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ORIGINAL ARTICLE

Frailty is associated with socioeconomic and lifestyle factors in community-dwelling older subjects

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Abstract
Background and aims This study assessed the association between frailty and sociodemographic, socioeconomic and lifestyle factors in community-dwelling older people.
Methods This was a cross-sectional survey in a population-based sample of 542 community-dwelling subjects aged 65 years and older living in a metropolitan area in Italy. Frailty was evaluated by means of the FRAIL scale proposed by the International Association of Nutrition and Aging. Basal and instrumental activities of daily living (ADL, IADL), physical activity, sociodemographic (age, gender, marital status and cohabitation), socioeconomic (education, economic conditions and occupational status) and lifestyle domains (cultural and technological fruition and social activation) were assessed through specific validated tools. Statistical analysis was performed through multinomial logistic regression.
Results Impairments in ADL and IADL were significantly associated with frailty, while moderate and high physical activity were inversely associated with frailty. Moreover, regarding both socioeconomic variables and lifestyle factors, more disadvantaged socioeconomic conditions and low levels of cultural fruition were significantly associated with frailty.
Conclusions Socioeconomic and lifestyle factors, particularly cultural fruition, are associated with frailty independently from functional impairment and low physical activity. Cultural habits may therefore represent a new target of multimodal interventions against geriatric frailty.

Keywords Aging · Frailty · Disability · Education · SES · Lifestyle · Cultural fruition

Introduction

Frailty has been defined as a condition of increased vulnerability to stressor events, as a consequence of the cumulative decline in many physiological systems, with an increased risk of health adverse outcomes, including falls, disability, institutionalization, hospitalization and death [1, 2]. Several studies have reported significant associations between socioeconomic status and health in adulthood [3, 4], providing evidence that the socioeconomically disadvantaged older subjects have a higher prevalence of chronic diseases and higher mortality rates than the more advantaged. Indeed, health advantages among individuals with higher socioeconomic status, as indicated by education, income and occupational status, are well established [5–8].

However, only recently, an increasing number of studies have approached frailty within a non-biological framework [9–13], evidencing the influence of social factors in the onset of frail conditions [14–18]. Thus, in order to obtain a more comprehensive view of health disparities in old age,

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it becomes increasingly important to explore the relationship between social, economic and lifestyle factors with the presence and/or the risk of frailty (9–11).

In particular, among the different lifestyle factors potentially involved in this area, little is known about the cultural fruition, i.e., the pattern of distinctive social practices and behaviors commonly accomplished by the individual and outlining her/his mode of living, depending both on personal taste and on structural factors, such as social origins, education, reference groups and class positioning. Thus, considering the implications of cultural fruition with daily activities and social integration of older people, identifying this factor and its potential role in the pathophysiology of frailty becomes of great importance to establish multidimensional models of prevention and treatment.

The aim of this study was to evaluate the associations between frailty and sociodemographic, socioeconomic or lifestyle factors, with a specific focus on the individual level of cultural fruition, in a community-dwelling population of older people living in Genoa, an Italian town with one of the highest aging indexes in Europe.

Methods

Study population

This study was carried out in Genoa, a metropolitan urban context of northern Italy with a major demographic aging, where the aging index was equal to 235.9 in 2013, compared to the Italian mean value of 152.7 and the European (EU28) mean value of 117.7 (https://open-data.europa.eu/en/data/publisher/estat).

Focusing on the area of the inner center district, we analyzed a population-based sample drawn from the 8504 residents aged 65 years and older (as of January 1, 2013). Two thousand subjects, equally distributed by gender and age class (65–74 years old and 75 years and older), were randomly extracted and contacted via recruitment notices, mails and phone calls. The preliminary inclusion criterion was the adequate cognitive ability to respond to a 30-min face-to-face questionnaire, administered by researchers at home or at the university. Of those contacted, 27.2 % responded. The response rate is due to mainly the efficiency of the starting mailing contact and on conditioned availability of potential respondents. We excluded from the analysis 19 not fully completed questionnaires, discarded for missing data in the indicators of frailty. However, the excluded cases reflect substantially the same distributions in the main sampling variables (gender and age class, see supplementary data). The final study population included 542 subjects, reflecting the starting population on the base of a factorial plan by age class and gender, according to a confidence interval of 5 % and a confidence level of 95 %.

