Journal of Gerontology: MEDICAL SCIENCES
1998, Vol. 53A, No. 6, M484–M490

Education and the Risk of Physical Disability and Mortality Among Men and Women Aged 65 to 84: The Italian Longitudinal Study on Aging

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Background. Most studies report that people with higher education enjoy better health and longer life. Although it is well known that most risk factors are more common among individuals with a lower level of education, the underlying mechanism of this association is not fully understood. The objective of this study was to assess the association between education, disability, and mortality.

Methods. We analyzed data on 1,817 men and 1,643 women, aged 65–84 years, to assess the association of educational level with physical disability and mortality adjusting for age, sex, smoking habit, occupation, and major chronic conditions.

Results. The association between educational level and disability was characterized by a dose-response effect, with the relative odds significantly decreased by about 30%, 60%, and 79% in those with 4 or 5, 6 to 8, and more than 8 years of education, compared to those with 3 or less years of education. Death rates were lower among persons with 4 or more years of education compared to those with less education. However, after adjusting for disability status, education was no longer associated with mortality (RR = 0.97, CI = 0.65–1.43).

Conclusions. The strong association of low education with disability found in this study may explain the inverse association with mortality reported in previous studies. Disability, indeed, seems to be the mediator between education and mortality and might be due to the higher severity level of diseases, leading to death, in the lower educated group.

AMONG older persons, a higher level of education is strongly associated with a decreased risk of mortality (1–4) and disease (5–8) in both sexes, different age groups, and races.

Several studies have also found an association between lower education and disability (9–12). Physical disability in older persons is related to the greater burden of chronic diseases that are highly prevalent in the aging population. In addition, it is considered an indicator of severity for many chronic conditions, including cardiovascular diseases (CVD) (13), arthritis (14), dementia (15), stroke (16), and Parkinsonism (17). Thus, the inverse association of education with both mortality and disability may be due to the greater prevalence and severity of disease among lower educated individuals, possibly resulting from earlier disease onset or diagnosis at a more advanced stage. To our knowledge, no previous studies have evaluated the association of education with disability while accounting for the major chronic conditions, clinically assessed.

Given the reported association of level of education with socioeconomic status (SES) and lifestyle factors, and considering that less educated individuals have less access to health services, the findings from previous studies, based largely on U.S. data, may not apply to other countries. In Italy, only about 20% of persons 65 years of age and older have more than 8 years of education (18), while in the United States this level of education is achieved by more than 75% of the population of the same age (19). Although there are some differences in the level of education by regions, it does not seem to be particularly relevant in older Italians. In Northern Italy, 8 years or more of education were achieved by 30% of men and 20% of women, compared to about 20% of men and 13% of women living in Central and Southern Italy (18). Also, unlike in the United States, free health care is provided to the entire Italian population. This universal coverage, available since the early 1950s in all regions, is financed by general taxation, and control of total expenditures as well as equity in the distribution of resources, ensured through a capitation-based system, is applied to all Italian residents. Before 1950, health care was guaranteed to all workers and their families through taxation paid by the employers. Local health units are now responsible for the delivery of health services to the entire population. Primary care is provided by general practitioners (GPs), and specialist services are available to all citizens, upon referral from a GP. Thus, access to health services in Italy is independent of socioeconomic status and of region of residence and, to a certain extent, this has been true for the large part of this century.

In this study, we use data from the baseline survey and the two-year mortality follow-up of the Italian Longitudinal Study on Aging (ILSA), a population-based study ongoing in eight centers, to determine major predictors of disability and mortality, including the level of education, in individuals aged 65–84. We hypothesize that individuals with less education are at higher risk of being disabled, but that education is not an independent predictor of mortality when the presence of disability and chronic conditions is taken into account.

Methods

Study population.—The ILSA study design has been described in detail elsewhere (20). In 1992, a random sample of 5,632 individuals aged 65–84 years was identified from the demographic lists of the registry office of eight municipalities in Northern, Central, and Southern Italy. The sample included both community-dwelling and institutionalized persons, and was stratified by age and sex using the equal allocation strategy. Thus, from each center, 88 subjects of each gender in four age groups (65–69, 70–74, 75–79, 80–84 years) were included in the study sample. After exclusion of 170 ineligible subjects who were dead or not resident at the address reported in the demographic list at the beginning of the study, the original sample consisted of 2,734 men and 2,728 women, approximately equally distributed in the four age groups. The response rates for the home interview and for the clinical examination were, respectively, 84% (4,588 individuals) and 63% of the original sample, leaving 3,460 participants (1,817 men and 1,643 women). The nonrespondents consisted largely of people who refused (82%) or could not be contacted. The percentage of nonrespondents in the clinical assessment was about 50% in three municipalities, about 35% in another three, and about 15% in the remaining two. Compared with the respondents, nonrespondents were older ($p <$ .05), but there was no significant difference in age-specific education level. Information on the disability status of nonrespondents was not collected.

