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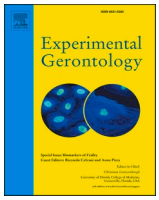

Association between frailty and main work during the LIFE: A cross-sectional analysis of the UK Biobank

Nicola Veronese [a,*,1], Laura Maniscalco [a,1], Domenica Matranga [a], Ligia J. Dominguez [a,b], Mario Barbagallo [a]

[a] Department of Health Promotion, Maternal and Infant Care, Internal Medicine and Medical Specialties, "G. D'Alessandro"- PROMISE - University of Palermo, 90127 Palermo, Italy
[b] Department of Medicine and Surgery, University Kore of Enna, Italy

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ABSTRACT

Background: The role of main work during the life course in predicting frailty, a typical geriatric syndrome, is still largely unknown. Therefore, with this research, we aimed to investigate the potential association between the main work done during the life with frailty and pre-frailty among participants 60 years and older of the UK Biobank study.
Methods: Frailty and pre-frailty presence were ascertained using a model including 5 indicators (weakness, slowness, weight loss, low physical activity, and exhaustion); the main employment status was ascertained using self-reported information. The association between frailty and main work was explored using an ordinal logistic regression model and reported as odds ratios (ORs) with their 95 % confidence intervals (CIs).
Results: The final sample comprised a total of 50,447 individuals (mean age: 64.2 years, females: 50.2 %). Individuals with higher qualifications had a reduced risk of frailty (OR = 0.881, 95%CI = 0.83–0.95, *p*-value<0.001 for pre-frail and OR = 0.681, 95%CI = 0.63–0.73, p-value<0.001 for frail) compared to those with lower qualifications. Moreover, active participation in the workforce, compared to being inactive, emerged as a protective factor from frailty (OR = 0.753, 95%CI = 0.70–0.81, *p*-value<0.001). The categories of Associate Professional and Technical Occupations exhibited protective effects against both pre-frailty and frailty. Similarly, occupations categorized as Professional and Management demonstrated protective effects against pre-frailty and frailty when compared to Elementary Occupations. Additionally, engagement in Trades and Services occupations, as opposed to Elementary Occupations, appeared to be protective against frailty.
Conclusions: In this large cross-sectional investigation based on the data of the UK Biobank we found that work during lifetime could be an important factor in determining frailty later in life.

1. Introduction

Frailty, a multidimensional syndrome characterized by decreased physiological reserve and increased vulnerability to stressors, has emerged as a critical concept in geriatric medicine and public health (Clegg et al., 2013). While it is well known the role of occupational history and lifetime work patterns for many health issues, the relationship with frailty remains an area of growing interest (Maniscalco et al., 2020; Maniscalco et al., 2022). Understanding the association between frailty and the main work during the life course is essential for identifying potential risk factors, informing preventive strategies, and promoting healthy aging in the workforce.

Frailty is increasingly recognized as a dynamic process influenced by a complex interplay of biological, psychosocial, and environmental factors, including lifestyle, socioeconomic status, and occupational exposures (Sternberg et al., 2011). While much of the research on frailty has focused on older adults, recent studies have highlighted the importance of early-life determinants, including childhood socioeconomic status, educational attainment, and occupational exposures, in shaping trajectories of frailty and health outcomes in later life (Haapanen et al., 2018).

Occupational factors may contribute to the development and

* Corresponding author at: Geriatric Unit, Department of Internal Medicine and Geriatrics, University of Palermo, via del Vespro, 141, 90127 Palermo, Italy.
E-mail address: nicola.veronese@unipa.it (N. Veronese).
[1] These authors equally contributed to this work.

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progression of frailty through various mechanisms, including physical demands, psychosocial stressors, ergonomic hazards, and exposure to occupational hazards such as chemicals, noise, and repetitive movements (Iavicoli et al., 2018; Veronese et al., 2023). For example, high levels of physical activity and demanding work environments may accelerate the aging process and increase the risk of frailty, particularly among individuals with limited access to healthcare, social support, and resources for health promotion (Iavicoli et al., 2018).

However, the relationship between frailty and the main work during the life course is complex and multifaceted, influenced by individual characteristics, job characteristics, and broader social and economic factors. Some studies have suggested that certain types of work, such as manual labor, shift work, and job strain, may be associated with an increased risk of frailty, while others have found protective effects of meaningful work, social engagement, and job satisfaction on frailty outcomes (Dent et al., 2023; Iavicoli et al., 2018).