Frailty, sociodemographic, socioeconomic and lifestyle indicators

Frailty was ascertained by means of the FRAIL scale, based on 5 items: fatigue, resistance, ambulation, illness and loss of weight [19]. Fatigue was measured by asking respondents how much time during the past 4 weeks they felt tired with responses of "all of the time" or "most of the time" scored 1 point. Resistance was assessed by asking participants whether they had any difficulty walking up 10 steps alone without resting and without aids, and ambulation by asking whether they had any difficulty walking several hundred yards alone and without aids; "yes" responses were each scored as 1 point. Illness was scored 1 for respondents who reported 5 or more illnesses out of 11 total illnesses. Loss of weight was scored 1 for respondents with a weight loss of 5 % or greater within the past 12 months based on self-report. The FRAIL scale scores range from 0 to 5 (i.e., 1 point for each of the aforesaid component); subjects were then classified as frail (score 3–5), pre-frail (score 1 and 2) and not frail (score 0). The FRAIL scale has been translated, tested and validated in the Italian context [20].

According to a multidimensional perspective of potential factors influencing the severity of frailty, different features were grouped across four main domains: functional, sociodemographic, socioeconomic and lifestyle factors.

Functional domain was evaluated by means of the basic activities of daily living (ADL) [21] and instrumental ADL (IADL) [22]. Basic ADLs included six items (bathing, dressing, feeding, transferring bed or chair, continence and using toilet). ADL difficulties represent the number of these tasks for which respondents reported difficulty performing the task. ADL dependency was defined as positive when respondents reported difficulty on an ADL item and, also, reported (a) being unable to do the task or (b) receiving help from another person to do the task. IADLs included eight items (preparing meals, shopping for groceries, managing money, making phone calls, doing light housework, doing heavy housework, getting to places outside walking distance and managing drugs) and were scored as the number of tasks for which the respondent reported difficulty performing that task. Each reported difficulty or inability to perform ADL and IADL tasks was counted by assigning 1 point; the sum of ADL and IADL deficits yielded the individual's final score. We defined the presence of ADL or IADL deficits to any positive individual score (i.e., equivalent to more than "0").

Among *socio-demographic domain* we considered age, gender, marital status and cohabitation. More specifically, cohabitation has been recorded according to Laslett's typology [23] as follows: solitary, nuclear, extended, multiple and non-structured, in order to have a proxy of the primary network of caregiving and of the level of isolation.

Socioeconomic domain was evaluated by analyzing SES in terms of both class (income and property) and status factors (level of education and social prestige) to observe the availability of material and symbolic resources [20]. The level of education was scored according to the International Standard Classification of Education: 0 = no qualification; 1 = primary school; 2 = secondary school; 3 = vocational school of 2–3 years; 4 = high school; 5 = bachelor's degree; 6 = PhD. The economic conditions, referred both to individual and to household disposable income [24], were evaluated in terms of: (a) the amount of the respondent's income and that of all other family members (pension, disability allowances, real estate rentals and investments, salary, economic aid from other family members or institutions or charities), (b) the incidence of the respondent's income on total family income and (c) the overall declared ability to support routine expenses [20]. The present and former occupation (85 % of our respondents were retired) was adopted as proxy of social prestige and recorded according to the socioeconomic model as described by De Lillo and Schizzerotto [25] as (a) unskilled workers; (b) less-qualified workers; (c) qualified workers and lower service class; (d) middle-class city-dwellers; (e) white-collar workers and (f) entrepreneurs, managers and higher service class. This classification reflects the conventional Erikson and Goldthorpe class schema [26] as adjusted to the Italian social context and related to the working period of our sample.

