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COVID-19 vaccine hesitancy among European older adults: the role of living alone, social isolation and loneliness☆

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ABSTRACT

Objective: Given the significant public health challenge posed by vaccine hesitancy during the COVID-19 pandemic, researchers have increasingly focused on understanding its underlying determinants. While previous research has paid attention to predisposing, enabling, and need factors the role of psychosocial factors remains less understood. This study examines COVID-19 vaccine hesitancy among older adults in Europe, specifically in relation to living alone, social isolation, and loneliness as distinct factors. Additionally, it considers potential cross-country variations in these effects, in relation to differences in policy stringency.

Methods: Using data from the Survey of Health Ageing and Retirement in Europe (SHARE) and SHARE Corona Surveys (2020−2021), this study analyses a sample of 36,890 adults aged 50 and above across 28 European countries and Israel. Two-level binomial logistic regression was employed.

Results: Household composition, social isolation and loneliness among older adults related to COVID-19 vaccine hesitancy. More specifically: older adults who (i) lived alone, (ii) were more socially isolated, and (iii) were more lonely, tended to be more hesitant to get vaccinated against COVID-19. These effects did not differ by policy stringency.

Conclusions: This study underscores the relevance of the absence of a partner, social isolation, and loneliness when addressing vaccine hesitancy in older adults. When implementing effective vaccination policies compassionate measures with sufficient attention for psychosocial factors are a necessity. Addressing the psychosocial roots of COVID-19 vaccine hesitancy is not just key to managing current COVID-19 risks, but a blueprint for a more resilient and inclusive approach to future health crises.

1. Introduction

COVID-19 spread rapidly across Europe, leading to high infection rates and increased mortality (Troiano and Nardi, 2021). In response, governments implemented strict physical distancing measures, including isolating high-risk groups like older adults (Arpino et al., 2023). Another key mitigation strategy was developing COVID-19 vaccines (Arpino et al., 2023), as sufficient coverage was essential to lowering incidence and mortality (Cartanyà-Hueso et al., 2022; Troiano and Nardi, 2021). Vaccinated older adults across Europe experienced substantially lower mortality than their unvaccinated peers (Meslé et al., 2021). To encourage uptake, most countries introduced vaccination certificates for travel, leisure, and social activities, supported by communication strategies emphasising personal and societal benefits of vaccination, which proved effective in promoting acceptance (Steinert et al., 2022).

However, both strategies faced challenges. Physical distancing led to unprecedented levels of social isolation, negatively affecting well-being (Baarck et al., 2022; Krendl and Perry, 2021). Loneliness increased, (Baarck et al., 2022; Stickley et al., 2021), particularly among younger and older adults (Su et al., 2023), and those living alone (Barjaková et al., 2023; Delaruelle et al., 2023). Additionally, COVID-19 vaccine hesitancy emerged as a public health concern (Cartanyà-Hueso et al., 2022; Gerretsen et al., 2021; Soares et al., 2021; Troiano and Nardi, 2021) driven by doubts about vaccine safety and effectiveness, amid rapid development, limited long-term data, and widespread

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misinformation during the early rollout.

This paper addresses the intersection of these challenges by examining the relationship between living alone, social isolation and loneliness, and COVID-19 vaccine hesitancy in older adults.

Furthermore, we investigate whether these associations between psychosocial factors and COVID-19 vaccine hesitancy differ by gender, and pandemic policy stringency. Gender differences are likely, as older men and women often engage differently in preventive behaviour (Brandt et al., 2023). Regarding policy stringency, existing literature highlights the importance of historical, political and socio-cultural contexts in shaping vaccine hesitancy (Dubé et al., 2014; Lermytte et al., 2024). Countries differed in the strictness of COVID-19 measures, which influenced daily experiences of autonomy, competence, and relatedness, key determinants of psychosocial wellbeing and motivation for health-protective behaviour (Waterschoot et al., 2023). In stricter settings, psychosocial factors may have been especially salient, amplifying their impact on vaccine hesitancy (Sabat et al., 2020).

We investigate whether living alone, social isolation and loneliness relate to COVID-19 vaccine hesitancy among older Europeans across varying policy stringency.