Since the association between frailty and usual work during the life course represents a complex and multifaceted relationship, we aimed to investigate the potential association between the main work done during the life with frailty and pre-frailty among participants 60 years and older of the UK Biobank study, a large epidemiological study conducted in the United Kingdom.

2. Materials and methods

2.1. Study population

This research is covered by generic ethical approval from the National Health System Research Ethics Committee (Ref. 11/NW/0382) for UK Biobank research. The analyses presented here were approved within project 82722 by the UK Biobank research committee on the 20th of May 2022.

Briefly, the UK Biobank is a large biomedical data repository collected for research purposes from UK people, which specifically aims to understand the importance of environmental factors, genetics and lifestyle impact upon a broad array of health outcomes. The recruitment phase was conducted through a formal mail invitation, initially sent to 9.2 million households. Of them, >500,000 individuals attended UK Biobank assessment centers, to provide informed written consent and complete baseline assessments. This process included touchscreen questionnaires, in person interviews, and physical health examinations (full details for the UK Biobank's assessment processes are available at https://www.ukbiobank.ac.uk/).

For the aims of this study, we included all people aging >60 years with sufficient data for calculating the outcomes of our interest, i.e., frailty. Since frailty diagnosis was demonstrated only in people aging >60 years, we included only these participants in our analyses.

2.2. Outcome: frailty

The frailty status was defined according to the five indicators of frailty phenotype proposed by Fried and colleagues, as implemented within the UK Biobank (Mickute et al., 2023; Veronese et al., 2023; Zhang et al., 2023).

Specifically:

- Weight loss was determined as self-reported changes in weight over the past year through the following yes = 1/no = 0 question: "Compared with 1 year ago, has your weight changed?"
- Exhaustion was assessed based on the frequency of feeling tired or lacking energy over the preceding two weeks. The question was: "Over the past 2 weeks, how often have you felt tired or had little energy?", with the following answer options: more than half the days or nearly every day = 1, other = 0.
- Low physical activity was identified using the UK Biobank questionnaire, with two answer options no/light = 1 and normal/high = 0 activity levels.
- Slow walking speed was self-reported as either slow = 1 or normal = 0: "How would you describe your usual walking pace?"
- Weakness was defined using the maximum grip strength value, which was adjusted for sex and body mass index (BMI). Weakness occurred if the respondent maximum grip strength value was higher than the corresponding cut-off.

Individuals were classified as robust if they showed no signs of frailty, prefrail if they met one or two criteria, and frail if they demonstrated three or more of the five indicators of frailty.

2.3. Exposure: job conditions

The main employment status was assessed with the following question: "Which of the following describes your current situation?" with categories "In paid employment or self-employed", "Retired", "Looking after home and/or family", "Unable to work because of sickness or disability", "Unemployed", "Doing unpaid or voluntary work" or "Full or part-time student". It was dichotomized as "Workforce" (employed or unemployed) and "Inactive Population" (all the others). The held jobs were the number of jobs reported by each participant who completed the Occupational questionnaire.

Regarding the occupational classification, the variable "job coding" reported the job category selected by the respondent from a drop-down three-level hierarchical menu. Afterwards, people were classified according to their job based on the Standard Occupational Classification sub-group. There were the following nine categories: "Managers and Senior Officials", "Professional Occupation", "Associate Professional and Technical Occupations", "Administrative and Secretarial Occupation", "Skilled Trades Occupations", "Personal Service Occupations", "Sales and Customer Service Occupations", "Process, Plant and Machine Operatives", and "Elementary Occupations". Eventually, "Managers and Senior Officials", "Professional Occupation" were included in "Professional occupation and Management" category. "Skilled Trades Occupations", "Personal Service Occupations", "Sales and Customer Service Occupations" in "Trades and Services" category. "Process, Plant and Machine Operatives" was included in "Elementary Occupations" category.

Briefly, the Associate Professional and technical occupation category covers occupations whose main tasks require experience and knowledge of principles and practices necessary to assume operational responsibility and to give technical support to Professionals and to Managers, Directors and Senior Officials. Sub-components include: science, engineering and technology associate professionals; health and social care associate professionals; protective service occupations; culture, media and sports occupations; business and public service associate professionals. While, jobs included in the elementary occupation category require the knowledge and experience necessary to perform mostly routine tasks. It includes elementary agricultural, construction and process plant occupations or elementary cleaning, security, sales and storage occupations (Vallance, 2015).

