ORIGINAL ARTICLES

Decreasing prevalence of disability in activities of daily living, functional limitations and poor self-rated health: a 6-year follow-up study in Spain

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ABSTRACT. ***Background and aims:*** *Forecasting functional status in elderly populations is uncertain. Our aim is to provide evidence of population trends of Activities of Daily Living (ADL) disability, functional limitations and self-rated health.* ***Methods:*** *Data come from a longitudinal study of aging in Leganés (Spain), collected in 1993, 1995, 1997 and 1999, on a representative sample of 1560 community dwelling people over 65. Response rate at baseline was 82%. ADL disability was defined as needing help in at least one of the following: walking across a small room, taking a shower, toileting, getting out of bed, getting up from a chair, using the toilet, dressing and eating. Functional limitations were based on questions of difficulty with upper and lower limbs. Self-rated health was assessed with a single question. ADL disability, functional limitations and self-rated health were regressed on age, survey year, sex and education.* ***Results:*** *There are significant declines in ADL disability, functional limitations and poor self-rated health at every age and up to very advanced ages. Over 90, the ADL disability trend may be reversed, with the emergence of a very old and disabled population. Women and people with little education have a higher prevalence of disability, functional limitations and poor health, when compared with men and those with higher education.* ***Conclusions:*** *Results suggest the postponement of severe disability onset in this Spanish population, leading to longer healthy life expectancy, and support the emergence of a very disabled population over 90 years of age. (Aging Clin Exp Res 2006; 18: 352-358)*

INTRODUCTION

Disability declines have been reported in the population over 65 in the United States, Japan, France and Germany; data from Sweden, the United Kingdom and Canada are less conclusive (1-3). In Australia, slight or no improvement in disability prevalence has been observed (4). In the Netherlands, improvements are hard to observe, since disability levels are among the lowest in the world (5). No significant changes in disability in Finland and declining disability prevalence have been reported in Spain (7). The CLESA collaborative study reports longer life expectancies and lower disability-free life expectancy in the older populations of Southern Europe than those in Northern Europe (8). To our knowledge, there is no report using longitudinal data on functional trends of the older population in Southern Europe.

Forecasting disability is needed within different geographic, cultural, socioeconomic and medical contexts (9). Robine and Michel have proposed a model of disability transition, in order to understand the dynamics between longevity, morbidity and disability (9). In the first stage of this transition, disability prevalence in old age increases as people survive in a less healthy state, suffering from multiple chronic diseases. In the second stage, there is compression of morbidity, due to better living conditions and improved management of chronic diseases; severe disability decreases as increases in mild or moderate disability are observed. In the third phase, there is an increase in the number of centenarians and an emerging frail population of very advanced age. Guralnik believes that, while the model of population aging of Robine and Michel is

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provocative, it requires more empirical evidence (10). Research results providing evidence for the three scenarios of their model are beginning to be published (7, 11).

In Spain, a rapidly changing society, we argue that, in accordance with Robine and Michel's framework, three main forces drive changes in the functional status of older populations: 1) improvements in the health status of successive cohorts, due to better access to material and social resources along the entire lifespan; 2) better management and control of progression of chronic diseases through a national health system with universal insurance for drugs and medical care; 3) the emergence of a community-dwelling, very disabled population, due to increased life expectancy and the availability of extensive family care.

In this paper, we provide evidence to test the Robine and Michel's model in a Southern European country, and examine trends in Activities of Daily Living (ADL) disability, functional limitations and poor self-rated health using longitudinal data from a community-dwelling population above age 65 living in the outskirts of Madrid with a six-year follow-up (1993 to 1999).

METHODS

Participants

Data come from the longitudinal study "Aging in Leganés". The study population was a random sample of community-dwelling people over 65 living in Leganés, a suburb of Madrid (12). The sample was drawn from the municipal roll according to 13 equal-size strata of two years of age (65-66, 67-68….89 and over), separately for men and women. The total number of eligible subjects in 1993 was 1560.

Marital status and the age and sex distributions of the 1993 Leganés sample are similar to those of the population of Spain over 65, according to 1991 national census data. Education in this elderly population is low. Illiteracy (17%) is as frequent as in most areas of North-west, Southern and Central Spain, and higher than in North-east Spain, the Basque country, Madrid or Catalonia.