The life-style domain refers to habits, attitudes, tastes, moral standards, economic level, etc., that together constitute the mode of living of an individual or group. Lifestyle is practiced at individual level through individual choices and actions, but it also depends on structural factors, such as social origins, culture, reference groups and class positioning. We intended lifestyle according to Bourdieu [27], i.e., as the combination of distinctive social practices tied to individual taste and class habitus, where the experience of a specific class condition imprints a particular set of dispositions upon the individual, providing generative schemes that make possible the production of thoughts, perceptions, action and behaviors. Our purpose was to observe how different forms of social practices, outlining different personal lifestyles, could potentially be associated with different individual frailty outcomes. We explored lifestyle factors by revising the social practice scale of Cesareo [28] and observing the frequency (null, rare, frequent and daily) of several activities in four main dimensions: *cultural fruition*, *technological access*, *physical activity and social activation*.

All of these dimensions of practices depend on personal attitudes and inclinations, but also on effective capabilities in terms of social, economic and cultural resources, differently available to the observed elderly population. *Cultural fruition* mainly concerns "mental exercise" linked to leisure activities (hobbies; reading books, magazines and newspapers; using media; going to the theater or cinema; participating in cultural events; traveling abroad or on short trips and frequenting public places). Respondents' *technological access* [29] was evaluated by observing the use of devices or technological practices (mobile, PC, Internet, online payments and credit cards). The level of *physical activity* was recorded by asking how often respondents went for a walk or engaged in sporting activities. Lastly, *social activation* was observed through a standardized index of social activation among elderly people [30], measured by observing the attitude to perform socially useful activities under four aspects: individual willingness to offer professional, social and cultural experience to others; collaboration with associations and organizations; voluntary activities; care activities, such as fostering or caring for children or disabled subjects.

Statistical methods

The relationships between frailty and all other potentially associated sociodemographic, functional, socioeconomic and lifestyle factors were examined by means of the FRAIL scale 3-level categorization (robust, pre-frail and frail) adopted by Morley et al. [19].

We adopted the ANOVA F test to test for differences between levels of frailty in the case of continuous factors, and the Kruskal–Wallis H test in the case of skewed distribution. The Pearson's Chi-square or the Fisher's exact tests were adopted in the case of count variables. Pearson's product–moment correlation coefficient or Spearman's rank correlation coefficient was calculated to estimate correlations between parameters.

A multinomial logistic regression model was used to test the association between the outcome, setting frail subjects as the reference category, and all factors cited above; the likelihood-ratio test was used to assess the statistical significance of each parameter in the model adopting a stepwise backward selection method (likelihood-ratio test <0.1). Multicollinearity was tested for all factors included in the regression models: Owing to the high correlation (Spearman rho = 0.8, $p < 0.001$) between economic conditions and occupational status, in order to take into account both their contributions to the model, we generated a new variable (economic level/status classification), calculated as the mean of the standardized values of the two

Table 1 Participants' characteristics ($n = 542$)

