

Relationship among Age, Education and Frailty in Older Persons

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Abstract

Preliminary data suggest that frailty tend to increase with age and is associated with fewer years of formal education. However, it is still unclear whether age and education synergistically act in the definition of frailty. Aim of the study is to evaluate the interaction between age and education in defining frailty in community-dwelling older persons. We considered 911 community-dwelling older adults (mean age 79.5 years) who underwent a comprehensive geriatric assessment. Our results showed that education and age interact in the definition of frailty following an exponential-type relationship. Whereas age is a non-modifiable risk factor, much can be done to address the social component of frailty here represented by education. The reported interaction suggests that social interventions might be particularly effective at an older age, paving the way for multidisciplinary interventions beyond the clinical field.

Key words: Prevention, geriatrics, frailty, older persons, social care.

Introduction

Frailty is a state of increased vulnerability to stressors which is highly prevalent in the older population (1, 2). One of the most widely used instruments to measure frailty is the so-called Frailty Index (FI), derived from the “deficit accumulation model” proposed by Rockwood and Mitnitski. In this model, frailty is defined by the age-related accumulation of symptoms, unhealthy behaviors, clinical signs, diagnoses, and functional limitations that plausibly contribute to poor health states (3). The FI has shown to be associated with a wide spectrum of adverse health-related outcomes (2).

Recently, the World Health Organization recognized age and education as “social determinants of health” (SDH), non-medical factors that influence health outcomes (4). Preliminary data suggest that frailty is more prevalent in people with fewer years of formal education and older age (5). However, it is still unclear whether age and education synergistically act in defining frailty.

The aim of the study is to evaluate the interaction between age and education in the definition of frailty in community-dwelling older persons.

Methods

Study population

The present analyses were conducted in 911 community-dwelling older adults enrolled in a registry study on memory complaints in older persons. The local Ethics Committee authorized the data collection and its use as part of a clinical registry. Patients (or proxies as appropriate) provided written informed consent.

All participants underwent a Comprehensive Geriatric Assessment (CGA). The level of education of the patients was self-reported or reported by the caregiver during the interview. Patients were divided into three groups according to the standards of the Italian education system: low (i.e., primary or no education: ≤ 5 years), intermediate (i.e., secondary: 6-8 years), or higher (high school or university: ≥ 9 years) educational level.

Frailty was measured using a 25-item FI, following the standardization criteria described by Searle and colleagues (6). Each health deficit included in the FI was coded ‘0’ to indicate the absence of the deficit or ‘1’ when the deficit was present. The FI was computed as the ratio between the number of deficits presented by the individual and the total number of health deficits considered ($n = 25$). Missing values for the variables included in the FI were taken into account in the computation of it by accordingly modifying the denominator.

Statistical Analysis

A linear regression model with interaction term was performed to assess the relationship between frailty (dependent variable) with education and age [(FI = $\alpha + \beta_1(\text{age}) + \beta_2(\text{education}) + \beta_3(\text{age} \cdot \text{education})$)]. The model was corrected by sex.

A $p < 0.05$ was considered as the threshold for statistical significance. R studio statistical package (Version 2022.12.0+353) was used to conduct the statistical analyses.

Results

Of the 911 patients included in the database, 70 were excluded because of missing values for education and/or a relevant number of FI items (i.e., $\geq 20\%$ of the FI items were

Table 1. Linear regression analysis exploring the association of age and education with predicting frailty FI adjusted by sex

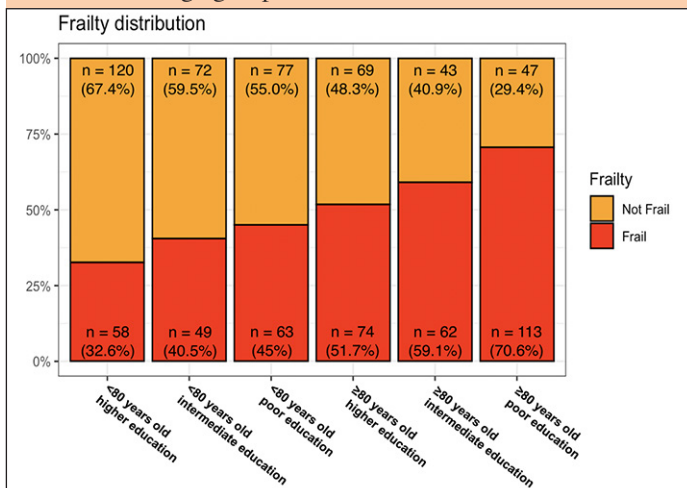
	Estimate	Standard Error	P Value
≥ 80 yo with poor education (Intercept)	0.320	0.010	
≥ 80 yo with intermediate education	- 0.028	0.014	0.056
≥ 80 yo with higher education	- 0.044	0.013	<0.001
< 80 yo with poor education	- 0.046	0.014	<0.001
< 80 yo with intermediate education	- 0.079	0.013	<0.001
< 80 yo with higher education	- 0.108	0.008	<0.001

Abbreviations: FI, Frailty Index; yo, Years Old; Poor education (i.e., primary or no education: ≤ 5 years); intermediate education (i.e., secondary: 6-8 years); higher education (high school or university: ≥ 9 years).

missing). The mean age of the sample was 79.5 (standard deviation, SD 5.83; range 50-95) years; 574 patients (64%) were women; 34.6%, 26.6%, and 38.8% had low, intermediate, and high education, respectively. Persons with low education were more dependent on activities of daily living than those with higher education. Moreover, they also presented a higher prevalence of sleep disorders, constipation, gait disturbances, cognitive impairment, and weight abnormalities.