2.4. Covariates

The covariates included in the analysis encompassed demographic factors such as gender, age, ethnicity and qualification classified as "No high school diploma", "High school diploma", and "College degree". Furthermore, other information included smoking behavior categorized in terms of frequency (never, daily, 1 to 4 times per week, 1 to 3 times per month, occasionally), and the Charlson Comorbidity Index (CCI), to assess the occurrence and severity of medical conditions. The conditions included in CCI were self-report or identified through the International Classification of Diseases, 10th Revision (ICD-10) codes from hospital

admissions prior to baseline assessment. The total score was dichotomized using the cut-off "<2" or "≥2". To end, context information was included through the Townsend deprivation index, which was divided into quintiles (the lowest quintile the least deprived) and the residency area (urban versus rural).

2.5. Statistical analysis

Participants younger than 60 years at the start of the study, those with missing BMI data, and individuals lacking information on work-related exposures were excluded from the analysis. Continuous variables were summarized using mean and standard deviation (SD), whereas categorical variables were expressed as counts and percentages. The study cohort was stratified based on frailty phenotype. Categorical variables were compared using Chi-squared or Fisher exact tests, while continuous variables were compared using *t*-tests. Given the ordinal nature of the response variable, ordinal logistic regression model was utilized, and the assumption of proportional odds was evaluated using the Brant test. Since this assumption was not met for certain covariates, a partial proportional odds model was applied using the VGAM package. Statistical analyses were conducted using R software (version 4.3.3). A significance level of $p < 0.05$ was used for determining statistical significance.

3. Results

Initially, 502,536 individuals were considered. After the exclusion of 264,996 individuals younger than 60 years, 17,461 individuals with missing values for any of the 5 frailty indicators, and 169,632 without information on work-related exposures, the final sample comprised a total of 50,447 individuals (Fig. 1). The sample was composed by 31,643 (62.7 %) robust, 17,789 (35.3 %) prefrail and 1015 (2.0 %) frail subjects. The included participants were mostly female (50.8 %) with a mean age of 64.2 (SD = 3.0) and a range [60–74], 35.5 % normal-weighted, 96.6 % no smokers, and reported alcohol assumption frequency of 1–4 times/week. Most of subjects belonged to the lowest deprived quantile (23.2 %) and reported white ethnicity (98.9 %); 82.1 % lived in an urban area and 79.5 % had <2 comorbidities. Furthermore, over half of the sample had a college degree (55.2 %), belonged to the inactive population (64.9 %), worked in Professional occupation and Management and held a mean of 3.2 ± 2.2 jobs (Table 1).

From the partial proportional odds regression model, participants with higher qualifications had a reduced risk of frailty (OR = 0.881, 95% CI = 0.83–0.95, *p*-value<0.001 for pre-frail and OR = 0.681, 95%CI = 0.63–0.73, p-value<0.001 for frail). Moreover, active participation in the workforce, compared to being inactive, emerged as a protective factor from frailty (OR = 0.753, 95%CI = 0.70–0.81, *p*-value<0.001). The categories of Associate Professional and Technical Occupations exhibited protective effects against both pre-frailty (OR = 0.895, 95%CI = 0.83–0.97, *p*-value<0.001) and frailty (OR = 0.697, 95%CI = 0.60–0.81, p-value<0.001). Similarly, occupations categorized as Professional and Management demonstrated protective effects against pre-frailty (OR = 0.860, 95%CI = 0.80–0.93, p-value<0.001) and frailty (OR = 0.662, 95%CI = 0.59–0.74, p-value<0.001 for frail) when compared to Elementary Occupations. Additionally, engagement in Trades and Services occupations, as opposed to Elementary Occupations, appeared to be protective against frailty (OR = 0.772, 95%CI = 0.68–0.88, $p < 0.001$). Eventually, the increase of the number of held jobs seemed to increase the risk of being pre-frail (OR = 1.015, 95%CI = 1.01–1.02, $p < 0.001$) compared to non-frail (Table 2).