Baseline data were collected in 1993 and at follow-up in 1995, 1997 and 1999, at respondents' homes. Response rate at baseline was 82% (n=1283); 277 selected individuals could not be reached for interview after three attempts. Completed questionnaires were 906 in 1995, 758 in 1997, and 520 in 1999. People who missed one data collection were allowed to re-enter the sample at future waves; 372 subjects participated in all four occasions, 314 at three, 315 at two, and 406 at one. Cumulative death rates in the total cohort (n=1560) were 11.7% in 1995, 21% in 1997, and 33.7% in 1999.

Measurements

ADL disability was defined as having restriction in at least one activity of daily living (ADL) associated with the need for personal help. The list of daily activities included was: walking across a small room, taking a shower or bath, toileting, getting out of bed, getting up from a chair, using the toilet, dressing and eating.

Four questions assessed functional limitations, i.e., stooping/kneeling, reaching/extending arms, pulling /pushing large objects like chairs, and handling or picking up small objects (13). Each question had four possible answers: no difficulty, slight difficulty, great difficulty and unable to do it. These questions were combined into two categories to distinguish those who had great difficulty or were unable to do any of the four activities.

Self-rated health (SRH), a valid indicator of health status (14, 15), was measured by a single question ("How would you rate your health?"), with five possible responses, "very good", "good", "fair", "poor", "very poor". Since self-rated health is a highly skewed variable, subjects were classified into one of two groups (good and very good=0 *vs* fair, poor and very poor=1).

Mortality follow-up was completed through the vital statistics registry of the Community of Madrid. Leganés cohort data were matched to death certificates on first name, two family names, as used in Spain, and date and place of birth up to December 31, 2000. Only 9 out of the 1560 subjects could not be matched correctly to determine their vital status.

Statistical analysis

Repeated measurements of the same subject are correlated, and multilevel models are usually used to take this correlation into account. However, in our study, the number of observations per subject was small (49% of subjects with three or four observations). Using a random effects multilevel model to fit this data would lead to unreliable estimates of the random effect covariance matrix. We therefore chose, to fit a logistic regression with fixed effects (i.e., the relation between outcome variable and explanatory variables is the same for every subject). Three series of analysis were carried out separately, to estimate the probability of ADL disability, functional limitations and poor self-rated health.

In these models, age is entered as an explanatory variable of individual change (level one); year of survey (using three dummy indicators), sex and education are entered at level two, as explanatory variables of between-subject variability. We hypothesize that sex, education and year of survey will influence the intercept of the model (outcome value at entry) and the slope. The quadratic function of respondent's age was tested, but was not found to be significant. Thus, the following equations were used:

$$\ln (p/1\text{-}p) = \beta_0 + \beta_1 * \text{age} + \varepsilon$$
$$\beta_0 = \gamma_{00} + \gamma_{01} * \text{year95} + \gamma_{02} * \text{year97} + \gamma_{03} * \text{year99} + \gamma_{04} * \text{sex} + \gamma_{05} * \text{education}$$
$$\beta_1 = \gamma_{10} + \gamma_{11} * \text{year95} + \gamma_{12} * \text{year97} + \gamma_{13} * \text{year99} + \gamma_{14} * \text{sex} + \gamma_{15} * \text{education}$$

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Table 1 - *Distribution of participants in 1993 survey. Weighted percentages.*

	Men (n=649)	Women (n=634)	Totals (n=1283)
Primary education	27.7	14.2	19.9
ADL disability	17.4	32.2	26.0
Functional limitations	10.7	23.5	18.1
Poor self-rated health	58.5	75.8	68.5

Table 2 - *Logistic regression coefficients to estimate population-average estimates of ADL disability prevalence.*

	Coefficient	Standard error
Intercept		
Constant	-2.65	0.27
Sex (women vs men)***	0.665	0.087
Education *** (at least primary vs less than primary education)	-0.428	0.012
Year 95 vs Year 93	-0.254	0.293
Year 97 vs Year 93	-0.129	0.278
Year 99 vs Year 93**	-0.849	0.256
Slope		
Age	0.123	0.014
Age by Year 95	0.011	0.016
Age by Year 97	-0.003	0.016
Age by Year 99*	0.027	0.015

***$p<0.001$; **$p<0.05$; *$p=0.06$

The HLM 5.0 software programme was used (16). Bernouilli distribution, with logit link function for level 1 variables and estimation of the over-dispersion parameter, was used. Since the model does not contain random effects, estimates with the Unit-specific model and Population average model are the same (17). Note that age was centered at 65 years (age of inclusion in the study) in order to interpret clearly the meaning of the intercept and the coefficients of the models.

