Social Status and Mortality With Activity of Daily Living Disability in Later Life

Edith Guilley and Christian J. Lalive d'Epinay

Center for Interdisciplinary Gerontology, University of Geneva, Switzerland.

Objectives. The aim of this study was to assess which social status factors predispose a person to dying with activity of daily living (ADL) disability in later life.

Methods. We followed 243 deceased members of the Swiss Interdisciplinary Longitudinal Study on the Oldest Old annually up to 8 years before their deaths. Using a multilevel regression, we analyzed age at death, gender, occupational category, and geographic area as potential factors predisposing a person to ending life with ADL disability.

Results. Disability scores showed a substantial increase as death approached. Individuals from a lower occupational category were at higher risk of ADL disability and experienced a greater functional decline prior to death compared to those from higher occupational categories.

Discussion. Consistent with the cumulative disadvantage theoretical framework, the health differential between the occupational categories seems to be exacerbated prior to death.

Key Words: ADL disability—End of life—Oldest old—Longitudinal.

THE question of whether the last years of a very long life are associated with a stage marked by poor health is a subject of personal concern as well as a crucial question for health care professionals. However, only a few studies have examined health states prior to death (Guralnik, LaCroix, Branch, Kasl, & Wallace, 1991). Among the studies devoted to this subject, some focused only on frailer older people (Bortz, 1990; Covinsky, Eng, Lui, Sands, & Yaffe, 2003) or on community-dwelling elders (Liao, McGee, Kaufman, Cao, & Cooper, 1999). Few were devoted to the oldest old: Only the studies by Palmore and Burchett (1997), Leveille, Guralnik, Ferrucci, and Langlois (1999), and Romoren (2003) focused on very old populations. According to the common assumption that individuals who live into their 80s are different from younger elderly people, the quality of the last years before death may differ in late life. In addition, some of the previous studies on health prior to death in advanced old age (Leveille et al., 1999; Palmore & Burchett, 1997) have focused primarily on the very last interview and consequently do not allow description of health trajectories prior to death. Lastly, apart from the study by Romoren in Norway, all research on health states prior to death has been conducted in the United States.

Using a sample of very old Swiss persons interviewed annually in the 8 years before their deaths and residing in different settings, our aim was to assess which social status factors predispose a person to dying with activity of daily living (ADL) disability. In particular, we investigated whether the risk of ADL disability prior to death was equally distributed among occupational categories. Numerous studies have documented that a low occupational status is associated with a higher risk of health impairments in old age (e.g., Land & Yang, 2006). A number of elements (e.g., unfavorable working conditions, behavioral risk factors, psychosocial factors, inequality of access to the care system and of treatment within it; cf. Land &

Yang, 2006) may create these social inequalities in health. There are inconsistent results with regard to later life, with some studies showing decreasing, or persisting or widening social inequalities in health (e.g., Ferraro & Farmer, 1996b). Convergence of inequalities in later life is often a matter of selective survival (Ferraro & Farmer, 1996a), whereas the increase in inequalities is consistent with the cumulative disadvantage theoretical framework (Dannefer, 2003). To our knowledge, the inequality literature has seldom explored whether aging amplifies, reduces, or maintains social inequalities in health, specifically prior to death among very old populations.

Of particular interest is also the question of whether women encounter higher risks of health limitations compared to men during their last years of life. The selective mortality between men and women (Manton, 1988), the biomedical specificities of each gender (Gold, Malmberg, McClearn, Pedersen, & Berg, 2002), as well as women's more demanding social roles (Antonucci, 2001) or their lower occupational status (Arber & Cooper, 1999) are factors contributing to gender differences in health. Although widely studied in old age (e.g., Lahelma, Arber, Martikainen, Rahkonen, & Silventoinen, 2001), gender differences in health have been far less investigated prior to death in very old age. Macintyre, Hunt, and Sweeting (1996) showed that gender differences in health varied according to stage of the life course. Therefore, it is necessary to conduct studies also in oldest old populations in order to verify whether gender differences in health persist prior to death in this specific age group.