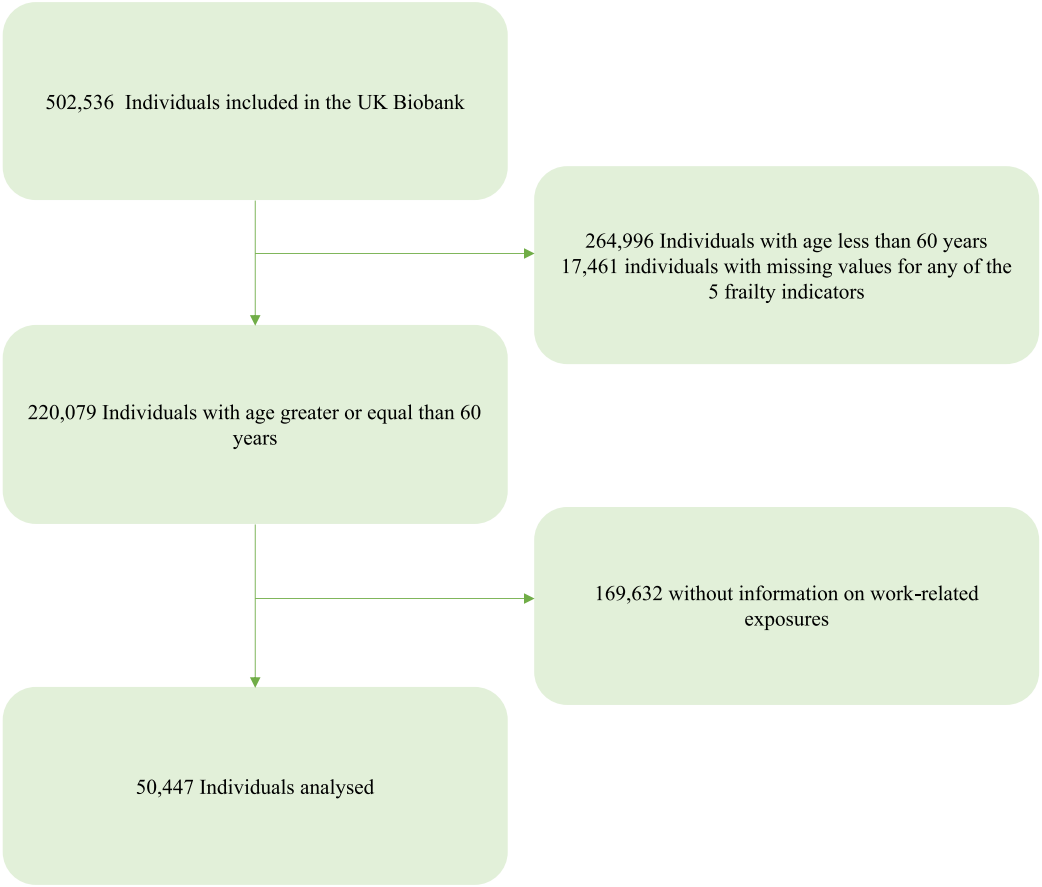

Fig. 1. Flowchart of the participants.

Table 1
Descriptive characteristics of the participants, by frailty status.