RESULTS

Education, ADL disability, functional limitations and poor self-rated health of participants in 1993 are shown in Table 1 (n=1283). Of the 277 who did not participate at baseline, 111 participated at least once in later data collections.

Trends in ADL disability prevalence (Table 2, Fig. 1)

At every age, the probability of ADL disability is higher among women than among men and among those who had not completed primary education compared with those who had. The probability of being disabled at any given age is significantly lower in 1999 than in 1993. This difference between 1999 and the first wave of the study decreases with increasing age. The curves cross after age 90, but the sample size at these advanced ages limits precision. There were 17 disabled men, and 24 dis-

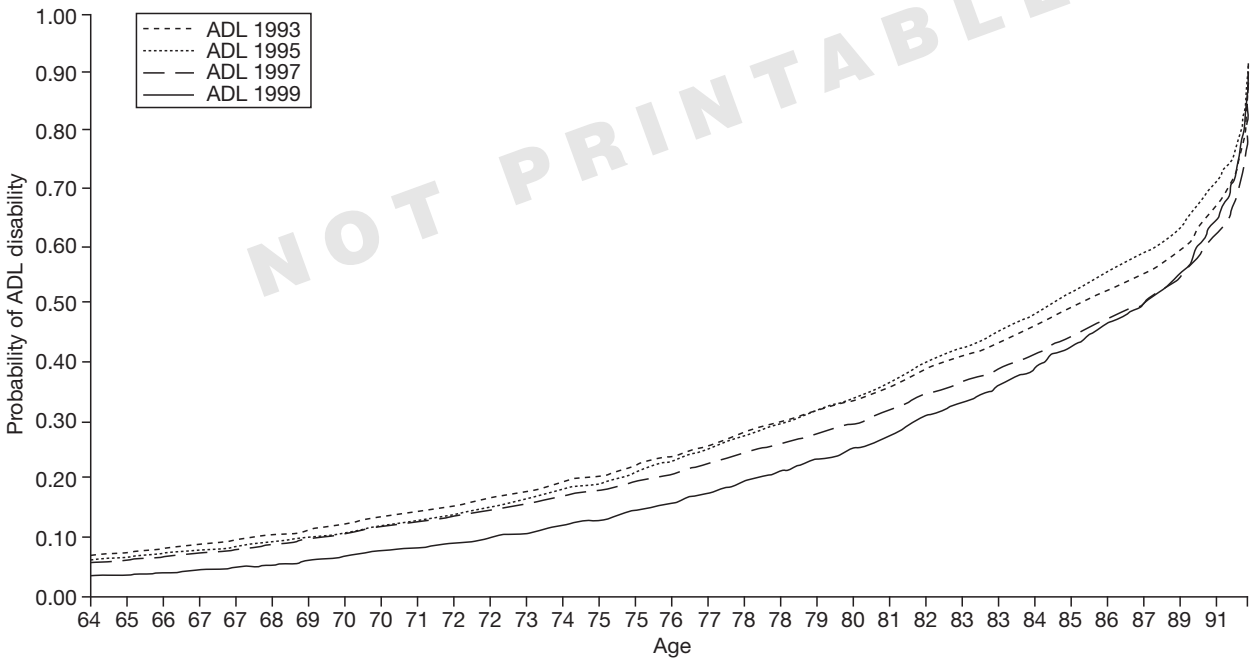

Fig. 1 - *Probability of ADL disability by age and year of survey: men with less than primary education.*

Table 3 - *Logistic regression coefficients to estimate population-average estimates of prevalence of functional limitations.*

	Coefficient	Standard error
Intercept		
Constant	-1.890	0.166
Sex (Women vs Men) ***	1.471	0.173
Education ** (less than primary vs at least primary)	-0.314	0.097
Year 95 vs Year 93	0.114	0.105
Year 97 vs Year 93	0.002	0.097
Year 99 vs Year 93***	-0.402	0.086
Slope		
Age	0.091	0.007
Age by Sex **	-0.024	0.011

***$p<0.001$; **$p<0.01$; *$p<0.05$

abled women, 14 non-disabled men and 6 non-disabled women over 90 in 1993, and similar sample sizes over 90 years of age at later waves. The *p* value for the effect of the year 1999 on the age slope is 0.06.