We also assessed whether the risk of ADL disability increases with age at death. Many studies have tested the compression of morbidity hypothesis with cross-sectional data, and some have found that the prevalence of disability and the proportion of life spent with disability are decreasing in younger generations, who live longer (e.g., Fries, 2003;

Manton, 2008). But few studies based on longitudinal data have analyzed whether health limitations increase with the life span. In other terms, do older decedents show a higher risk of premortem ADL disability than their counterparts of the same birth cohort who died younger?

Finally, we explored rural/urban residence as a potential determinant of health prior to death. Although some studies have indicated that rural elderly individuals are less health dependent than urban elders, other findings have reported poorer health and increased physical impairments among rural older adults (e.g., Golant, 2003). Does this variable, which has shown inconsistent effects on health in old populations, still have an impact on health prior to death?

METHODS

Participants

We included in these analyses participants who died while enrolled in the Swiss Interdisciplinary Longitudinal Study on the Oldest Old between February 1994 and September 2004. Details on the baseline and follow-up of this larger study have been published previously (cf. Ghisletta, Bickel, & Lövdén, 2006). Note that interviews were carried out on an approximately yearly basis (every 12 or 18 months), and the initial sample included 340 participants, aged between 80 and 84 years, randomly selected from the community-dwelling octogenarians living in the canton of Geneva (urban area) and the central Valais (semi-rural area) of Switzerland. At baseline, the sampling frame was stratified by geographic area and gender. Participants gave their answers to a trained interviewer, either in person or through the intermediary of a proxy. Those who moved to a nursing home remained in the study.

By the end of the study (i.e., the ninth wave), 243 (71.5%) participants had died. The decedents had participated on average in four waves (from one up to eight waves; a total of 942 interviews were performed). The decedent cohort consisted of 111 women (45.7% of the sample) and 132 men; 50.2% were living in the urban area, 24.5% were of middle or upper class, 33.6% had been self-employed, 13.7% were white-collar workers, and 28.2% were blue-collar workers. The mean age at death was 87.2 years. The status characteristics of the decedents closely matched those of the survivors, except the latter were younger and more likely to be female compared to their counterparts who had died during the study follow-up.

Health Measures

Individuals were asked how much difficulty they had (0 = able, 1 = able with difficulty, and 2 = unable) performing five activities including washing, dressing and undressing, eating, moving in and out of bed, and moving from one room to another (cf. Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963). The five items reached a reliability level (Cronbach's alpha) of .91. The disability score, ranging from 0 to 2, was equal to the average of the five responses (for a similar methodology, see Hubert, Bloch, Oehlert, & Fries, 2002). We scored difficulty in only one of the five activities, the minimal level of disability, as 0.2; the maximal level of disability represented complete inability to perform the five ADLs. Research has found that difficulty in these tasks is predictive of future dependence,

which has predictive validity for admission to skilled nursing facilities and mortality (Gill, Robison, & Tinetti, 1998). Examining the score distribution showed that there were greater proportions of people with no disability (569 on 942 occasions having no disability). An examination of the data by proximity to death showed that score followed a similar shape of distribution to the total sample.

Social Status Variables

The social status variables used in the present study included geographic area of residence (urban or semi-rural), gender, age at death, and former occupational category (self-employed [small farmers and owners of small businesses], blue-collar worker, white-collar worker, or middle/upper social class [including liberal professions]). The occupational categorizations were based on the main occupation the participant held during his or her working life. A household classification was used whereby each individual was classified according to the "higher" of the two spouses' respective social rankings. This classification is an adapted version of the original six-category class schema presented by Desrosières and Thévenot (1992).