Parameter	Categories	Total	Non-Frail	Pre-Frail	Frail	P-value
		$n = 50,447$	$n = 31,643$ (62.7 %)	$n = 17,789$ (35.3 %)	$n = 1015$ (2.0 %)	
Gender	Female	25,624 (50.8 %)	15,471 (48.9 %)	9526 (53.5 %)	627 (61.8 %)	<0.001
	Male	24,823 (49.2 %)	16,172 (51.1 %)	8263 (46.5 %)	388 (38.2 %)	
Age		64.2 (3.0)	64.1 (3.0)	64.3 (3.0)	64.2 (3.1)	<0.001
BMI	18–25	17,895 (35.5 %)	12,779 (40.4 %)	4970 (27.9 %)	146 (14.4 %)	<0.001
	25–30	22,551 (44.7 %)	14,332 (45.3 %)	7911 (44.5 %)	308 (30.3 %)	
	≥30	10,001 (19.8 %)	4532 (14.3 %)	4908 (27.6 %)	561 (55.3 %)	
Smoking status	Current	1699 (3.4 %)	908 (2.9 %)	711 (4 %)	80 (7.9 %)	<0.001
	Never	48,742 (96.6 %)	30,730 (97.1 %)	17,077 (96 %)	935 (92.1 %)	
	Missing value	3				
Frequency of alcohol intake	Daily	14,449 (28.6 %)	9771 (30.9 %)	4513 (25.4 %)	165 (16.3 %)	<0.001
	1–4 times/week	24,083 (47.7 %)	15,574 (49.2 %)	8149 (45.8 %)	360 (35.5 %)	
	1–3 times/month	4814 (9.5 %)	2780 (8.8 %)	1909 (10.7 %)	125 (12.3 %)	
	Occasionally/never	7090 (14.1 %)	3518 (11.1 %)	3209 (18 %)	363 (35.8 %)	
	Missing value	11				
Townsend Deprivation Index	1st quantile (least)	11,712 (23.2 %)	7816 (24.7 %)	3729 (21 %)	167 (16.5 %)	<0.001
	2nd quantile	11,058 (21.9 %)	7097 (22.4 %)	3776 (21.2 %)	185 (18.3 %)	
	3rd quantile	10,585 (21 %)	6657 (21.1 %)	3739 (21 %)	189 (18.7 %)	
	4th quantile	9683 (19.2 %)	5840 (18.5 %)	3612 (20.3 %)	231 (22.8 %)	
	5th quantile (most)	7364 (14.6 %)	4204 (13.3 %)	2919 (16.4 %)	241 (23.8 %)	
	Missing value	45				
Ethnic	White	49,871 (98.9 %)	31,371 (99.1 %)	17,502 (98.4 %)	998 (98.3 %)	<0.001
	Other ethnic group	576 (1.1 %)	272 (0.9 %)	287 (1.6 %)	17 (1.7 %)	
Urbanicity	Urban	41,139 (82.1 %)	25,531 (81.2 %)	14,715 (83.3 %)	893 (88.2 %)	<0.001
	Non-urban	8983 (17.9 %)	5916 (18.8 %)	2947 (16.7 %)	120 (11.8 %)	
	Missing value	325				
CCI	<2	40,113 (79.5 %)	25,477 (80.5 %)	13,913 (78.2 %)	723 (71.2 %)	<0.001
	≥2	10,334 (20.5 %)	6166 (19.5 %)	3876 (21.8 %)	292 (28.8 %)	
Education	College Degree	27,781 (55.2 %)	18,106 (57.4 %)	9234 (52.1 %)	441 (43.6 %)	<0.001
	High School Diploma	17,439 (34.7 %)	10,623 (33.7 %)	6423 (36.2 %)	393 (38.8 %)	
	No high school diploma	5069 (10.1 %)	2827 (9 %)	2064 (11.6 %)	178 (17.6 %)	
	Missing value	158				
Current employment status	Workforce	17,619 (35.1 %)	11,113 (35.3 %)	6213 (35.1 %)	293 (29 %)	<0.001
	Inactive population	32,548 (64.9 %)	20,350 (64.7 %)	11,480 (64.9 %)	718 (71 %)	
	Missing value	280				
Occupational classification	Administrative and Secretarial Occupation	11,096 (22 %)	6583 (20.8 %)	4236 (23.8 %)	277 (27.3 %)	<0.001
	Associate Professional and Technical Occupations	8528 (16.9 %)	5419 (17.1 %)	2952 (16.6 %)	157 (15.5 %)	
	Elementary occupations	4301 (8.5 %)	2483 (7.8 %)	1681 (9.4 %)	137 (13.5 %)	
	Professional occupation and Management	19,821 (39.3 %)	13,199 (41.7 %)	6341 (35.6 %)	281 (27.7 %)	
	Trades and Services	6701 (13.3 %)	3959 (12.5 %)	2579 (14.5 %)	163 (16.1 %)	
Held job		3.2 (2.2)	3.2 (2.1)	3.3 (2.3)	3.3 (2.4)	<0.001

Abbreviations: BMI: body mass index; CCI: Charlson comorbidity index.

4. Discussion

In this large cross-sectional study, including >50,000 older subjects participating to the UK Biobank Study, we found that the work made during the lifetime could be considered as an important determinant of pre-frailty and frailty. Briefly, when compared to elementary occupations, associate professional, technical and professional occupations, management and trades and services were associated with a lower prevalence to be frail and/or pre-frail, overall suggesting an important role of work during lifetime in preventing frailty.