Two years after the baseline contact, a telephone interview to assess hospitalization and mortality rates in the cohort acquired information from 83% of the original sample. The death certificates for all participants who died were obtained from the registry offices. After exclusion of 275 persons with missing information on education, disability, or disease status at baseline, data for 3,185 individuals were available for analysis.

Baseline interview and examination.—The baseline study had two phases:

(a) a first phase (screening phase), based on an interview, a clinical examination, laboratory and diagnostic tests;
(b) a second phase (disease diagnosis phase), that consisted of the clinical confirmation of disease by a specialist among cases who screened positive.

Sociodemographic and behavioral characteristics.—A comprehensive questionnaire, administered in the participants' homes, included information on sociodemographic characteristics, living arrangements, social and behavioral risk factors. Based on participants' report of the highest year of school they had completed, educational attainment was categorized as 3 years or less, 4–5 years, 6–8 years, or more than 8 years. The occupation held for the longest period was recorded for all participants and categorized as farmers, blue-collar workers, white-collar workers, or housewives. Self-report of cigarette smoking was categorized as current, past, or never.

Assessment of diseases.—The presence of major chronic diseases was clinically assessed through an examination by a physician at the ILSA clinical center, including completion of EKG, spirometry, and retinography, and the review of clinical records. A fasting-blood sample was obtained at the home of the participants. For selected conditions the clinical diagnoses were confirmed by specialists, according to standard criteria, in a second phase of the study. The clinical confirmation was carried out within 15–21 days of the initial screening by a geriatrician (for CVD, diabetes, hypertension) or by a neurologist (for stroke, dementia, Parkinsonism, and distal symmetric neuropathy of the lower limbs). Arthritis was assessed by the physician at the clinical center through a physical examination of the limbs and a symptoms questionnaire. Those positive at this stage were considered as cases, without undergoing the second phase confirmation by the geriatrician. Signs and symptoms, as assessed by the physician, were therefore considered reliable enough to be used as definite criteria for the diagnosis. The severity of major conditions was assessed by standardized criteria. In particular, for heart failure we used the WHO dyspnoea questionnaire in carrying out ADLs (13), for dementia the ICD-10 criteria (15), for stroke the Rankin's scale (16), and for Parkinsonism the Hoehn and Yahr scale (17).

Assessment of disability.—Participants were classified as having a mild disability in the basic activities of daily living (ADLs) (21) if they reported that they needed help from another person in performing or were unable to perform one or two of the following activities: bathing, dressing, using the toilet, transferring from bed to chair, or eating. Moderate–total disability was classified when they needed help in performing three or more activities.

Vital status ascertainment.—Two years after the baseline assessment, all participants were contacted by telephone to determine the rates of hospitalization during the follow-up and to obtain information on vital status. For persons who had died or were unable to participate in the interview, information was collected from a proxy respondent. Cause-specific mortality data for all deaths were retrieved from the death certificates. In this study, only data on all-cause mortality are presented.

Data analysis.—To account for the equal allocation sampling and the different rates of response across centers, the prevalence rates of disability and its correlates were calculated by averaging the center-age-sex specific rates with weights determined by the ratio of the number of respondents to the sampling fraction of the stratum (22). The sociodemographic characteristics of the study population, by sex, were compared using the chi-square test.

To determine the independent association of education with disability, we calculated odds ratios from a multiple logistic regression model with level of disability as the dependent variable and education as the primary independent variable, adjusting for previously identified risk factors (age, sex, occupation, smoking status, number of diseases) and selected diseases (CVD, diabetes, hypertension, arthritis, dementia, stroke, Parkinsonism, peripheral neuropathy). We also performed a multiple logistic model with level of education as the outcome and disability status with the above listed variables as covariates.