Analysis Strategies

We assessed the risk of ADL disability prior to death in very old age according to social status factors by conducting univariate descriptive analyses and then a multivariate multilevel regression. The multivariate regression analyzed the risk of ADL disability prior to death as a function of the following fixed effects: age at death, gender, geographic area, occupational category, and proximity to death. For proximity to death, higher scores corresponded to greater proximity to death and therefore fewer years of life. We included proximity to death and its square function (in years and centered on its grand mean) as Level 1, time-varying predictors; and age at death, gender, occupational category, and geographic area as Level 2, time-invariant predictors. We also examined every possible interaction effect. We included in the final model those that were significant and at the same time increased significantly the quality of the model (cf. likelihood-ratio test). We also estimated random components to account for individual variation around the group average predictions. Use of a quadratic function (proximity to death and its square function) allowed for nonlinear changes. We report results with a robust estimation of the standard error. We tested fixed and random effects of the multilevel model by using the method of restricted maximum likelihood using hierarchical linear modeling Version 6 (Raudenbush, Bryk, Cheong, & Congdon, 2004). Given the skewness of the distribution of ADL disability score, we also experimented with fitting a generalized estimating equation (GEE) with Poisson distribution (Ballinger, 2004). Major results from the two competitive models were similar. Note that the effect of the square function of proximity to death was no more significant in the generalized estimating equation because the link function (i.e., the log of the dependent variable "linearized" the regression equation).

RESULTS

Table 1 shows the mean ADL disability score among decedents by social status variable according to the univariate

Table 1. Decedents' Mean Activity of Daily Living Disability Score, by Social Status ($N = 243$)

Variable	n	M Score[a] (SE)	p[b]
Age at death			
≤87.5 years	122	0.42 (0.05)	—[c]
>87.5 years	121	0.34 (0.04)	
Gender			
Male	132	0.35 (0.04)	—[c]
Female	111	0.42 (0.05)	
Geographic area			
Semi-rural	121	0.51 (0.05)	<.001
Urban	122	0.25 (0.04)	
Occupational category			
Middle/upper classes	59	0.13 (0.04)[d,e]	<.001
White-collar workers	33	0.25 (0.06)[d,e]	
Blue-collar workers	68	0.46 (0.07)[f,g]	
Self-employed	81	0.55 (0.06)[f,g]	

Notes: SE = standard error.
[a]Mean of the average score of each participant.
[b]p values based on bivariate analysis of variance.
[c]Insufficient power to test this difference.
[d]Significantly different from blue-collar workers ($p < .05$).
[e]Significantly different from self-employed ($p < .05$).
[f]Significantly different from middle/upper classes ($p < .05$).
[g]Significantly different from white-collar workers ($p < .05$).

Table 2. Multivariate Multilevel Regression Analysis of Social Status Determinants of Activity of Daily Living Disability Score Prior to Death ($N = 243$; 942 Interviews)

Effect	Coefficient (SE)	p
Fixed effects		
Proximity to death (in years)	0.19 (0.02)	<.001
Proximity to death squared (in years)	0.01 (0.00)	<.001
Age at death (in years)	0.01 (0.01)	.151
Gender (women)	−0.02 (0.05)	.738
Geographic area (urban)	−0.07 (0.05)	.100
Middle/upper classes vs blue-collar workers	−0.22 (0.06)	.001
White-collar workers vs blue-collar workers	−0.14 (0.08)	.068
Self-employed vs blue-collar workers	0.17 (0.08)	.027
Proximity to death × Middle/upper classes	−0.05 (0.01)	.001
Proximity to death × White-collar workers	−0.03 (0.02)	.064
Proximity to death × Self-employed	0.02 (0.02)	.378
Random effects		
Intercept variance		
Variance component	0.13	
Degrees of freedom	150	
χ^2	998.18	
p	<.001	
Slope variance (proximity to death)		
Variance component	0.04	
Degrees of freedom	153	
χ^2	275.58	
P	<.001	
Slope variance (proximity to death squared)		
Variance component	0.00	
Degrees of freedom	156	
χ^2	212.47	
p	.002	
Deviance	925.14	

Note: SE = standard deviation.

analyses. Prior to death and in very old age, age at death and gender did not seem to be related to the mean ADL disability score. Persons residing in the semi-rural area had higher ADL disability score. The order in occupational category from least to most disabilities was as follows: middle/upper classes, white-collar workers, blue-collar workers, and the self-employed.