Trends of functional limitations (Table 3, Fig. 2)

Similar results are observed for functional limitations, whereas differences between 1999 and the first waves of the study are even more pronounced. However, there are no effects of the year of survey on the age slope. The lines for 1995 and 1997 are almost identical and indistinguishable in the figure. Women have a more accelerated functional decline with advancing age compared with men. Note that, at age 65, women's OR for functional decline compared with that of men is exp (1,471)=4.35, whereas at age 90, it is exp (1.471+0.091*25-0.024*25)=23.2.

Trends in self-rated health (Table 4, Fig. 3)

There is a significant period trend in which self-reported health continuously and significantly improved in the sample population from 1993 to 1999. Women and low-educated subjects report significantly worse health than men and more educated people. In addition, among men, self-rated health does not change significantly with increasing age, whereas among women, the probability of reporting poor health decreases with advancing age ($p=0.04$).

Possible effects of losses to follow-up on prevalence estimates

Losses to follow-up, due to subjects moving out of the area, may have biased the sample, if those who moved did so for health or disability reasons. We examined both mortality and health differences among those who participated, and those who refused, or were lost to follow-up at each wave. In 1999, the mortality of those who refused participation in 1997 or were lost to follow-up was 15.4%, whereas that of those who had completed the in-

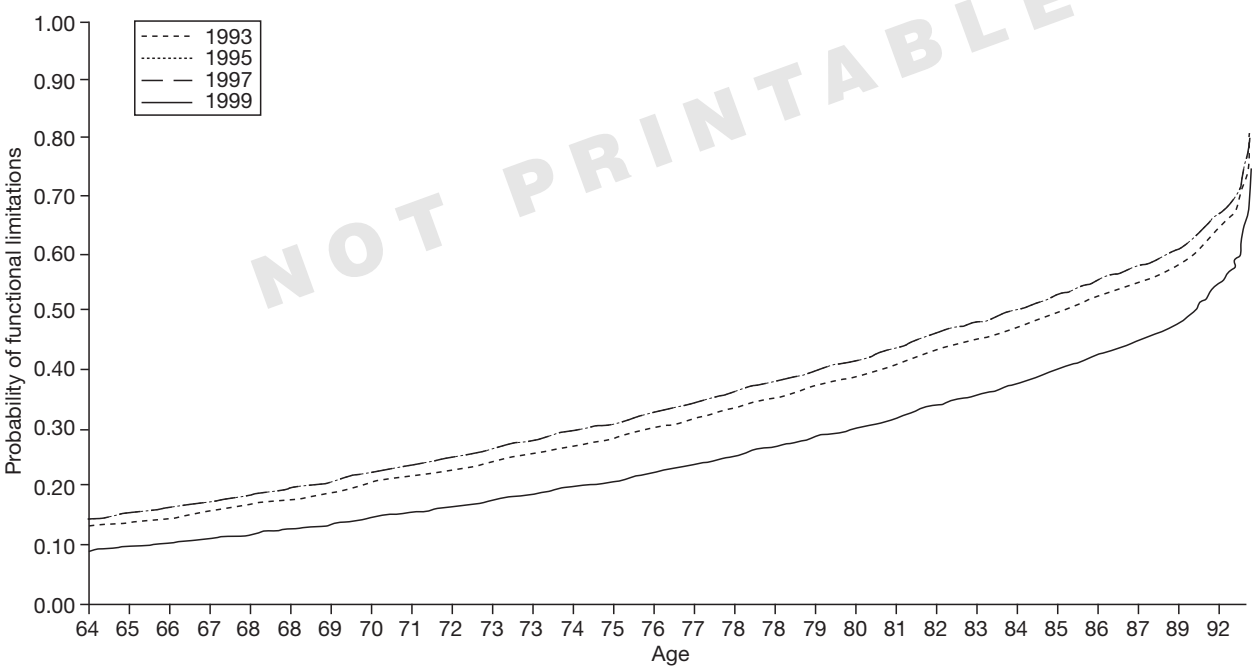

Fig. 2 - *Probability of functional limitations by age and year of survey: men with less than primary education.*