Survival curves to determine the association of education and mortality for persons with lower education versus those with higher education were estimated using the Lifetest procedure (SAS Institute, Cary, NC) (23). Overall estimates of the relative risk (RR) of death were calculated from Cox proportional hazards regression models (SAS PHREG procedure) (23), adjusting for the other risk factors listed above.

Results

Table 1 shows the sociodemographic and health characteristics of the study participants. Women had a lower level of education than men ($p < .001$) and about 48% of them were housewives. Overall, about 26% of participants had disability in one or more ADLs (17% had mild disability and about 8% had moderate–total disability), with no significant difference between sexes. A trend of increasing disability with age was noted, and was significant ($p < .05$) in women (from 19% in the age group 65–69 to 32% among those 80–84 years old). Among both, men and women, farmers had the highest percentage, reporting 3 or less years of education (about 63% of them). White-collar workers had the lowest percentage, reporting 3 or less years of education (about 6%). Thirty percent of women who were housewives also reported this low level of education.

Women had a significantly higher prevalence of heart failure (7.3% vs 5.4%), hypertension (67.3% vs 59.4%), and arthritis (60.8% vs 51%), while men had a higher prevalence of myocardial infarction (10.7% vs 4.8%), arrhythmia (25.1% vs 20.3%), and peripheral arterial disease (8.1% vs 5.2%). No significant differences were detected in men and women for stroke (7.4% and 5.9%, respectively), dementia (5.3% and 7.2%, respectively), diabetes (13% in both sexes), Parkinsonism (3%), and peripheral neuropathy (6.5%) (data not shown).

Table 2 shows the distribution of level of education, occupation, and smoking habit by disability status in males and females. Participants with low educational level (≤3 years) had the highest percentage of disability (25.8% and 11.8% of mild and moderate–total disability in women, 26.7% and 12.4% respectively in men). About 40% of

Table 1. Sociodemographic and Health Characteristics by Sex

	Men $n = 1817$	Women $n = 1643$
Age (%)		
65–69 yrs	41.5	37.5
70–74 yrs	24.8	23.4
75–79 yrs	21.1	22.8
80–84 yrs	12.6	16.3
Education (%)*		
≤3 yrs	22.5	36.5
4–5 yrs	35.9	36.4
6–8 yrs	13.8	12.0
>8 yrs	27.8	14.8
Occupation (%)*		
Farmers	27.4	18.4
Blue-collar workers	35.8	18.1
White-collar workers	36.8	15.6
Housewives	—	47.9
Smoking habit (%)*	77.0	16.3
Disability Status (%)		
No disability	74.9	74.2
Mild disability†	17.4	17.1
Moderate–total disability‡	7.7	8.8

*Chi-square $p < .001$.

†Need for help from a person to perform one or two activities of daily living: bathing, dressing, using the toilet, transferring from bed to chair, or eating.

‡Need for help from a person to perform three or more activities of daily living.

Source: ILSA, 1992.

Table 2. Distribution of Level of Education, Occupation, and Smoking Habit by Disability Status

Women	Independent ($n = 1153$)	Mild Disability ($n = 261$)	Moderate–Total Disability ($n = 130$)
Education (%)*			
≤3 yrs	62.4	25.8	11.8
4–5 yrs	77.3	15.7	7.0
6–8 yrs	87.8	5.2	7.0
>8 yrs	94.8	3.8	1.4
Occupation (%)*			
Farmers	61.4	24.5	14.1
Blue-collar workers	74.7	17.0	8.3
White-collar workers	88.7	7.8	3.5
Housewives	77.1	16.1	6.8
Smoking habit (%)*	87.5	8.6	3.9
Men	($n = 1308$)	($n = 299$)	($n = 125$)
Education (%)*			
≤3 yrs	60.9	26.7	12.4
4–5 yrs	76.3	18.6	5.1
6–8 yrs	77.5	15.1	7.4
>8 yrs	88.6	6.5	4.9
Occupation (%)*			
Farmers	62.7	26.3	11.0
Blue-collar workers	77.0	17.7	5.3
White-collar workers	85.0	9.5	5.5
Smoking habit (%)*	76.2	16.2	7.6

*Chi-square $p < .001$.

Source: ILSA, 1992.

farmers had some level of disability, and compared to all other occupation categories farmers with lower education were at higher risk of being disabled ($p < .05$) (data not shown). Among smokers, 87.5% of females and 76.2% of males were independent in ADLs.

