Published in final edited form as:
Am J Public Health. 2012 December ; 102(12): 2330–2335. doi:10.2105/AJPH.2012.300791.

Pregnancy as a Risk Factor for Ambulatory Limitation in Later Life

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Abstract

Objectives—We investigated the relationship between the number of times a woman has been pregnant and walking difficulty in later life.

Methods—With data from the Hispanic Established Populations for Epidemiologic Studies of the Elderly, a representative population-based cohort of Mexican Americans aged 65 years and older residing in 5 Southwestern states, we measured walking difficulty using 2 items from the performance-oriented mobility assessments: the timed walk and seated chair rise.

Results—We observed significantly higher rates of ambulatory limitation among women with 6 or more pregnancies than among women with 4 or fewer pregnancies: 44.9% and 27.0%, respectively, were unable to perform or performed poorly in the seated chair rise and timed walk. Ordinal logistic regression models show that gravidity predicts level of performance in both mobility tasks and that higher gravidity is associated with worse performance, even after adjustment for both age and chronic disease.

Conclusions—Gravidity is a risk factor for ambulatory limitation in old age. A life course approach to reproduction in public health research and practice is warranted.

In the United States, approximately 1 in 4 adults aged 65 years and older experiences ambulatory limitation.[1] From 45 years on, the prevalence of walking difficulty rises rapidly[2] and is accompanied by an increased risk of falls. The consequences of such falls can be costly to both physical and mental health, often resulting in further declines in independent

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Contributors
A. R. A. Aiken completed the analyses and led the writing. J. L. Angel and T. P. Miles initiated and supervised the study. All authors contributed to interpretation of the results and review and editing of the article.

Human Participant Protection
Study protocols were approved by the institutional review board of the University of Texas at Austin.

mobility.[3,4] Public health interventions designed to reduce walking difficulty in later life typically involve a rehabilitative approach, seeking improvement in ability through conventional athletic enhancement.[5] Yet these therapeutic methods, despite benefitting overall health, demonstrate limited improvement in individual functional capacity.[6–8] Preventing walking difficulty in older age and prolonging functional independence are, therefore, key concerns for public health researchers, practitioners, and advocates.

Across global populations as diverse as Japan, Sweden, and Nigeria, the prevalence of walking difficulty is higher among older women than among older men.[9–11] Indeed, this phenomenon has consistently been found in studies worldwide. In a recent US population health survey, women aged 65 years and older were almost 20% more likely than were men to experience walking difficulty,[2] a fact reflected in their rates of fractures and joint problems.[12]

Explanation of the high prevalence of walking difficulty in women has so far focused on variation by gender in the prevalence of chronic diseases that accompany aging.[13,14] We hypothesized that such risk factors, although important, cannot explain all the observed variation in walking difficulty among women, nor can they fully explain why such limitation is more prevalent among women than among men. In light of the well-known association between high fertility and poor health status,[15] we examined gravidity (the number of times a woman has been pregnant) as a gender-specific risk factor for walking difficulty.

The Hispanic Established Populations for Epidemiologic Studies of the Elderly (H-EPESE) cohort provides a prime opportunity to formally test gravidity as a risk factor. The cohort consists of Mexican American men and women, aged 65 years and older at baseline, for whom measures of activity limitation, family size, pregnancy history, and various chronic diseases were ascertained. High fertility is a feature of the H-EPESE cohort, affording us a greater range over which to test our hypothesis. Using a panel of established risk factors, we evaluated the contribution of high gravidity to walking difficulty among elderly women.

METHODS

The H-EPESE is a 17-year panel study of older Mexican Americans residing in 1 of 5 Southwestern states (Arizona, California, Colorado, New Mexico, and Texas) who were first interviewed in 1993–1994. The sample and detailed characteristics of the H-EPESEs have been described elsewhere.[16] Our cross-sectional analytic sample (n =1408) consisted of men (n = 541) and women (n = 867) who were interviewed at wave 4 (2000–2001) about their sociodemographic characteristics, performance-based mobility, and physical health, including the presence of specific chronic diseases. Tests of walking ability, namely the seated chair rise and timed walk, were also performed. At wave 2 (1995–1996), the women in our sample were also interviewed retrospectively about their reproductive and maternity history.