	Robust ($n = 279$)	Pre-frail ($n = 181$)	Frail ($n = 82$)
Age (years)	73.6 ± 5.9	75.7 ± 6.5	79.6 ± 5.1
Male	142 (50.9)	84 (46.4)	33 (40.2)
Presence of ADL deficit	22 (7.9)	49 (27.1)	62 (75.6)
Presence of IADL deficit	65 (23.3)	117 (64.6)	76 (92.7)
Marital status			
Married/cohabiting	177 (63.1)	92 (51.1)	30 (36.6)
Divorced/separated	14 (5.0)	11 (6.1)	7 (8.5)
Widowed	69 (24.7)	61 (33.9)	40 (48.8)
Single	20 (7.2)	16 (8.9)	5 (6.1)
Education (ISCED)			
No qualification (0)	2 (0.7)	2 (1.1)	3 (3.7)
Primary school (1)	39 (14.0)	21 (17.1)	21 (25.6)
Secondary school (2)	49 (17.6)	50 (27.6)	28 (34.1)
Vocational school (3)	21 (7.5)	17 (9.4)	4 (4.9)
High school (4)	100 (35.8)	47 (26.0)	15 (18.3)
Bachelor's degree or PhD. (5–6)	68 (24.3)	34 (18.8)	11 (13.4)
Household classification			
Solitaries	81 (29.0)	66 (36.5)	36 (43.9)
Nuclear	184 (66.0)	96 (53.0)	34 (41.5)
Extended	5 (1.8)	7 (3.9)	5 (6.1)
Multiple	2 (0.7)	2 (1.1)	2 (2.4)
No structure	7 (2.5)	10 (5.5)	5 (6.1)
Economic condition			
Lower	43 (15.4)	41 (22.7)	29 (35.4)
Lower-middle	41 (14.7)	36 (19.9)	18 (22.0)
Middle	99 (35.5)	60 (33.2)	22 (26.8)
Middle-upper	35 (12.5)	22 (12.2)	4 (4.9)
Upper	61 (21.9)	22 (12.2)	9 (11.0)
Status classification			
Unskilled workers	31 (11.1)	22 (12.2)	17 (20.7)
Semi-skilled working class	4 (1.4)	11 (6.1)	9 (11.0)
Skilled working class and lower service class	40 (14.3)	29 (16.0)	10 (12.2)
Middle-class city-dwellers	37 (13.3)	19 (10.5)	10 (12.2)
White collars	99 (35.5)	66 (36.5)	27 (32.9)
Entrepreneurs and higher service class	68 (24.4)	34 (18.8)	9 (11.0)
Physical activity level			
Lower	25 (9.0)	53 (29.3)	54 (65.9)
Average	182 (65.2)	105 (58.0)	25 (30.5)
Higher	72 (25.8)	23 (12.7)	3 (3.7)
Level of cultural fruition			
Lower	7 (2.5)	9 (5.0)	19 (23.2)
Lower-average	37 (13.3)	54 (29.8)	33 (40.2)
Average	112 (40.14)	68 (37.6)	25 (30.5)
Above average	96 (34.4)	42 (23.2)	4 (4.9)
Higher	27 (9.7)	8 (4.4)	1 (1.2)
Level of technological fruition			
Lower	17 (6.1)	37 (20.4)	24 (29.3)
Lower-average	49 (17.6)	48 (26.5)	24 (29.3)
Average	73 (29.2)	45 (24.9)	26 (31.7)
Above average	23 (8.2)	12 (6.6)	4 (4.9)
Higher	117 (41.9)	39 (21.6)	4 (4.9)
Level of social activation			
Lower	62 (22.2)	45 (24.9)	41 (50.0)

Table 1 continued

	Robust ($n = 279$)	Pre-frail ($n = 181$)	Frail ($n = 82$)
Lower-average	71 (25.5)	55 (30.4)	28 (34.2)
Average	77 (27.6)	48 (26.5)	5 (6.1)
Above average	51 (18.3)	21 (11.6)	6 (7.3)
Higher	18 (6.5)	12 (6.6)	2 (2.4)

Data are summarized as mean ± standard deviation (SD) or numbers (%)

original variables and then categorized into three classes (lower, average and higher), considering its tri-modal distribution (data not shown). Results did not show any other cases of highly correlated variables.

All analyses were conducted by means of SPSS (version 23; SPSS Inc. Chicago, IL, USA) and Stata (version 14.1; StataCorp., College Station, TX, USA) software. Two-tailed probabilities were reported, and the p value of 0.05 was used to define nominal statistical significance.

Results

Descriptive analysis

Baseline characteristics of the study population by frailty status are summarized in Table 1. The final distribution of respondents resulted in 279 (51.4 %) not frail, 181 (33.3 %) pre-frail and 82 (15.1 %) frail subjects. Age was significantly associated with frailty: Mean age ± standard deviation (SD) was 73.6 ± 5.9 years in robust subjects, 75.7 ± 6.5 in pre-frail subjects and 79.6 ± 5.1 in frail subjects (p for trend <0.001). The prevalence of females increased as frailty status increased, but this trend did not reach statistical significance ($p = 0.2$). As expected, ADL and IADL were strongly and positively associated with frailty ($p < 0.001$). Single, divorced, separated or widowed subjects were significantly frailer than married or cohabiting subjects. Low level of education was significantly associated with frailty ($p < 0.001$). Similarly, levels of cultural and technological fruition and social activation were significantly lower in pre-frail and frail subjects than in robust subjects.