2. Psychosocial factors and COVID-19 vaccine hesitancy

Although related, living alone, social isolation, and loneliness are distinct (Victor et al., 2000). Living alone refers to household composition; social isolation, to objectively limited social contacts (De Jong-Gierveld et al., 2018; Ong et al., 2016). Although related, social isolation and loneliness may occur independently (Coyle and Dugan, 2012; De Jong-Gierveld et al., 2018). Loneliness is "the unpleasant experience that occurs when a person's network of social relations is deficient in some important way" (Perlman and Peplau, 1981, p. 31).

The pandemic heightened the risk of loneliness and social isolation among those living alone, often lacking emotional or practical support from a partner or others (Arpino et al., 2022; Baarck et al., 2022; Delaruelle et al., 2023). Physical distancing measures directly increased social isolation (Baarck et al., 2022; Peng and Roth, 2022). However, not all socially isolated individuals felt lonely (Ernst et al., 2022). Although older adults initially showed resilience, loneliness increased due to prolonged isolation and disruption (Su et al., 2023).

Differentiating between living alone, social isolation and loneliness is also relevant given their distinct associations with COVID-19 vaccine hesitancy and underlying mechanisms. First, living alone may reduce social support and urgency to protect others, increasing hesitancy among older adults (Zhang et al., 2022). The absence of a partner may be key, as they frequently provide support, social control and encourage preventive health behaviours, like screening (Arpino et al., 2022; Jolidon et al., 2024; Vozikaki et al., 2017). Those living alone may also fear being left helpless in the event of vaccine complications, contributing to reluctance (Jackson et al., 2015; Liu et al., 2023).

Second, social isolation is linked to underutilisation of preventive care among older adults, including fewer medical visits and lower flu vaccination rates (Vozikaki et al., 2017). Likewise, it can relate to COVID-19 vaccine hesitancy, by limiting access to vaccination information, increasing the risk of 'lagging behind' on preventive healthcare (Jaspal and Breakwell, 2022; Jolidon et al., 2024; Ukai and Tabuchi, 2023), and weakening civic responsibility to protect others (Ukai and Tabuchi, 2023).

Third, under reciprocal altruism theory, lonely individuals may feel fewer social rewards for following preventive health guidelines (Schultz and Newman, 2023). Loneliness may drive COVID-19 vaccine hesitancy by eroding trust, amplifying alienation (Galgali et al., 2023), anxiety, vaccine fears, conspiracies, and loss of control (Galgali et al., 2023; Stickley et al., 2021; Ukai and Tabuchi, 2023).

Furthermore, investigating psychosocial factors for men and women separately also matters. Despite higher risk perception of infection, women are often more hesitant than men, a COVID-19 gender paradox (Galasso et al., 2021; Toshkov, 2023). Gendered care dynamics also matter: older men in heterosexual relationships generally rely more on partners for support, while women draw from broader social networks, particularly adult children (Brandt et al., 2023). As women typically engage more in preventive behaviours, and men generally have worse health-seeking behaviour, cohabiting partnerships may particularly benefit men's health (Jolidon et al., 2024).

Thus, *we expect higher COVID-19 vaccine hesitancy among (i) European older adults living alone (H1), (ii) socially isolated European older adults (H2)*, and (iii) *lonely European older adults (H3), yet gender differences might be observed in the strength of the associations.*

3. Policy stringency as a moderator

Pandemic severity varied across Europe. Countries like Italy and Spain, adopted stricter distancing measures, due to high mortality. Others, like Sweden, adopted softer strategies based on recommendations rather than legal mandates (Al-Zubaidy et al., 2023; Kavaliunas et al., 2020; Waterschoot et al., 2023).

We hypothesize that more stringent national COVID-19 measures exacerbated the relationship between living alone, social isolation, loneliness and COVID-19 vaccine hesitancy among European older adults (H4). Under strict lockdowns, those living alone may have faced greater disconnection, reduced support, and less urgency to protect others, heightening fears of helplessness during vaccine complications (Zhang et al., 2022). Socially isolated older adults may have struggled further to access adequate vaccination information, amplifying the risk of falling behind on preventive healthcare (Jaspal and Breakwell, 2022; Jolidon et al., 2024; Ukai and Tabuchi, 2023). Loneliness, in stringent contexts, may have deepened alienation and distrust, fuelling anxiety, fear of side effects, conspiracy beliefs, and loss of control (Galgali et al., 2023; Stickley et al., 2021; Ukai and Tabuchi, 2023).