Table 2 shows the results of a multilevel regression evaluating the risk of ADL disability prior to death according to social status factor. Disability scores showed a substantial increase as death approached (β [SE] = 0.19 [0.02]; $p < .001$). The effect of proximity to death on the ADL disability score increased over time (see the effect of the square function of proximity to death: β [SE] = 0.01 [0.00]; $p < .001$) and represents the well-known rapid increase of impairments before death. Controlling for the other factors, we found that age at death (β [SE] = 0.01 [0.01]; $p = .151$), geographic area (β [SE] = −0.07 [0.05]; $p = .100$), and gender (β [SE] = −0.02 [0.05]; $p = .738$) did not influence the risk of ADL disability prior to death. Self-employed persons had a higher ADL disability score prior to death (β [SE] = 0.17 [0.08]; $p = .027$), and persons from middle/upper classes had a lower ADL disability score (β [SE] = −0.22 [0.06]; $p = .001$) compared to blue-collar workers. The increase of the disability score as death approached was lower among those from the middle/upper classes (β [SE] = −0.05 [0.01]; $p = .001$).

DISCUSSION

In the present study, the risk of ADL disability in the last years of life was far from being equally distributed among occupational categories. Small self-employed persons were at higher risk than blue-collar workers, who themselves were at higher risk than the middle/upper classes. The present article demonstrates further that, in spite of this differential mortality, membership in an occupational category does have consequences for health in very old age, even up to the years preceding death. This finding fails to support the hypothesis that health disparities of social origin disappear at the end of long lives. By using a longitudinal design, we also provide evidence that individuals from a lower occupational category experienced a greater functional decline prior to death compared to those from higher occupational categories. Thus, the health differential between occupational categories seems to be exacerbated prior to death. This result, referring to the years prior to death for very old persons, is consistent with the cumulative disadvantage theoretical framework (Dannefer, 2003; Ferraro & Kelley-Moore, 2003) and is similar to results of Chandola, Ferrie, Sacker, and Marmot (2007) showing that people from lower occupational grades age faster in terms of a quicker deterioration in physical health.

Few studies have examined the gender differences in health during the years prior to death and specifically among very old populations residing in different settings. Furthermore, the majority of studies on this topic have analyzed the gender difference in health at a given age (e.g., Verbrugge, 1989). As life expectancy is longer in women, it may be more revealing to take that factor into account by comparing the health of women and men at the same age at death, as we did in the present

study. This study reveals that, compared to men, women have similar risks of ADL disability prior to death. This result fits with the ones from Leveille and colleagues (1999) and Palmore and Burchett (1997) on the risk of disability in the year prior to death of very old populations. The absence of gender differences in health prior to death in this sample of women and men who died at approximately the same age (87.5 and 87.0 years old, respectively; $F = 1.44$, *ns*) may indicate that gender differences in health are partly explained by women's greater life expectancy.

In the present study, the oldest decedents had levels of risk of ADL disability before dying similar to those of their contemporaries who had died some years before. In other words, the probability of ADL disability seems not to increase with the life span. This is out of tune with results from Guralnik and colleagues (1991) on persons aged 65 and older and those from Romoren (2003) on very old decedents; these researchers demonstrated that the percentage of disabled elders increases with longer life span. Inconsistency between the studies may come from the use of different outcome variables (binary vs continuous), different analytical methods (logistic vs multilevel regression), or different lengths of follow-up (more than 10 years vs 10 years). The relative better health of the Swiss, for instance in terms of a greater propensity for walking, may also explain the lack of increase in ADL disability with increased age at death found in the present study.