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Table 4 - *Logistic regression coefficients to estimate population-average estimates of prevalence of poor self-rated health.*

	Coefficient	Standard error
Intercept		
Constant	0.787	0.148
Sex (Women vs Men)***	0.846	0.160
Education***		
(at least primary vs. less than primary education)	-0.524	0.088
Year 95 vs. Year 93	-0.062	0.104
Year 97 vs. Year 93*	-0.216	0.097
Year 99 vs. Year 93***	-0.338	0.083
Slope		
Age	-0.001	0.007
Age by Sex*	-0.023	0.010

***$p<0.001$; **$p<0.01$; *$p<0.05$

terviews in 1997 was 16.5%. The same observations were drawn for 1995-1997, when mortality differences were not significant (10.4% for those who participated in 1995, and 10.8% for those who refused or were lost to follow-up). There were no significant health or disability differences between those who continued participation and those lost to follow-up in the period 1993-1997 (18). Institutionalization during the six-year study period was rare (0.7%/year) and was related to low income, being single or suffering from depression but not to disability or self-rated health.

DISCUSSION

This research provides empirical evidence for the compression of morbidity and the postponement of severe disability to more advanced ages. In Leganés, there is a decline in ADL disability prevalence, functional limitations and poor self-reported health and a probable delay of onset of ADL disability. In this population, there is a clear improvement in the health status of new cohorts of elderly people and the emergence of a very old and disabled population. In terms of the disability transition model proposed by Robine and Michel (9), this Spanish population may be at a stage between morbidity compression and morbidity expansion.

The observed trends are too rapid to be attributable to genetic changes (19). Many reasons may be invoked, stemming from the many social changes occurring in the last half of the 20th century, particularly since the advent of democracy in 1975: the increase in the gross national product, universal access to nutrition and clean water, reduction of infectious diseases, universal public education, and a national health system with universal coverage and improvements in medical diagnosis and treatment (20). The Leganés population provides a case in point. Leganés was small until the 1960's, when migrants from the rural west and south of Spain came to Madrid looking for work. In addition to the overall socioeconomic change in Spanish society, the Leganés population may have undergone an overlapping change, as-