4. Methods

4.1. Data

This study utilised publicly available, anonymized data from the Survey of Health, Ageing and Retirement in Europe (SHARE), a cross-national longitudinal panel survey conducted every two years in 28 European countries and Israel since 2004, among representative samples of respondents aged 50 and over (Börsch-Supan et al., 2013). Regular data collection for Wave 8 was interrupted in 2020 due to COVID-19, prompting two additional SHARE Corona Surveys (SCS) in 2020 and 2021. These surveys transitioned from in-person to telephone interviews (Bergmann et al., 2024). The second SCS (SHARE-ERIC, 2024), which captured COVID-19 vaccine hesitancy, served as our primary dataset, supplemented by data from SHARE Waves 6 (2015), 7 (2017) and 8 (2019/2020), and SCS Wave 1, for predictor variables and accurate time-sensitive measurements (See Appendix A). The starting sample size was 46,081 individuals taking part in the first and second SCS. We excluded respondents aged below 50 ($N = 162$), not residing in nursing homes ($N = 384$), as those circumstances were unique, and with missings on relevant variables ($N = 8645$). The final analytical sample comprised 36,890 individuals across 28 countries, 21,912 women and 14,978 men.

4.2. Measurements

4.2.1. Individual-level

COVID-19 vaccine hesitancy was measured using a binary variable derived from two survey questions, similar to Delaruelle et al. (2025) and following the SAGE definition of vaccine hesitancy (MacDonald, 2015). First, respondents were asked whether they had received at least one dose of the COVID-19 vaccine. Those who replied 'No' were asked about their willingness to be vaccinated. Our binary variable includes:

'Not hesitant' (those who replied 'Yes' to the first question, and those who replied 'No' to the first question but 'Yes, I already have a vaccination scheduled' and 'Yes, I want to get vaccinated' to the second) and 'Hesitant' (those who replied 'No' to the first question and 'I'm still undecided' or 'No, I do not want to get vaccinated' to the second).

Psychosocial factors were measured at the beginning of the pandemic to account for potential reverse causality, providing a baseline of older adults' social situations.

Household composition combined household size and the presence of a partner within the household (0 = 'living alone'; 1= 'living with a partner; 2= 'living with a partner(and others)'; 3= 'living with others than a partner'). This categorisation builds on literature highlighting its importance for older adults (de Jong-Gierveld et al., 2012). Partners significantly influence preventive health attitudes, while other household members, such as adult children, may also play a distinct role (Arpino et al., 2023; Jackson et al., 2015; Vozikaki et al., 2017). This four-category distinction captures these unique influences, while maintaining model parsimony and theoretical clarity.

Social isolation was measured using the *Social Connectedness scale* derived from the SHARE data, covering network size, network proximity, contact frequency, network support, and network diversity (Litwin and Stoeckel, 2016). Factor analysis confirmed a single factor structure, with a Cronbach's alpha of 0.93. The scale ranges from 0 to 4 with higher scores reflecting greater connectedness and lower social isolation.

Loneliness was measured by asking respondents 'how often they feel lonely'. A dichotomous variable was created (0 = 'not lonely'/'hardly ever or never'; 1 = 'some of the time'/'often'), analogous to Arpino et al. (2022).

To address potential confounding, we included control variables based on research linking them to both the psychosocial predictors (Arpino et al., 2022; Cohn-Schwartz et al., 2022; Delaruelle et al., 2023; Heidinger and Richter, 2020; Peng and Roth, 2022), and to COVID-19 vaccine hesitancy (Arpino et al., 2023; Delaruelle et al., 2025; Liu et al., 2023; Okubo et al., 2021; Soares et al., 2021). By incorporating these variables as covariates in our regression models, we aim to isolate the independent associations of living alone, social isolation, and loneliness with vaccine hesitancy. These variables include: the *number of children* (continuous), *retirement* (employed = reference; retired and other, including unemployed, permanently sick or disabled and homemaker), *age groups* (50–64 = reference; 65–79; 80+), *health conditions* (continuous; including hip fractures, diabetes or high blood sugar, high blood pressure or hypertension, heart attack or other heart problems, chronic lung disease, cancer or malignant tumour and other health conditions), and *educational level* (based on the International Standard Classification of Education; low = reference = ISCED 0–2; middle = ISCED 3–4; high = ISCED 5–6). To define the number of children, both valid responses and imputed values provided by SHARE were used to account for missings (De Luca and Li Donni, 2024). These imputations were generated using the hot-deck method and the FCS method. Other variables had <0.1 % missing.