The outcomes of interest—performance in the seated chair rise and timed walk—are elements of the standard clinical “performance-oriented mobility assessments,”[17] which together test the essential elements of walking ability. The seated chair rise involves rising from the seated position and measures balance and lower body strength, both of which strongly predict walking ability. The timed walk involves walking 10 feet and assesses gait. Participants were asked to perform the tests, and interviewers trained by physicians were asked to assess performance as best, good, moderate, poor, or unable to do, according to time taken. The use of these objective measures helps us to avoid the potential methodological biases of self-reported assessments of mobility.[18,19]

We measured the key independent variable, gravidity, by asking women participants to state the number of times they had been pregnant (range 0–27). In our data set, we Winsorized the sole observation of 27 to 20. Winsorizing is a statistical transformation technique used to limit extreme values, thus tempering the effect of outliers. Gravidity is a continuous variable in our regression models; however, we partitioned it into lower, middle, and upper tertiles to examine the association of each with performance in the seated chair rise and timed walk before we conducted regression analyses. We also asked both women and men to state the number of living children they had (range 0–18).

In our analyses we controlled for a key set of variables that are known to increase the risk of walking difficulty. Established risk factors included age, hysterectomy, chronic diseases known to affect walking ability,[20] and incontinence, which has been strongly associated with functional limitation.[21,22] We asked participants to state their age and whether they had ever received a medical diagnosis of diabetes, arthritis, stroke, osteoporosis, or cardiac failure. We standardized age and included positive diagnoses of diabetes, arthritis, stroke, osteoporosis, and cardiac failure as dummy variables. We accounted for a history of hysterectomy, coded as a dummy variable, because it is a major surgical procedure carrying a risk of urinary incontinence.[23]

We also controlled for self-reported incontinence, which we derived from a 5-item ordinal scale—4: all the time; 3: most of the time; 2: some of the time; 1: hardly ever; and 0: never. We constructed 4 dummy variables, D1–D4, to represent these categories of severity. We coded dummy variable D*j* if the participant selected category *j* or any more severe category. In this way the coefficient associated with each dummy represented the marginal effect on the dependent variable of a participant's falling into category *j* compared with category *j* – 1. For example, we coded a participant who chose 4: all the time as 1 for all 4 dummy variables.

Previous research has shown that socioeconomic variables predict health outcomes,[24] yet the H-EPESE cohort is relatively homogeneous with respect to such factors, with nearly all members having low income and the vast majority lacking private health insurance. To avoid consequent SE inflation, we did not include these variables in the model. Educational attainment is associated with both gravidity and mobility limitation,[25,26] and our model included a dummy variable to represent respondents with greater than a high school education.

A key difference among cohort members is nativity status, in that some are first-generation immigrants born in Mexico, whereas others were born in the United States. Several demographic factors associated with nativity may affect walking ability,[27] and any differences in fertility trends and early life experiences between Mexican immigrants and US-born Mexican Americans must also be taken into account.[28,29] For this reason, we used birthplace information to create a dummy variable representing those respondents born in the United States rather than in Mexico.

Using ordinal logistic regression models, we estimated variation in both seated chair rise and timed walk performance by number of pregnancies (for women only), controlling for other contributing factors. Because pregnancy is a gender-specific factor, we also performed a control analysis substituting number of children as the key independent variable. Friedlander found that lifetime reproductive intensity lessened the survivorship of women and had no effect on men.[30] To test the impact of lifetime reproductive intensity (i.e., the number of offspring one has), we performed ordinal logistic regression models separately for men and women using number of children as a predictor of performance in the timed walk and seated chair rise.

We have denoted all regression coefficients as changes in log-odds and performed all statistical analyses using the R statistical software package (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

The demographic, reproductive, and chronic disease characteristics of the H-EPESE sample are shown in Table 1. Consistent with known gender differences in chronic disease rates and with current trends in Hispanic health data, women in the sample had significantly higher rates than did men of diabetes (28.7% vs 22.9%), arthritis (59.9% vs 45.8%), and osteoporosis (14.4% vs 1.9%). There were no statistically significant differences between men and women in the rates of stroke, urinary incontinence, and cardiac failure.

Our sample reflects the well-established fact that aging women are more likely than are aging men to have difficulty walking. Women were significantly more likely than were men to be unable to perform the timed walk (18.0% vs 12.0%) or the seated chair rise (22.3% vs 17.0%). Among those able to perform these tasks, women were significantly more likely to be poor performers of the seated chair rise (22.6% vs 17.0%).