According to the literature, geographic area has inconsistent effects on health. To our knowledge, only Palmore and Burchett (1997) tested whether geographic area could be a factor that influences the risk of disability in the final years of life; they did not find a significant correlation. In our study, geographic area had a significant effect on ADL disability in the univariate analysis (see Table 1), but this relationship disappeared when we controlled the occupational categories in the multivariate analysis (see Table 2). Actually, the populations of these two areas (urban and semi-rural) display different occupational structures, with the differentiation being even more marked among the oldest generations. Elderly persons previously employed in manual professions, such as blue-collar workers and the self-employed (mostly farmers), were indeed more likely to live in the semi-rural area, $\chi^2(3, N = 241) = 23.0$, $p < .001$. Thus, the higher risk of impaired health prior to death among very old persons residing in the semi-rural area is explained primarily by the specific occupational structure of this area.

The major strength of this study is that it focused on the years immediately preceding death, which have been little studied in previous research, especially among oldest old populations. Furthermore, the use of longitudinal data represents a strength, as it allowed us to take into account the aging process. This study also has some limitations. First, due to the study design and stratification, men, community-dwelling persons, and rural elderly persons were overrepresented in the study population of decedents. However, sample representativeness did not affect the analysis of the social status determinants of ADL disability prior to death. Second, the results may have been influenced by the recourse to proxy reports. But in this study, proxies were asked about clearly observable phenomena, and, according to Epstein, Hall, Tognetti, Son, and Conant (1989), such evaluation is fairly valid.

This study demonstrates that occupational inequalities persist and are exacerbated prior to the death of very old people. Future research should focus on how higher occupational groups postpone disability until the very last year of life. Future works should also benefit from considering differences in the resources that individuals bring to their last years of life.

REFERENCES

Antonucci, T. C. (2001). Social relations: An examination of social networks, social support, and sense of control. In J. E. Birren & K. W. Schaie (Eds.), *Handbook of the psychology of aging* (5th ed., pp. 427–453). San Diego: Academic Press.

Arber, S., & Cooper, H. (1999). Gender differences in health in later life: The new paradox? *Social Science & Medicine, 48*, 61–76.

Ballinger, G. A. (2004). Using generalized estimating equations for longitudinal data analysis. *Organizational Research Methods, 7*, 127–150.

Bortz, W. M. (1990). The trajectory of dying: Functional status in the last year of life. *Journal of the American Geriatrics Society, 38*, 146–150.

Chandola, T., Ferrie, J., Sacker, A., & Marmot, M. (2007). Social inequalities in self reported health in early old age: Follow-up of prospective cohort study. *British Medical Journal, 334*, 963–964.

Covinsky, K. E., Eng, C., Lui, L.-Y., Sands, L., & Yaffe, K. (2003). The last 2 years of life: Functional trajectories of frail older people. *Journal of the American Geriatrics Society, 51*, 492–498.

Dannefer, D. (2003). Cumulative advantage/disadvantage and the life course: Cross-fertilizing age and social science theory. *Journal of Gerontology: Social Sciences, 58B*, S327–S337.

Desrosières, A., & Thévenot, L. (1992). *Les catégories socio-professionnelles* [The occupational categories]. Paris: La Découverte.

Epstein, A. M., Hall, J. A., Tognetti, J., Son, L. H., & Conant, L. (1989). Using proxies to evaluate quality of life. *Medical Care, 27*, 91–98.

Ferraro, K. F., & Farmer, M. M. (1996a). Double jeopardy, aging as leveler, or persistent health inequality? A longitudinal analysis of white and black Americans. *Journal of Gerontology: Social Sciences, 51B*, S319–S328.

Ferraro, K. F., & Farmer, M. M. (1996b). Double jeopardy to health hypothesis for African Americans: Analysis and critique. *Journal of Health and Social Behavior, 37*(1), 27–43.

Ferraro, K. F., & Kelley-Moore, J. A. (2003). Cumulative disadvantage and health: Long-term consequences of obesity? *American Sociological Review, 68*, 707–729.