The mean FI score was 0.27 (SD = 0.12), with a median of 0.24 (interquartile range, IQR = 0.17-0.33). The highest FI value was 0.63, consistent with the 0.7 limit suggested by previous studies (6) as the maximum value compatible with life. No significant difference was found in the mean FI between women (0.27 [SD 0.12]) and men (0.26 [SD 0.12]) (p-value 0.24). The mean FI value was higher in people aged ≥ 80 years old (mean FI = 0.30 [SD 0.12]) compared to younger persons (mean FI = 0.24 [SD 0.11]) (p-value < 0.001). Frailty was higher in people with low (0.30 [SD = 0.13]) compared with those with high (0.24 [SD = 0.11]) education (p-value < 0.001). The prevalence of frailty (FI ≥ 0.25) was the highest in the group composed of older people with low education, decreased with age and increased with education (Figure 1). Education level and age were associated with the FI, also after adjustment for sex (Table 1). A linear regression model showed a significant interaction between age and education in predicting frailty (interaction term: p-value <0.001).

Figure 1. Distribution of frailty in the population according to education and age groups



Poor education (i.e., primary or no education: ≤ 5 years); intermediate education (i.e., secondary: 6-8 years); higher education (high school or university: ≥ 9 years).

Discussion

The present study found a synergistic action between age and education in predicting frailty. Whereas age is a non-modifiable risk factor, the social component of frailty (here represented by education) may provide opportunities to prevent the disabling cascade.

In the last decade, much has been done to promote education in the European Union (EU). According to the EUROSTAT data, in the EU countries, the overall share of early leavers from education and training (individuals aged 18-24 who have completed, at most, a lower secondary education) fell by 3.5% points between 2011 and 2021 (7). However, there is still margin to improve, especially in those Countries with the highest share of early leavers, like Romania (15.3%), Spain (13.3%), and Italy (12.7%) (7).

Several studies demonstrated that low education could lead to worse choices regarding unhealthy behaviors (i.e., smoking, binge drinking, and dietary habits) (8, 9). The World Health Organization’s (WHO) framework for Health Promoting Schools recognized the need to nest preventive strategies for healthy ageing through the direct interventions on health (e.g., by modifying school policies, improving catering or encouraging staff and students to walk or cycle) (9).

Raising awareness about aging and age-related health conditions, reducing environmental barriers, facilitating access to care, and supporting universal health coverage may all represent actions that may address social inequalities and prevent frailty.

Frailty is a complex syndrome that cannot be independently explained by biological or social factors but rather by their interaction. Our results showed that education and age interact in the definition of frailty following an exponential-type relationship, as suggested by the significant interaction term we reported from our model. Our findings were confirmed also when different categorizations were applied to the age variable, suggesting the existence of the reported interaction. This may imply that social interventions might be particularly effective among the oldest persons, paving the way for multidisciplinary interventions beyond the clinical field.

The analyses are limited by the cross-sectional nature of our study which does not allow for the definition of the cause-effect relationship of the associations. At the same time, our data come from a registry study on memory complaints in community-dwelling older adults. Our findings may thus

have limited generalizability to the broader population of older persons. In our database, education was reported as a categorical variable rather than in terms of completed years of education, affecting our capacity to conduct more in-depth analyses. Finally, the complexity of social domain and its capacity to impact on frailty may not fully be explained by education. Further studies are thus required to confirm our findings and explore the association of interest more in depth, for example considering different aspects of social living (such as long-life psychological support and cognitive stimulation subordinate to social interaction). These results may further reinforce the usefulness of social intervention in older age.

In summary, frailty is a multidimensional condition of older persons, requiring a comprehensive approach to be adequately disentangled in its causes and contributors. The active role played by social aspects (i.e., education) in the frailty definition implicitly indicates the need to extend strategies for its prevention beyond the purely clinical field. Preventive interventions should be implemented from a young age to reduce social barriers and promote a healthy lifestyle.

Conflict of Interest: On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical standards: The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, Italy) and with the Helsinki Declaration of 1975, as revised in 2000.

References

1. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. *Lancet Lond Engl*. 2013. Doi: 10.1016/S0140-6736(12)62167-9
2. Mitnitski AB, Mogilner AJ, Rockwood K. Accumulation of deficits as a proxy measure of aging. *ScientificWorldJournal*. 2001. Doi: 10.1100/tsw.2001.58
3. Rockwood K, Mitnitski A. Frailty in relation to the accumulation of deficits. *J Gerontol A Biol Sci Med Sci*. 2007. Doi: 10.1093/gerona/62.7.722
4. Marmot M, Allen JJ. Social Determinants of Health Equity. *Am J Public Health*. 2014. Doi: 10.2105/AJPH.2014.302200
5. Diaz-Toro F, Petermann-Rocha F, Lynskey N, et al. Frailty in Chile: Development of a Frailty Index Score Using the Chilean National Health Survey 2016-2017. *J Frailty Aging*. 2023;12(2):97-102. Doi: 10.14283/jfa.2023.2
6. Searle S, Mitnitski A, Gahbauer E, Gill T, Rockwood K. A standard procedure for creating a frailty index. *BMC Geriatr*. 2008. Doi: 10.1186/1471-2318-8-24
7. Kotzeva M. Eurostat regional yearbook. 2022.
8. Viinikainen J, Bryson A, Böckerman P, et al. Does better education mitigate risky health behavior? A mendelian randomization study. *Econ Hum Biol*. 2022; 46:101-134. Doi: 10.1016/j.ehb.2022.101134
9. Bonell C, Farah J, Harden A, et al. Systematic review of the effects of schools and school environment interventions on health: evidence mapping and synthesis. *Public Health Res*. 2013. Doi: 10.3310/phr01010

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