Disability outcome.—Table 3 shows the adjusted odds ratio for the association of ADL disability (one or more ADLs) with education, occupation, and diseases. In a forward stepwise logistic regression model including all covariates (age, sex, education, smoking habit, alcohol habit, number of diseases, and all chronic conditions listed above), only education, occupation, Parkinsonism, stroke, heart failure, and diabetes were significant predictors ($p < .05$). Higher level of education was associated with a decreased risk of disability compared to the reference group of persons with three or less years of education. A strong, statistically significant dose-response effect was observed, with the odds decreased by 30%, 60%, and 79% in those with 4 or 5, 6 to 8, and more than 8 years of education, respectively. Those participants who were either blue- or white-collar or housewives decreased their risk of being disabled by about 40% with respect to farmers. The probability of being disabled was about 7 times greater for persons with Parkinsonism and 3 times greater for those with stroke. Participants with heart failure were more than 2 times more likely to be disabled, and those with diabetes had their odds increased by 37%.

Dementia is strongly associated with disability, with greater than fivefold increased odds among persons aged 80 years or more. However, octogenarians with no dementia were more than 2 times as likely to have ADL disability.

Table 3. Adjusted Odds Ratios of ADL Disability by Level of Education, Occupation, and Diseases

	OR*	95% CI
Education		
≤3 yrs	1.00	
4–5 yrs	0.70	0.57–0.86
6–8 yrs	0.40	0.28–0.58
>8 yrs	0.21	0.14–0.32
Occupation		
Farmers	1.00	
Blue-collar workers	0.58	0.42–0.80
White-collar workers	0.62	0.48–0.79
Housewives	0.65	0.51–0.85
Diseases		
Parkinsonism	6.66	4.14–10.71
Stroke	3.04	2.20–4.20
Heart failure	2.13	1.54–2.96
Diabetes	1.37	1.05–1.77
Dementia × Persons aged ≥ 80 yrs	5.01	2.73–9.50
Age ≥ 80 yrs × Persons with no dementia	2.48	1.91–3.21

*From a single forward stepwise logistic regression model, adjusted for sex, smoking habit, alcohol habit, ischemic heart disease, arrythmia, angina, peripheral arterial disease, hypertension, peripheral neuropathy of lower limbs, arthritis, number of diseases.

Source: ILSA, 1992.

Education outcome.—Table 4 analyzes the association of all variables with education. Persons aged more than 75 years, those with some level of disability, or with dementia or heart failure are more likely less educated, whereas blue- and white-collar occupations and housewives, comorbidity, and smoking habit appear to be associated with higher level of education. No significant interactions were found.

Mortality outcome.—During the 2-year follow-up, 426 deaths occurred among the ILSA participants. Death rates were significantly lower among persons with 4 or more years of education compared to those with less education (Figure 1).

The continuous and graded relation observed for education and disability was also observed for mortality, although small numbers within the strata of education limited the statistical power. However, after adjusting for age, sex, and disability status, education was no longer associated with mortality (RR = 0.97, CI = 0.65–1.43), whereas disability was strongly associated with increased risk of mortality (RR = 2.77, CI = 2.14–3.59).

Discussion

This study provides strong evidence of the protective effect of a higher level of education on the estimated risk of disability in older Italians. Although older Italians in this study achieved significantly lower levels of education than those typical for older Americans, we found a strong gradient of association with disability. Specifically, older persons with 8 years or more of education had 79% lower estimated

Table 4. Adjusted Odds Ratios of Low Level of Education (≤3 yrs) by Age, Occupation, Number of Diseases, Smoking Habit, Disability Status, and Diseases

	OR*	95% CI
Age (≥75 yrs)	1.74	1.44–2.08
Occupation		
Farmers	1.00	
Blue-collar workers	0.08	0.06–0.11
White-collar workers	0.35	0.28–0.43
Housewives	0.27	0.22–0.34
Number of diseases		
None	1.00	
One disease	0.71	0.57–0.88
Two or more diseases	0.86	0.70–1.05
Smoking habit	0.39	0.33–0.47
Disability status		
No disability	1.00	
Mild disability	1.80	1.44–2.25
Moderate–Total disability	1.35	0.94–1.95
Diseases		
Dementia	1.70	1.18–2.44
Heart failure	2.26	1.41–3.59

*From a single forward stepwise logistic regression model, adjusted for sex, alcohol habit, ischemic heart disease, arrythmia, angina, peripheral arterial disease, hypertension, stroke, Parkinsonism, diabetes, peripheral neuropathy of lower limbs, arthritis.