Mean gravidity in our sample was 5.9 pregnancies per woman. On analyzing performance in both the seated chair rise and timed walk within each tertile of gravidity (0–4, 5–7, ≥ 8), we found that the women in our sample were nonrandomly distributed between performance categories according to each tertile (Pearson χ^2 test = 19.42; P = .013). Moving from the lowest to the highest tertile, women were more likely to have worse performance in the seated chair rise and timed walk. A much higher percentage of women in the highest tertile were in the poor or unable to do categories compared with women in the middle and lowest tertiles, and a lower percentage were in the best or good categories (models not shown).

Table 2 shows the control analyses comparing performance in the seated chair rise and timed walk by number of children for women and men separately. These models clearly show that a higher number of children predicts worse performance in both the seated chair rise and the timed walk for women but not for men. For women, each additional child increased the log-odds of poor performance in both the chair rise and the timed walk by 5%. Ancillary analyses (models not shown) revealed that women who were never pregnant or had no children appeared to be protected from poor performance in the seated chair rise (41%) and the timed walk (22%).

Tables 3 and 4 show the formal testing of the association between gravidity and ambulatory limitation. Using 5 models, we allowed the sensitivity of the relationship between number of pregnancies and performance in the seated chair rise (Table 3) and timed walk (Table 4) to be tested against a successively increasing panel of control variables.

Model 1, a simple regression model, shows that a higher number of pregnancies predicts a worse outcome in both the seated chair rise and the timed walk. Model 2 accounts for the marginal impacts of incontinence severity. In all studies of ambulatory limitation, incontinence is the strongest predictor of chair rise and timed walk performance. The always incontinent and always, most of the time, or sometimes incontinent categories are both significantly associated with poor performance. In model 2, number of pregnancies remains a significant predictor of poor performance in the seated chair rise and the timed walk.

History of hysterectomy is added to model 3 to control for the potential adverse effects of this common gynecological procedure. The negative effect of a high number of pregnancies remained unchanged for the timed walk and seated chair rise. Interestingly, hysterectomy was significantly associated with better performance in the seated chair rise, although we did not observe an effect for the timed walk.

Model 4 adjusts for the influence of age, nativity, and education on the association between number of pregnancies and performance in the timed walk and seated chair rise. Adding these variables did not change the relationship between number of pregnancies and performance in either task. In this model, incontinence remained a significant predictor of poor performance, whereas hysterectomy continued to predict better performance. We elected to use nativity to test potential differences between US-born and foreign-born Mexican American women. Interestingly, there was no effect of nativity on poor performance once other factors were taken into account.

The final model, model 5, accounts for the contributions of 5 major chronic diseases associated with walking difficulty: diabetes, stroke, arthritis, osteoporosis, and cardiac failure. Number of pregnancies continued to predict poor performance in both the seated chair rise and the timed walk. For every additional pregnancy, the odds of having a worse performance in the seated chair rise increased by 4% ($P < .01$) and the odds of having a worse performance in the timed walk increased by 3% ($P < .05$). The association between number of pregnancies and poor ambulatory performance remained statistically significant after adjustment for proximal risk factors such as advanced age, incontinence, and chronic diseases such as diabetes or cardiac failure.

In summary, we found that high gravidity is associated with worse performance in both the timed walk and seated chair rise and that this relationship is robust, retaining the direction, magnitude, and statistical significance of its effect across all 5 models. Both predictor variables, number of children and number of pregnancies, showed the same association for women, indicating that they can be used interchangeably in this analysis.

DISCUSSION

We focused on Mexican Americans, the largest Hispanic ethnic group in the United States, with a life expectancy advantage at birth of 2.5 years over the non-Hispanic White population and 7.7 years over the non-Hispanic Black population.[31] A complex interaction of socioeconomic and biological risk factors puts Mexican Americans at high risk for walking difficulty in later life. Vulnerability to diabetes, osteoporosis, and obesity plays an important role (we conducted a latent analysis that included body mass index—defined as weight in kilograms divided by the square of height in meters—in the model as a measure of obesity and found that it did not alter the magnitude or significance of the correlation between pregnancy and performance in either task). Our results suggest that the high gravidity Mexican American women experience is also a contributing factor to walking difficulty in later life.