Multinomial logistic regression model

The results of the multinomial logistic regression model, after adjustment for age and gender, are shown in Table 2.

Regarding functional domain, disabilities in the ADL were independently associated with frailty considering both contrasts, frail versus pre-frail subjects (OR = 4.35, 95 % CI 2.17–9.09) and frail vs. robust subjects (OR = 5.26, 95 % CI 2.22–12.5), while the IADL were significantly associated with frailty only considering frail versus robust subjects (OR = 7.69, 95 % CI 2.70–25.0).

Physical activity was inversely associated with frailty both passing from frail to pre-frail subjects (average vs. lower activity: OR = 0.41, 95 % CI 0.21–0.79, higher vs. lower: OR = 0.56, 0.14–2.38) but more strongly and significantly considering the difference between frail and robust subject (average vs. lower activity: OR = 0.16, 95 % CI 0.07–0.35, higher vs. lower: OR = 0.18, 0.04–0.77).

The socioeconomic domain is associated with frailty only considering the difference between frail and robust subjects (average vs. lower socioeconomic level/status: OR = 0.29, 95 % CI 0.10–0.85, higher vs. lower: OR = 0.20, 0.07–0.63), while the association lost its significance when we considered the difference between frail and pre-frail subjects (average vs. lower socioeconomic level/status: OR = 0.61, 95 % CI 0.24–1.56, higher vs. lower: OR = 0.58, 0.22–1.54).

Similarly, considering the difference between frail and robust subjects in the lifestyle domain, the level of cultural fruition was independently associated with frailty: Subjects with an average level of cultural fruition had a ~50 % reduced risk of being frail (OR = 0.47, 95 % CI 0.22–1.01) than subjects with a lower level, while subjects with a higher or above average level of cultural fruition had 75 % reduced risk of frailty than subjects with a lower level (OR = 0.24, 95 % CI 0.08–0.73), adjusting for all factors included in the model. Considering the difference between frail and pre-frail subjects, this association was not statistically significant.

Discussion

Our results showed that different sociodemographic socioeconomic and lifestyle factors were significantly associated with frailty, independently from functional impairment and physical activity.

In terms of functional impairments, ADL and IADL proved to be positively and independently associated with frailty, while, as expected, physical activity was inversely associated with it.

Relating functional losses to sociodemographic factors, age was considered only in chronological terms, as loss of

Table 2 Multivariate multinomial logistic regression model related to frailty status (reference category: frail subjects)

	N	OR	(95 % CI)	*p*[a]
Frail versus pre-frail subjects				
ADL				
No	409	1.00		
Yes	133	4.35	(2.17–9.09)	<0.001
IADL				
No	284	1.00		
Yes	258	1.72	(0.61–5.00)	0.3
Economic level/status classification[b]				
Lower	55	1.00		
Average	285	0.61	(0.24–1.56)	0.3
Higher	205	0.58	(0.22–1.54)	0.3
Physical activity level				
Lower	132	1.00		
Average	312	0.41	(0.21–0.79)	0.007
Higher	98	0.56	(0.14–2.38)	0.4
Level of cultural fruition				
Lower/lower-average	159	1.00		
Average	205	0.79	(0.41–1.54)	0.5
Above average/higher	178	0.43	(0.15–1.22)	0.1
Frail versus robust subjects				
ADL				
No	409	1.00		
Yes	133	5.26	(2.22–12.5)	<0.001
IADL				
No	284	1.00		
Yes	258	7.69	(2.70–25.0)	<0.001
Economic level/status classification[b]				
Lower	55	1.00		
Average	285	0.29	(0.10–0.85)	0.03
Higher	205	0.20	(0.07–0.63)	0.005
Physical activity level				
Lower	132	1.00		
Average	312	0.16	(0.07–0.35)	<0.001
Higher	98	0.18	(0.04–0.77)	0.02
Level of cultural fruition				
Lower/lower-average	159	1.00		
Average	205	0.47	(0.22–1.01)	0.05
Above average/higher	178	0.24	(0.08–0.73)	0.01