Source: ILSA, 1992.

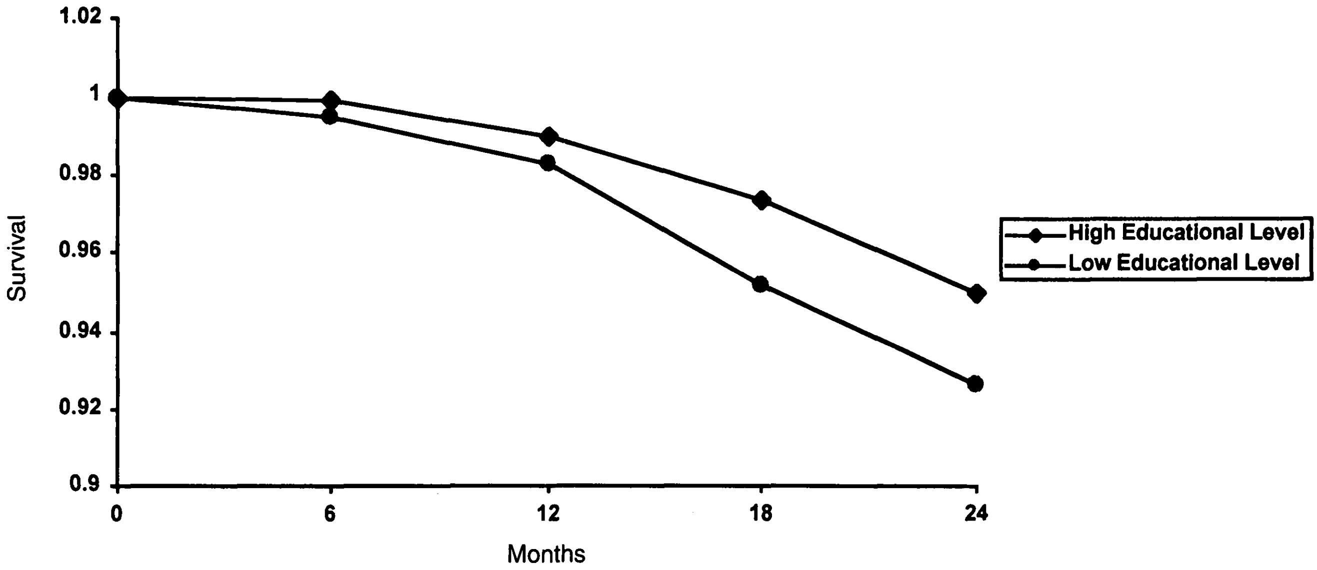

Figure 1. Two-year survival rates, by educational level (source: ILSA, 1992).

risk of ADL disability, even after controlling for occupation, smoking habit, chronic diseases, comorbidity, sex, and age. Of course, occupation is strongly related to education, and higher educated individuals are mainly in the white-collar category. We found that farmers, who are also the lowest educated group, are at higher risk of disability. However, we did not find an interaction between education and occupation in predicting disability, and these results are puzzling. A possible interpretation is that there are other factors affecting disability and the interaction between these two variables, such as socioeconomic status (SES), for which we cannot control in this study. SES has been shown to be a significant predictor of morbidity and mortality (6,8), and often it does not reflect the occupational status. There are, particularly among older women, individuals with low education who are very wealthy, due to their spouse's income, and they live in a very healthy and wealthy environment.

Although similar findings on the association with education and disability have been reported previously for other populations, mainly from the U.S. (9–12), to our knowledge these are the first reported for Italy. Moreover, a major strength of our study was the ability to control for clinically assessed diseases and comorbidity.

Because access to health care is universal in Italy, it is unlikely that lack of access to health services among Italians with lower levels of education could explain these findings. However, the use of services might still be lower among lower educated persons, who might be less likely to seek medical care for preventive measures or for early symptoms detection. If this is true, our findings could, indeed, be explained by the relationship between disability and disease severity. Specifically, persons with lower levels of education may have disease onset earlier in life or may be diagnosed at more advanced stages of disease and, thus, at higher severity levels, leading to greater disability. This is confirmed also by the findings that in our sample only about 12% of participants with severe stages of dementia, Parkinsonism, stroke, or heart failure had more than 8 years of education, while about 50% had 3 years or less. Among those without the diseases or with mild symptoms, about 35% had more than 8 years of education. Moreover, higher degree of severity was related to moderate–total disability, and more than 75% of persons with severe dementia, Parkinsonism, stroke, and heart failure were from moderately to totally disabled.

