	Functional Limitation	Attitude Toward Aging
Year 1	Mean (S.D)	84.16 (14.03)	17.02 (8.83)	
	Range	27–105	1–47	
Year 2	Mean (S.D)	83.75 (15.68)	17.80 (9.87)	
	Range	21–105	1–54	
Year 3	Mean (S.D)	84.73 (15.36)	17.94 (9.76)	
	Range	24–105	0–49	
Year 4	Mean (S.D)	84.67 (14.77)	18.04 (9.47)	
	Range	34–105	0–46	
Year 5	Mean (S.D)	85.33(14.85)	17.97 (9.53)	
	Range	32–105	0–46	
Year 7	Mean (S.D)	85.28 (15.31)	17.82 (9.62)	2.43 (1.66)
	Range	23–105	0–54	0–5

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Table 2

Correlations among Variables (95% Confidence Interval)

Time Period		Social Support (SS)	Functional Limitation (FL)	Attitude Toward Aging (AG)
Time 1	SS	1	−.17, N=502, (–0.25 – −.08)	
	FL	−.17, N=502 (−0.25 – −0.08)	1	
Time 2	SS	1	−.24, N=503 (−0.32 – −0.16)	
	FL	−.274, N=503 (−0.32 – −0.16)	1	
Time 3	SS	1	−.23, N=453 (−0.32 – −0.14)	
	FL	−.23, N=453 (−0.32 – −0.14)	1	
Time 4	SS	1	−.18, N=439 (−0.27 – 0.09)	
	FL	−.18, N=439 (−0.27 – −0.09)	1	
Time 5	SS	1	−.24, N=419 (−0.33 – −0.15)	
	FL	−.24. N=419 (−0.33 – −0.15)	1	
Time 6	SS	1	−.28, N=372 (−0.37 – −0.18)	.46, N=361 (0.38 – 0.53)
	FL	−.28, N=372 (−0.37 – −0.18)	1	−.43, N=361 (−0.51 – −0.34)
	AG	.46, N=361 (0.38 – 0.53)	−.43, N=361 (−0.51 – −0.34)	1

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Table 3

Indices of fit for three *FL* growth models (*n*=503)

Growth Model	χ^2	df	Deviance	AIC	RMSEA
No growth	246	24	18236	18242	.135
Linear growth	44.8	21	17998	18010	.047
Quadratic growth	21.7	17	17969	17989	.023

Notes: The deviance is equal to −2*lnL. The Akaike Information Criterion (AIC) is −2*lnL + 2p, where p is the number of model parameters. Under all models the level-1 errors were assumed to be independent between occasions with constant variance. Analyses were based on data generated using multiple imputation with 10 replications. FL=Functional Limitation

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Table 4

Maximum likelihood estimates based on a quadratic growth model for FL scores (n=503)

Parameter	**MLE (SE)**	**95% CI**
FL Level	23.6 (2.99)	(17.7, 29.5)
FL Linear change	.173 (.116)	(−.0544, .400)
FL Acceleration	.011 (.019)	(−.0262, .0482)
Within-individual effect of SS	−.046 (.011)	(−.0676, −.0244)
Between-individual effect of SS	−.208 (.030)	(−.267, −.149)
Effect of *AGE* on *FL Level*	.254 (.039)	(.178, .330)
Covariance Coefficient		
Intercept, Intercept	75.2 (5.49)	
Linear, Intercept	.077 (1.10)	
Linear, Linear	1.58 (.493)	
Quadratic, Intercept	−.023 (.169)	
Quadratic, Linear	−.196 (.075)	
Quadratic, Quadratic	.038 (.013)	

Notes: Tabled values are maximum likelihood estimates (MLE) with robust standard errors (SE) in parentheses. MLE's are averaged across results based on 10 imputed data sets obtained using MI with a MCMC method assuming missing data were missing at random. SE's take MI into account. The 95% CI's are estimated 95% confidence intervals for the fixed effects. Time is centered at the start of the longitudinal study. FL=functional limitation; SS=Social Support; Age=Chronological Age

Table 5

Maximum likelihood estimates for predicting *Aging* scores by characteristics of change in FL scores for time centered at the start of the longitudinal study (*n*=503)

Fixed Effect	**MLE (SE)**	**95% CI**
Constant	−.268 (.534)	(−1.31, .78)
FL Level	23.6 (2.99)	(17.7, 29.5)
FL Linear change	.173 (.116)	(−.054, .40)
FL Acceleration	.011 (.019)	(−.026, .048)
Within-individual effect of SS on FL	−.046 (.011)	(−.068, −.024)
Between-individual effect of SS on FL	−.208 (.030)	(−.27, −.15)
Effect of *AGE* on *FL Level*	.255 (.039)	(.18, .33)
Effect of FL *Level* on *AGING*	−.051 (.011)	(−.073, −.029)
Effect of *Mean SS* on *AGING*	.041 (.005)	(.031, .051)
Variance/covariance coefficient	MLE (SE)	
Intercept, Intercept	75.0 (5.49)	
Linear, Intercept	.157 (1.11)	
Linear, Linear	1.58 (.493)	
Quadratic, Intercept	−.023 (.168)	
Quadratic, Linear	−.201 (.076)	
Quadratic, Quadratic	.039 (.014)	
Residual *AGING* Variance	1.97 (.453)	

Notes: Tabled values are maximum likelihood estimates (MLE) with robust standard errors (SE) in parentheses. MLE's are averaged across results based on 10 imputed data sets obtained using MI with a MCMC method assuming missing data were missing at random. SE's take MI into account. The 95% CI's are estimated 95% confidence intervals for the fixed effects. Time is centered at the start of the longitudinal study. FL=functional limitation; SS=Social Support; Age=Chronological Age, Aging=Attitude Toward Aging

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Table 6

Maximum likelihood estimates for predicting *Aging* scores by characteristics of change in FL scores for time centered at the mid-point of the study (*n*=503)

Fixed Effect	**MLE (SE)**	**95% CI**
Constant	−.274 (.536)	(−1.32, .78)
FL Level	24.4 (2.99)	(18.5, 30.3)
FL Linear change	.236 (.051)	(.136, .336)
FL Acceleration	.011 (.019)	(−.026, .048)
Within-individual effect of SS on FL	−.043 (.011)	(−.065, −.021)
Between-individual effect of SS on FL	−.208 (.031)	(−.27, −.15)
Effect of *AGE* on *FL Level*	.251 (.039)	(.17, .33)
Effect of FL *Level* on *AGING*	−.044 (.011)	(−.066, −.022)
Effect of *FL Linear Change* on *AGING*	−.581 (.157)	(−.89, −.27)
Effect of *Mean SS* on *AGING*	.042 (.005)	(.032, .052)
Variance/covariance coefficient	MLE (SE)	
Intercept, Intercept	81.9 (5.99)	
Linear, Intercept	1.39 (.558)	
Linear, Linear	.607 (.093)	
Quadratic, Intercept	−.252 (.193)	
Quadratic, Linear	.040 (.028)	
Quadratic, Quadratic	.037 (.013)	
Residual *AGING* Variance	2.19 (.165)	

Notes: Tabled values are maximum likelihood estimates (MLE) with robust standard errors (SE) in parentheses. MLE's are averaged across results based on 10 imputed data sets obtained using MI with a MCMC method assuming missing data were missing at random. SE's take MI into account. The 95% CI's are estimated 95% confidence intervals for the fixed effects. Time is centered at the mid-point of the longitudinal study. FL=functional limitation; SS=Social Support; Age=Chronological Age, Aging=Attitude Toward Aging