Measurement of the impact of early and middle life events on late life health has long been a key concept in population health research, for example, the consistent link between low educational attainment and earlier age of onset of Alzheimer's disease[32] and the accelerated osteoporosis experienced by children who survived the Dutch famine of 1944.[33] In recent years, life course women's health research has slowly begun to shift its focus from the proximal to the more distal health consequences of childbearing, moving from the short-term effects on health and socioeconomic status to the long-term physical and mental effects of early and high parity.[34]

Several studies have found that high parity increases the risk of mortality,[35,36] and a few have also linked high parity to poor self-reported physical health and increased self-reported activity limitation in older age.[37,38] The notable strength of our investigation is that the timed walk and seated chair rise are objective measures of ambulatory limitation. This provides an advantage over subjective measures of limitation in which potential methodological bias may arise because of more frequent self-reporting of such limitation among women.[39,40]

Because it occurs earlier in the life course than does the time at which walking difficulty becomes prevalent, reproductive history is a factor rarely considered by gerontologists and public health experts studying ambulatory limitation. Yet it has consequences for both research and practice. Our study suggests that public health and aging practitioners should consider including gravidity in epidemiological models of ambulatory limitation. Additionally, management of high gravidity as a risk factor is also a possibility both proximally, in terms of contraception, and later, after pregnancies have already occurred. For example, policies designed to increase access to effective, affordable methods of contraception for Hispanic women of all income levels and immigration statuses (a particular problem in states such as Texas at present) may have the potential to delay ambulatory limitation in old age. Additionally, women older than a certain age who have had a certain number of pregnancies might be advised about pelvic floor exercises or other lower body muscle strengthening regimens to lower the risk of ambulatory limitation in later life.

Limitations

Despite the advantages offered by our data set, there are several limitations. Data on number of pregnancies, number of children, and diagnosis of chronic conditions rely on self-reporting, and the cross-sectional nature of the analyses means that we can provide only a snapshot of walking ability and chronic disease status and that we must treat consecutive pregnancies as if they happened simultaneously. These issues merit further attention and should be addressed when possible in future studies. Although some attrition occurred over time in the H-EPESE cohort, ancillary analyses comparing the characteristics of those who exited the cohort between baseline and wave 4 with those who remained reveal no concerning bias.

Perhaps the most important limitation is the lack of ability in this cohort to explore the association between high gravidity and ambulatory limitation in its environmental context. Environmental factors and contextual influences affect our full understanding of functional limitation and of the disablement process generally,[41,42] and future studies should aim to consider such factors. Additionally, the women in our sample were all Mexican American, and some had a very high number of pregnancies. Women experienced walking limitation proportionally more at the middle and highest tertiles than at the lowest tertile of gravidity, but because not all populations experience such fertility variation, these results merit further investigation in other cohorts before wider generalizations can be made.

Conclusions

Distinguishing between number of pregnancies and number of children is an important conceptual piece of our analysis. Gravidity has the advantage of being precisely measured in the cohort, whereas measurement of parity relies on number of children. We also suspect that a high number of pregnancies may have a related, but distinct, role to that of parity in ambulatory limitation. By comparing the results of gender-specific models, our analysis suggests that there is a biological mechanism underlying the relationship between gravidity and walking difficulty. Although the nature of this mechanism cannot be determined from our study, the well-recognized effects of pregnancy on women’s anatomy offer some insight. Incomplete uterine involution following each pregnancy may lead to an enlarged, bulky uterus that persists over the rest of the life course. As our results suggest, the association between hysterectomy and better performance in the seated chair rise lends initial support to this observation. Additionally, cumulative stress to the pelvic floor musculature occurring over multiple pregnancies often leads to damage of the vulnerable pelvic neural plexus during the childbearing years. This damage may then be unmasked by subsequent age-related declines in pelvic neural integrity, eventually leading to the emergence of walking difficulty.

Pregnancy, however, is not the only process causing cumulative pelvic floor injury. Although its effect is large, there are other activities associated with pelvic floor trauma that could create a similar risk profile for men. For example, there is emerging medical literature on repeated pelvic floor trauma among bicycle racers.[43] To detect other sources of cumulative pelvic floor stress, new data collection efforts should consider improved measurement of occupation and recreational activities in addition to obstetrical details.