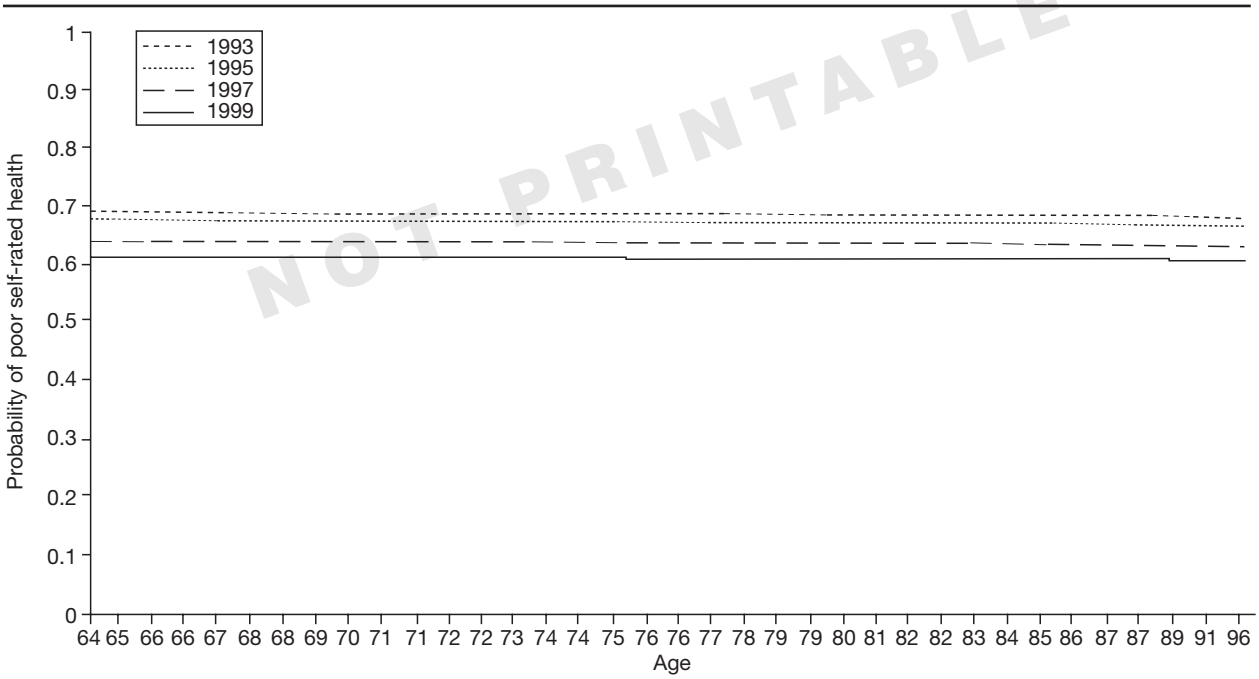

Fig. 3 - *Probability of poor self-rated health by age and year of survey: men with less than primary education.*

sociated with urbanization and inclusion in a more economically advanced society, with better access to goods and more diversified nutrition. The close-knit family structure, which provides social networks, has also been preserved by aggregation of migrant family members in nearby neighborhoods. The elderly of Leganés may represent a population with a high probability of experiencing an improvement in health and a disability decline, so that caution is advised when extrapolating these results.

The steeper disability decline in the younger age groups and the delayed onset of disability is consistent with the diminished capacity of recovery at advanced ages. We have already reported that, compared with the youngest group, those 75 and over were more likely to remain dependent and had lower rates of restoration of function during a two-year follow-up (12).

Functional limitations decreased at every age. These results coincide with those reported by Freedman et al. on the trends of functional limitations in the US (20). Self-rated health is quite stable with age, and improved during the study period. This fact is in agreement with economic improvements in Spain, since socio-economic factors are strong determinants of self-reported health status (21-24) and with results for the US population (25). A recent study has shown improvements in self-rated health for men and women between 25-69 years of age in 10 countries in Europe. However, we did not find comparative data for Europeans over 70 years of age (26).

Most authors find that the effect of sex on ADL disability and health-related quality of life is largely explained by social and health-related variables (27-29). Several researchers have argued that increasing the level of education in a society is the driving force of disability decline. Guralnik et al. provided evidence on the dramatic differences in active life expectancy due to individual education level (30). Increasing the education level in a population leads to increased knowledge of how to avoid health risks and of how to gain access to material and social resources during the life-span (31). More recent research has shown that US disability declines are more pronounced in the most educated elderly persons, and declines in disability prevalence are stemming from gains in education: 65% of the reduction in disability was explained by education (32). In Leganés, a strong association between ADL disability and education was observed. However, the rate of change in ADL disability was not related to education, probably due to the narrow education range in Leganés, going from illiteracy to complete primary school, and to the relatively short period of observation.

Cultural aspects may influence the perceptions of disability, and elderly people may be less willing to accept dependence today than they were several years ago, since values of autonomy are becoming more accepted as society evolves from that of the traditional family to a more individualistic one. However, the time needed for these cultural changes to operate on disability reporting is probably longer than the six years covered by this study (33).

Loss to follow-up and refusals probably did not influence our results, since persons in these categories underwent the same mortality, and did not differ from participants in health status or disability at baseline.

The findings of this study may give an over-optimistic view of the future. There is an improvement in ADL ability, functional and health status among elderly people living in Leganés, and several issues need to be considered when extending these results to a wider community. External validity is questionable in population studies based on specific locations. For example, institutionalization of people over 65 in Spain is fairly uncommon, although it increased from 2.7 in 1993 to 3.1 in 2001, and this may also reflect the Italian, Greek or Portuguese scenarios. Comparison with the literature from the United States and Europe is difficult, due to differences in the socio-demographic composition of our sample, its social organization, family structure and living arrangements, and in the nature of health and long term care systems.

Postponing disability will lead to a lower number of disability years per person in early old age, but the number of people who reach advanced ages will increase (10). This increase in the population at risk of becoming disabled at advanced ages may balance and even surpass the benefits of postponing severe disability.

The Leganés study provides evidence of a decline in ADL disability, functional limitations and poor self-rated health. Results may be valid for Southern Europe with similar age, sex and education, in the context of social and economic transformations.

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