The number of conditions was not associated with disability and was actually positively associated with years of schooling. This might be due to the fact that better educated participants might have more conditions, but at a less severe stage, simply because this group more often uses health care services and is diagnosed at earlier stages of disease. Data from the U.S. National Center for Health Statistics, show that years of schooling are positively associated with the incidence of acute conditions, perhaps because of the greater use of health services by better educated individuals, but negatively associated with days spent in the hospital, days of restricted activity, and number of hospital discharges (24). Smoking did not predict disability, and it was significantly associated with higher level of education in our sample. To the contrary of what is currently seen in younger generations, among older Italians smoking is more frequent among educated individuals of high SES (18).

The association of a low education level with disability and disease severity may also be a potential explanation for the inverse association of level of education and mortality reported in previous studies (1–4) and is clearly shown by our unadjusted results. That persons with lower education have higher levels of disability and a clear mortality gradient according to the degree of disability has been reported previously (25,26,27) and confirmed by our data. Indeed, when we controlled for disability status, education was no longer associated with mortality. These results support the hypothesis that the higher mortality risk in older Italians with a lower education level could be due to their higher prevalence of disability, which is on the causal pathway between education and mortality. A likely explanation for our findings is that education is related to disability and thus to mortality through a complex association involving lifestyle, sensitivity to health promotion and disease prevention issues, biological, and socioeconomic factors. Scientific evidence supports an inverse relationship between education and blood pressure, and serum cholesterol (28), and a positive association of education with more frequent exercise, better diet, and health knowledge (29).

Our study has some limitations that may affect the generalizability of our findings. First, we lacked standardization for the diagnosis of arthritis, a major cause of disability that may also be related to level of education (6). While diabetes, cardiovascular, and neurologic conditions were identified by a physician as part of a general health assessment in the first phase of the study, and then diagnosed by a specialist in the second phase of the study, arthritis was assessed only by the general health assessment. However, the prevalence of arthritis (62% in women and 50% in men) in our study is similar to that reported in another national sample in Italy (18). Second, the ILSA study population may not be representative of the general Italian population. Although the selected centers are representative of the eight regions included in the study, and they are distributed in Northern, Central, and Southern Italy, in both rural and urban areas, the study population is not a random national sample. However, the distribution of sociodemographic characteristics among older Italians in the ILSA, including level of education, living arrangements, and occupations, is similar to that reported by the National Institute of Statistics (18) for the whole country, supporting the representativeness of our sample. Moreover, as far as the inclusion of subjects in different levels of disability is concerned, we are confident about the representativeness of our sample. If, indeed, some subjects were unable to go to the study's clinical center, due to health or mobility problems, they were examined at home by a physician. This approach guaranteed the inclusion of the most severely disabled; they, indeed, represented about 6% of the overall sample.

Finally, the data on disability and education are based on a cross-sectional study. It is therefore impossible to ascribe causality to the association found, and longitudinal studies would be needed to confirm any cause-effect relationship between level of education and incident disability.

In conclusion, our data revealed a strong, inverse association between educational level and disability, independently of major chronic diseases. In relation to mortality, our data support an effect of education mediated by disability. Thus, it is likely that the association reported in previous studies (1–4) is due to the association of lower education levels with greater severity of diseases and, thus, with the greater prevalence of physical disability among older individuals. If it is true, that lower education is related to an earlier onset of diseases or a delay in their diagnosis, leading to decreased survival and increased disability, lower education is a relevant, modifiable risk factor for both disability and mortality. Improvement in the level of education of a population might, therefore, be an important step—increasing the likelihood of a healthier lifestyle and greater sensitivity to health issues earlier in life, leading to an increase in disability-free and total life expectancy.

ACKNOWLEDGMENTS

As part of the Progetto Finalizzato Invecchiamento, the ILSA was supported by the Italian National Research Council, with annual grants to each research unit from 1991 through 1995. The Epidemiology, Demography, and Biometry (EDP) program, National Institute on Aging, National Institutes of Health, provided a visiting fellowship to Dr. Maggi during the preparation of the manuscript for this article.

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Received July 14, 1997
Accepted March 18, 1998