Table 1
Descriptive characteristics of adults aged 50+ in 28 European countries and Israel, based on SHARE Corona Surveys 1 (2020) and 2 (2021), with background variables from Waves 6 (2015), 7 (2017), and 8 (2019/2020) (N = 36,890).

Variable	Range	N(%)	Mean (SD)
Vaccine Hesitancy[e]			
Hesitant		5569 (15.1)	
Loneliness[d]			
Lonely		10,603 (28.7)	
Social connectedness[a,c]	0–4		2.0 (0.9)
Living Arrangements[d]			
Living alone		9558 (25.9)	
Living with a partner		19,189 (52.0)	
Living with a partner and others		5680 (15.4)	
Living with other(s) than a partner		2463 (6.7)	
Number of children[a,b,c]	0–19		2.1 (1.3)
Health Conditions[e]	0–7		1.4 (1.1)
Retirement[e]			
Retired		31,159 (84.5)	
Education[a,b,c]			
Low		12,137 (32.9)	
Middle		16,015 (43.4)	
High		8738 (23.7)	
Gender[e]			
Men		14,978 (40.6)	
Women		21,912 (59.4)	
Age in years[e]	50–105		71.6 (8.9)
Age groups[e]			
50–64		8678 (23.5)	
65–79		20,741 (56.2)	
80 and older		7471 (20.3)	

Data Source: SHARE waves 6[a], 7[b] and 8[c]; SHARE Corona Surveys 1[d] and 2[e]; release version 9.0.0.
SD: Standard Deviation.

4.2.2. Country-level

Pandemic policy stringency was measured using the Oxford COVID-19 Government Response Tracker (Hale et al., 2021). Composite indicators are valuable for capturing the multifaceted nature of policy environments, among which the OxCGRT Stringency Index is a well-established and suitable measure for assessing cross-national policy stringency, including among older adults (Kugai, 2023). The *stringency index* combines 19 indices into four composite indices: 1) Containment and closure, 2) Economic response, 3) Health systems, and 4) Miscellaneous policies. Ranging from 1 to 100 and reflecting the extent of lockdown policies and government public information campaigns, with higher scores indicating stricter measures. We calculated each country's mean index score from January to August 2021, as this timeframe aligns with SHARE Corona Wave 2, captures delayed effects of January 2021 policies amid an Omicron-driven infection peak, and covers the vaccination rollout from March 2021(Waterschoot et al., 2023).

To control for pandemic severity, we included national *excess mortality* due to COVID-19, calculated using Eurostat data. As a robust cross-national indicator of additional deaths (Statistics | Eurostat, 2024), excess mortality was measured over the same period (January–August 2021) to match the the stringency index timeframe.

4.3. Statistical analysis

Descriptive statistics summarised key sample characteristics and levels of vaccine hesitancy, including country-level variation. Bivariate associations between vaccine hesitancy and psychosocial factors for men and women separately were assessed using chi-square tests for categorical variables (with Cramér's V and Φ as effect size measures) and *t*-tests for continuous variables (with Cohen's *d* as effect size). Multilevel binomial logistic regression was then employed. To examine gender differences in both the outcomes and predictors of hesitancy, all models were estimated separately for women and men. The odds ratios and confidence intervals from the final model are presented, which includes all relevant predictors (*loneliness*, *social isolation*, *household composition*, and country-level *stringency*) and allows for random slope variation where appropriate. Cross-level interaction effects were tested but are not reported due to lack of significance. Intermediate steps are documented in the Appendix for reference. No overdispersion was detected (Pearson $\chi^2/df > 0.95$, $p > 0.90$), and all adjusted GVIF values were below two, indicating no collinearity concerns. Continuous variables were grand-mean centred. Model fit was evaluated using AIC, BIC, and log-likelihood comparison. All analyses used RStudio 4.4.0. and lme4.