It is known that unemployment, job insecurity, type of engagement (e.g., fixed-term employment, part-time engagements, apprenticeship programs, late or early exit from working life) should be more carefully investigated in combination with psycho-social risks as possible determinants of frailty in older people (Iavicoli et al., 2018). In an approach considering frailty as a preventable condition, targeting risk factors during the adult age, and not only in older age groups, occupational medicine (i.e., occupational the branch of medicine concerned

Table 2
Multivariate analyses.

		Pre-frail				Frail			
Parameter	Categories	OR	95 % CI		P-value	OR	95 % CI		P-value
Gender	Male vs Female	0.830	0.80	0.86	<0.001	0.726	0.67	0.79	<0.001
Age		1.021	1.01	1.03	<0.001	1.000	0.98	1.01	0.346
BMI	25–30 vs 18–25	1.426	1.37	1.49	<0.001	1.387	1.19	1.61	<0.001
	≥30 vs 18–25	2.886	2.74	3.04	<0.001	9.686	8.49	11.05	<0.001
Smoking status	Never vs Current	0.693	0.63	0.76	<0.001	0.271	0.24	0.31	<0.001
Frequency of alcohol intake	1–4 times/week vs Daily	1.087	1.04	1.14	<0.001	1.104	0.96	1.27	0.160
	1–3 times/month vs Daily	1.317	1.23	1.41	<0.001	1.518	1.27	1.81	<0.001
	Occasionally/never vs Daily	1.791	1.69	1.90	<0.001	4.935	4.31	5.66	<0.001
Townsend Deprivation Index	2nd quantile vs 1st	1.081	1.02	1.14	0.006	1.059	0.91	1.23	0.458
	3rd quantile	1.110	1.05	1.17	<0.001	1.056	0.91	1.23	0.479
	4th quantile	1.219	1.15	1.29	<0.001	1.362	1.18	1.57	<0.001
	5th quantile (most)	1.334	1.25	1.42	<0.001	1.832	1.60	2.10	<0.001
Urbanicity	Urban vs Non-Urban	1.059	1.01	1.11	0.026	1.189	1.05	1.35	0.010
CCI	≥2 vs <2	1.118	1.07	1.17	<0.001	1.52	1.42	1.63	<0.001
Education	College degree vs No high school diploma	0.881	0.83	0.95	<0.001	0.681	0.63	0.73	<0.001
	High school diploma vs No high school diploma	0.937	0.88	1.01	0.085	0.746	0.68	0.82	<0.001
Current employment status	Workforce vs Inactive population	1.007	0.97	1.05	0.810	0.753	0.70	0.81	<0.001
Occupational classification	Administrative and Secretarial Occupation vs Elementary Occupations	0.973	0.90	1.05	0.328	0.788	0.71	0.88	<0.001
	Associate Professional and Technical Occupations vs Elementary Occupations	0.895	0.83	0.97	0.001	0.697	0.60	0.81	<0.001
	Professional occupation and Management vs Elementary Occupations	0.860	0.80	0.93	<0.001	0.662	0.59	0.74	<0.001
	Trades and Services vs Elementary Occupations	0.991	0.92	1.07	0.258	0.772	0.68	0.88	<0.001
Job held		1.015	1.01	1.02	<0.001	0.997	0.98	1.02	0.645

Abbreviations: BMI: body mass index; CCI: Charlson comorbidity index.

with the maintenance of health and the prevention and treatment of diseases and accidental injuries in working populations in the workplace) may offer a relevant help by providing suitable occasions for exchanging with workers about their environment and promote the implementation of preventive strategies in support of healthy aging.

A previous systematic review, seminal about this topic (Iavicoli et al., 2018), concluded that the literature before 2018 does not allow to adequately consider the large heterogeneity of jobs with specific income levels, job-related physical activities, and health risks as we tried to do in our present work. Overall, our work tried to better approach the possible "occupational risks for frailty" (i.e., whether frailty conditions are related to the performed professions/job tasks and to the occupational risks) (McMunn et al., 2006). Our results, overall, suggest that white collars jobs are at lower risk of frailty and pre-frailty with some further differences. The role of job in determining frailty could be bidirectional since, theoretically, both manual and non-manual jobs may increase the risk of frailty. In particular, manual works are usually associated with a higher physical activity level during the life course and, since frailty phenotype is defined using physical domains, one could expect that manual works could be associated with a lower risk of frailty; at the same time, white collars (i.e., people with a less exposition to manual work) are usually more educated and health education can prevent the risk of several chronic medical conditions usually associated with frailty.