We have provided initial evidence that gravidity influences walking difficulty among older women. A higher number of pregnancies predicts a greater likelihood of walking difficulty, even when other well-established risk factors are taken into account. This finding contributes to our understanding of the consequences of high fertility for women and the life course risk factors associated with ambulatory limitation. In light of emerging global trends in aging, a framework for the prevention of ambulatory limitation that includes consideration of reproductive health policy deserves serious attention.

Acknowledgments

This research was supported by the National Institutes of Health, National Institute on Minority Health and Health Disparities (grant 5R01MD-005894-02) and the National Institute of Aging (grant R01-AG10939).

We would like to thank Catherine E.M. Aiken, MBBChir, PhD, University of Cambridge, for her helpful contributions.

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TABLE 1

Characteristics by Gender for Pregnancy and Later Life Ambulatory Limitation: Hispanic Established Populations for Epidemiologic Studies of the Elderly (H-EPESE) Data, Southwestern States, 2000–2001

Characteristic	Men (n = 541), Mean or %	Women (n = 867), Mean or %
Age, y	78.9	79.4
Foreign born	45.5	39.6
≤ high school education	89.3	90.9
Chronic conditions and disability,		
Diabetes	22.9	28.7*
Stroke	4.6	3.5
Arthritis	45.8	59.9***
Always incontinent	3.0	3.9
Always, most of the time, or sometimes incontinent	19.0	22.8
Osteoporosis	1.9	14.4***
Cardiac failure	19.9	19.7
Gravidity by tertile[a]		
0–4	…	42.6
5–7		24.8
8–20		32.6
Number of children by tertile[a]		
0–3	…	43.0
4–5		24.3
6–18		32.4
Hysterectomy[a]	…	30.3
Physical function		
Best performance in the seated chair rise	30.3	21.3***
Poor performance in the seated chair rise	17.2	22.6*
Unable to perform the seated chair rise	17.0	22.3*
Best performance in the timed walk	27.7	19.6***
Poor performance in the timed walk	6.1	9.0
Unable to perform the timed walk	12.8	18.0*

[a]Data from wave 2 of the H-EPESE (1995–1996).

*$P \leq .05$;

***$P \leq .001$.

P values were determined by the *t*-test or χ^2 difference of means test.

TABLE 2

Ordinal Logistic Regressions of Performance in the Seated Chair Rise and Timed Walk on Number of Children by Gender for Pregnancy and Later Life Ambulatory Limitation: Hispanic Established Populations for Epidemiologic Studies of the Elderly (H-EPESE) Data, Southwestern States, 2000–2001

	Seated Chair Rise		Timed Walk, b (SE)	
Variable	**Women (n = 867), b (SE)**	**Men (n = 541), b (SE)**	**Women (n = 867), b (SE)**	**Men (n = 541), b (SE)**
No. of children[a]	0.05** (0.02)	−0.02 (0.02)	0.04* (0.02)	−0.02 (0.02)
Always, most of the time, or sometimes incontinent	0.24 (0.16)	0.65** (0.22)	0.24 (0.16)	0.37 (0.22)
Always incontinent	1.77*** (0.42)	0.51 (0.55)	1.92*** (0.42)	0.33 (0.58)
Age	0.48*** (0.07)	0.26** (0.09)	0.50*** (0.07)	0.48*** (0.09)
Nativity	0.12 (0.13)	−0.13 (0.16)	0.01 (0.12)	0.28 (0.16)
Education	−0.06 (0.44)	−0.36 (0.43)	−0.96* (0.47)	−0.45 (0.46)
Diabetes	0.33* (0.14)	0.70*** (0.19)	0.40* (0.14)	0.87*** (0.19)
Stroke	0.24 (0.35)	0.76 (0.43)	0.37 (0.36)	0.96* (0.41)
Arthritis	0.13 (0.13)	0.23 (0.16)	0.27 (0.13)	0.06 (0.16)
Osteoporosis	0.28 (0.19)	1.01 (0.61)	0.51** (0.18)	1.54** (0.59)
Cardiac failure	0.38* (0.17)	0.48* (0.20)	0.32* (0.16)	0.25 (0.20)

Note. Cutpoints for performance in the seated chair rise: Women: best to good −1.03; good to moderate −0.11; moderate to poor 0.59; poor to unable 1.78. Cox-Snell pseudo R^2 = 0.14. Men: best to good −1.33; good to moderate −0.49; moderate to poor 0.26; poor to unable 1.29. Cox-Snell pseudo R^2 = 0.08. Cutpoints for performance in the timed walk: Women: best to good −1.20; good to moderate 0.18; moderate to poor 1.44; poor to unable 2.03. Cox-Snell pseudo R^2 = 0.16. Men: best to good −1.63; good to moderate −0.19; moderate to poor 1.00; poor to unable 1.51. Cox-Snell pseudo R^2 = 0.09.