OR odds ratio; we used the term OR to facilitate interpretation for a clinician audience even if is not formally an odds ratio, but rather a relative risk ratio; *CI* confidence interval; adjusted for age and gender. OR > 1 indicates a higher association with frailty or pre-frailty

[a] Two-sided Wald test

[b] See statistical methods for a detailed description

autonomy is only partially related to age [31]. Nevertheless, results confirm how risk of frailty increases with aging. Our study confirmed evidences of gender gap both in frailty and in socioeconomic domains, particularly for older women, as emerged in other recent studies exploring in other national contexts the association of frailty with gender and low SES [13–15]. Similarly, marital status (associated with living in couple) confirmed to be a typical protective factor on overall health [32].

Shifting to the socioeconomic dimension, the main difficulty in measuring and relating social conditions to frailty arises from the "many-sided" concept of socioeconomic status, which is a broad term related to economic indicators, education, cultural behaviors, knowledge, supportive networks and even to geographic and ethnic dimensions [9, 10, 33–35]. Thus, the socioeconomic domain has not been limited to the standard education and income factors, but more specifically operationalized in a class and status perspective, specifically adjusted to the historical period when our sample developed their working experiences, building their actual social prestige and class positioning [20]. As shown in other recent studies [10, 16–18], education is a good social predictor for frailty conditions. In our study, subjects with higher educational levels had a significantly lower risk of being frail or pre-frail than subjects with no qualifications or a primary/secondary/vocational education. Similarly, class (income) and status (social prestige) factors were inversely associated with frailty, confirming as protective factors not only for economic resources, but also for enhancing the lifestyle opportunities.

Regarding the lifestyle domain, the new and interesting aspect that emerges from our analysis is that the level of cultural fruition was independently associated with frailty: Subjects with higher levels of cultural fruition had a significantly lower risk of frailty. The cultural fruition expresses the differentiation in terms of individual access to different social practices and behaviors in terms of leisure, interest and also of active social participation. A higher level of cultural fruition defines a protective factor against frailty by maintaining cognitive stimulation and reducing the risk of subjective disengagement as consequences of structural absence of role and marginalization [20]. More frequent social practices and occasion of involvement not only help to maintain self-identity, but provide also a better access to supportive and relational networks, and even promoting healthier forms of lifestyle (for instance, encouraging physical exercise).

The main point of strength of our study is the evidence of associations of frailty and levels of cultural fruition, offering an additional element for multidimensional evaluation of frailty.

Limitations of the study are: (1) a study focused only on one single center (making data non-generalizable as in a multicentric study); (2) the exclusion of cases with cognitive impairment unable to answer the questionnaire; (3) the cross-sectional design of the study, excluding longitudinal

analysis; (4) the small number of frail respondents in the final sample; (5) the limited response rate.

Conclusion

Our study confirms that social factors are relevant to understanding of frailty, suggesting that active lifestyle and cultural fruition could be effectively protective against this condition. To our knowledge, this is the first report, almost in the Italian context, in which more active cultural behaviors seem to be independently associated with a lower level of frailty.

This study demonstrated that frailty in older people is associated with socioeconomic and lifestyle factors, besides functional impairments, and that the levels of cultural fruition and consequent social integration may play a significant protective role against frailty, with a clear advantage for males and young-old respondents.

Thus, the conservation of individual cultural practices, by expressing a distinctive personal habit, can positively reflect in older life. Indeed, higher levels of cultural fruition facilitate through good practices an overall healthier lifestyle, derived from regular physical exercise, constant cognitive stimulation and better social integration [8, 36].

Such complex combination of multiple generative factors of frailty, combining health with individual social characteristics and structural conditions, underlines once more the need to integrate proper multidimensional tool for frailty evaluation, combining adequately clinical instruments with techniques for measuring different social, economic and cultural dimensions.

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Compliance with ethical standards

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