In our work, Associate Professional and Technical Occupations (APTOs) were associated with a lower risk of frailty in older people probably due to several factors inherent to these occupations. First, these participants could have a higher intellectual stimulation: APTOs typically involve tasks that require higher levels of cognitive engagement, problem-solving, and decision-making. Engaging in intellectually stimulating work has been linked to better cognitive function and reduced risk of cognitive decline in later life, which in turn may contribute to lower frailty risk (Fancourt and Steptoe, 2020). Second, many APTOs involve moderate levels of physical activity, such as walking, standing, or light manual labor. Engaging in regular physical activity is associated with better physical function, mobility, and muscle strength, all of which are important factors in preventing frailty (Chodzko-Zajko et al., 2009). Furthermore, APTOs often involve working in teams or interacting with colleagues and clients, providing opportunities for social engagement and support. Social connectedness has been shown to be protective against frailty, as it promotes emotional well-being, reduces stress, and encourages healthy behaviors (Ragusa et al., 2022). Similarly, APTOs typically offer stable employment, income, and access to benefits, which contribute to financial security and socioeconomic stability. Higher socioeconomic status is associated with better access to healthcare, nutrition, and other resources that promote overall health and well-being, thereby reducing the risk of frailty (Stringhini et al., 2017). Overall, we believe that the combination of intellectual stimulation, physical activity, social interaction, financial security associated with APTOs contributes to a lower risk of frailty in older people. By recognizing the importance of these factors and promoting healthy work environments, policymakers and employers can support the well-being and resilience of older workers (Iavicoli et al., 2018).

Moreover, in our research, the engagement in Trades and Services occupations is associated with a lower risk of frailty. We can explain these findings with some hypotheses. Other than physical activity, social interaction, financial security mentioned above, it could be possible that performing tasks in Trades and Services occupations requires individuals to maintain functional independence and mobility. Occupational tasks that involve bending, reaching, and kneeling help to maintain flexibility and range of motion, which are important factors in preventing frailty (Guralnik et al., 2000). Moreover, Trades and Services occupations often involve providing essential services to others, such as construction, maintenance, or repair work. Having a sense of purpose and contributing to the well-being of others promotes mental and emotional well-being, reducing the risk of depression and frailty (Kim et al., 2014). Finally, Trades and Services occupations require individuals to develop and maintain a diverse set of skills, including problem-solving, adaptability, and technical proficiency. Engaging in mentally stimulating tasks promotes cognitive function and resilience, which are important for maintaining independence and reducing frailty risk (Brigola et al., 2015).

Finally, we believe that our findings may further contribute to the concept adopting a comprehensive life-course approach to frailty (Iavicoli et al., 2018) and not only exploring risk factors typical of older people, such as dementia. Only with this approach, in fact, it could be possible to further prevent the onset of frailty in older people, having in mind that frailty is associated with several negative complications in

older people (Kuh, 2007).

The findings of our study must be interpreted within its limitations. First, the cross-sectional nature of our investigation does not permit to infer a potential cause-effect relationship, even if work activity was asked retrospectively. Second, many variables were ascertained on self-report information that can introduce a recall bias. Third, we adapted the definition of frailty according to the information present in the UK Biobank, even if to adapt Fried's criteria with the data available could introduce an important deviation from the original version (Theou et al., 2015). Fourth, it is important to note that UK Biobank is not entirely a nationally representative sample since more affluent participants were more likely to be White and had fewer long-term health conditions than the national average and this could be relevant for our research focused on work. Finally, while one of the strengths of this study is the large sample size, our research used about only 9 % of the initial database possibly making less valid our data, also considering that in the UKBB participants with >70 years, in which frailty is particularly present, are practically not represented. Therefore, other researches are needed to better cover old age.

In conclusion, in this large cross-sectional investigation based on data of the UK Biobank we found that work during lifetime could be an important factor in determining frailty later in life. We believe that future longitudinal studies must assess this important relationship in order to further highlight those works at higher risk of frailty and pre-frailty and, consequently, to other geriatric syndromes relevant among older people.

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CRediT authorship contribution statement

Nicola Veronese: Writing – original draft, Data curation. **Laura Maniscalco:** Formal analysis. **Domenica Matranga:** Formal analysis, Data curation. **Ligia J. Dominguez:** Writing – review & editing. **Mario Barbagallo:** Writing – review & editing.

Declaration of competing interest

None.

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