[a]Data from wave 2 of the H-EPESE (1995–1996).

*P ≤.05;

**P ≤.01;

***P ≤.001.

TABLE 3

Ordinal Logistic Regressions of Performance in the Seated Chair Rise on Gravidity and Covariates (Women Only) for Pregnancy and Later Life Ambulatory Limitation: Hispanic Established Populations for Epidemiologic Studies of the Elderly (H-EPESE) Data, Southwestern States, 2000–2001

Variable	Model 1, b (SE)	Model 2, b (SE)	Model 3, b (SE)	Model 4, b (SE)	Model 5, b (SE)
Gravidity[a]	0.04* (0.02)	0.04* (0.02)	0.04* (0.02)	0.04** (0.02)	0.04** (0.02)
Always, most of the time, or sometimes incontinent		0.33* (0.16)	0.35* (0.16)	0.41** (0.16)	0.24 (0.16)
Always incontinent		1.86*** (0.4)	1.81*** (0.41)	1.67*** (0.41)	1.69*** (0.42)
Hysterectomy[a]			−0.32* (0.13)	−0.27* (0.13)	−0.32* (0.14)
Age				0.47*** (0.06)	0.47*** (0.07)
Nativity				0.12 (0.13)	0.15 (0.13)
Education				0.16 (0.45)	0.04 (0.45)
Diabetes					0.35* (0.15)
Stroke					0.18 (0.36)
Arthritis					0.15 (0.13)
Osteoporosis					0.31 (0.19)
Cardiac failure					0.41* (0.17)

Note. Model 5 cutpoints for performance in the seated chair rise: best to good −1.20; good to moderate −0.28; moderate to poor 0.42; poor to unable to do 1.60. Residual deviance = 2636.9; Akaike information criterion = 2670.9 (smallest of all 5 models); Cox-Snell pseudo R^2 = 0.14. The sample size was n = 867.

[a] Data from wave 2 of the H-EPESE (1995–1996).

* $P \leq .05$;

** $P \leq .01$;

*** $P \leq .001$.

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TABLE 4

Ordinal Logistic Regressions of Performance in the Timed Walk on Gravidity and Covariates (Women Only) for Pregnancy and Later Life Ambulatory Limitation: Hispanic Established Populations for Epidemiologic Studies of the Elderly (H-EPESE) Data, Southwestern States, 2000–2001

Variable	Model 1, b (SE)	Model 2, b (SE)	Model 3, b (SE)	Model 4, b (SE)	Model 5, b (SE)
Gravidity[a]	0.03* (0.02)	0.03* (0.02)	0.03* (0.02)	0.03* (0.02)	0.03* (0.02)
Always, most of the time, or sometimes incontinent		0.39* (0.16)	0.35* (0.16)	0.46** (0.16)	0.23 (0.16)
Always incontinent		2.0*** (0.4)	1.98*** (0.41)	1.77*** (0.41)	1.83*** (0.42)
Hysterectomy[a]			−0.17 (0.13)	−0.11 (0.13)	−0.15 (0.14)
Age				0.49*** (0.06)	0.49*** (0.07)
Nativity				0.08 (0.13)	0.12 (0.13)
Education				−0.73 (0.47)	−0.94* (0.47)
Diabetes					0.41** (0.14)
Stroke					−0.50 (0.37)
Arthritis					0.27 (0.13)
Osteoporosis					0.53** (0.18)
Cardiac failure					0.33* (0.16)

Note. Model 5 cutpoints for performance in the seated chair rise: best to good −1.23; good to moderate 0.15; moderate to poor 1.40; poor to unable to do 2.0. Residual deviance = 2530.5; Akaike information criterion = 2564.5 (smallest of all 5 models); Cox-Snell pseudo R^2 = 0.16. The sample size was n = 867.

[a]Data from wave 2 of the H-EPESE (1995–1996).

*$P \leq .05$;

**$P \leq .01$;

***$P \leq .001$.