Fries, J. F. (2003). Measuring and monitoring success in compressing morbidity. *Annals of Internal Medicine, 139*, 455–459.

Ghisletta, P., Bickel, J. F., & Lövdén, M. (2006). Does activity engagement protect against cognitive decline in old age? Methodological and analytical considerations. *Journal of Gerontology: Psychological Sciences, 61B*, P253–P261.

Gill, T. M., Robison, J. T., & Tinetti, M. E. (1998). Difficulty and dependence: Two components of the disability continuum among community-living older persons. *Annals of Internal Medicine, 128*, 96–101.

Golant, S. M. (2003). The urban-rural distinction in gerontology: An update of research. In H.-W. Wahl, R. J. Scheidt, & P. G. Windley (Eds.), *Annual review of gerontology and geriatrics* (Vol. 23, pp. 281–312). New York: Springer.

Gold, C. H., Malmberg, B., McClearn, G. E., Pedersen, N. L., & Berg, S. (2002). Gender and health: A study of older unlike-sex twins. *Journal of Gerontology: Social Sciences, 57B*, S168–S176.

Guralnik, J. M., LaCroix, A. Z., Branch, L. G., Kasl, S. V., & Wallace, R. B. (1991). Morbidity and disability in older persons in the years prior to death. *American Journal of Public Health, 81*, 443–447.

Hubert, H. B., Bloch, D. A., Oehlert, J. W., & Fries, J. F. (2002). Lifestyle habits and compression of morbidity. *Journal of Gerontology: Medical Sciences, 57A*, M347–M351.

Katz, S., Ford, A. B., Moskowitz, R. W., Jackson, B. A., & Jaffe, M. W. (1963). Studies of illness in the aged. The index of ADL: A standardized measure of biological and psychosocial function. *Journal of the American Medical Association, 185*, 94–101.

Lahelma, E., Arber, S., Martikainen, P., Rahkonen, O., & Silventoinen, K. (2001). The myth of gender differences in health: Social structural determinants across adult ages in Britain and Finland. *Current Sociology, 49*(3), 31–54.

Land, K. C., & Yang, Y. (2006). Morbidity, disability, and mortality. In R. H. Binstock & L. K. George (Eds.), *Handbook of aging and the social sciences* (6th ed., pp. 41–58). San Diego, CA: Academic Press.

Leveille, S. G., Guralnik, J. M., Ferrucci, L., & Langlois, J. A. (1999). Aging successfully until death in old age: Opportunities for increasing active life expectancy. *American Journal of Epidemiology, 149*, 654–664.

Liao, Y., McGee, D. L., Kaufman, J. S., Cao, G., & Cooper, R. S. (1999). Socioeconomic status and morbidity in the last years of life. *American Journal of Public Health, 89*, 569–572.

Macintyre, S., Hunt, K., & Sweeting, H. (1996). Gender differences in health: Are things really as simple as they seem? *Social Science & Medicine, 42*, 617–624.

Manton, K. G. (1988). A longitudinal study of functional change and mortality in the United States. *Journal of Gerontology: Social Sciences, 43*, S153–S161.

Manton, K. G. (2008). Recent declines in chronic disability in the elderly U.S. population: Risk factors and future dynamics. *Annual Review of Public Health, 29*, 91–113.

Palmore, E. B., & Burchett, B. M. (1997). Predictors of disability in the final year of life. *Journal of Aging and Health, 9*, 283–297.

Raudenbush, S. W., Bryk, A. S., Cheong, Y. F., & Congdon, R. T., Jr. (2004). *HLM 6: Hierarchical linear and nonlinear modelling* (6th ed.). Lincolnwood, IL: Scientific Software International.

Romoren, T. I. (2003). *Last years of long lives: The Larvik Study.* London: Routledge.

Verbrugge, L. M. (1989). Gender, aging, and health. In K. S. Markides (Ed.), *Aging and health: Perspectives on gender, race, ethnicity, and class* (pp. 23–78). Newbury Park, CA: Sage.