5. Results

5.1. Descriptive statistics

Table 1 presents the descriptive statistics for the sample, revealing that only 14.7 % reported *COVID-19 vaccine hesitancy*. Country differences were substantial (see Table 2, Appendix B). Bulgaria (71.7 %) and Romania (63.0 %) reported the highest rates of *COVID-19 vaccine hesitancy*; whereas Malta, Portugal, Denmark, Spain, and Sweden each reported rates <3 %. Regarding *household composition*, most participants (52.0 %) lived solely with their partner, 25.9 % lived alone, 15.4 % lived with a partner and others, and 6.7 % lived with others than a partner. The mean *social connectedness* score was 2.0 (SD = 0.9) for the total sample (on a scale ranging from 0 to 4, indicating moderate social connectedness/isolation). *Loneliness* was reported by 28.7 % of the respondents.

Table 3 presents vaccine hesitancy by psychosocial factors. First, *household composition* revealed gendered disparities, most hesitant women lived with others (but not a partner) (27.4 %), compared to 21.8 % of hesitant men. The association between *household composition* and *vaccine hesitancy* was equally strong for women and men (Cramér's $V = 0.1$) and both were statistically significant ($p < 0.001$). Second, hesitant women reported higher mean social connectedness (1.9; SD = 0.9) than hesitant men (1.7; SD = 0.9), a trend mirrored among non-hesitant individuals (2.1 vs. 1.9). Effect sizes indicated a moderate difference (Cohen's $d = 0.9$ for women, $d = 0.9$ for men, $p < 0.001$). Finally, hesitancy was more common among lonely women (17.7 %) than men (16.7 %), and this pattern persisted among non-lonely individuals (women: 15.1 %, men: 13.1 %). The associations between *loneliness* and *vaccine hesitancy* were small but significant ($\Phi = 0.034$ for women, $\Phi = 0.043$ for men, $p < 0.001$).

5.2. Multivariable associations

Table 4 presents the gender-specific multivariable results from Model 4. For women living with other(s) than a partner, compared to living alone, was associated with greater hesitancy (OR = 1.45, p < 0.001). Women living with a partner (OR = 0.72, p < 0.001) compared to living alone and with higher *social connectedness* (i.e. less social isolation) (OR = 0.88, p < 0.001) reported lower hesitancy. *Loneliness* showed no net impact for women. For men, living with a partner compared to those living alone (OR = 0.67, p ⟨0,001) and more *social connectedness* (OR = 0.88, p < 0.001) were associated with lower hesitancy, while lonely men were more likely to be vaccine hesitant compared to those who did not feel lonely (OR = 1.24, $p < 0.01$). Unlike women, men living with others than a partner did not differ significantly from men living alone. The *stringency index* showed no significant main effect on *COVID-19 vaccine hesitancy*, but higher *excess mortality* was

Table 2
Country-level psychosocial characteristics and mean stringency index among vaccine-hesitant adults aged 50+ in 28 European countries and Israel, based on SHARE Corona Surveys 1 (2020) and 2 (2021), with background variables from Waves 6 (2015), 7 (2017), and 8 (2019/2020); includes mean stringency index scores by country and overall ($N_{countries} = 28$).

	Vaccine Hesitancy (%)	Vaccine hesitancy by Loneliness (%)		Vaccine hesitancy by Living Arrangements (%)				Social Connectedness for Vaccine Hesitant	Stringency Index
Country	Hesitant	Lonely	Not Lonely	Living Alone	Living with a Partner	Living with a partner and others	Living with Others than a partner	Mean	Mean
Austria	10.8	14.2	9.9	12	8.9	10.7	18.1	2.3	67.4
Belgium	3.9	4.1	3.8	6.7	1.7	5.6	6.1	2.1	57.1
Bulgaria	71.7	73.3	71.1	69.5	71.3	81	67.4	1.9	49.1
Croatia	24.8	26.5	23.9	26.7	23	23.5	33.1	2.1	45.0
Cyprus	14.3	14.4	14.2	18.9	12.1	8.6	30.8	1.5	65.2
Czech Republic	12	12.6	11.8	14.5	9.3	12.4	20.5	1.9	60.8
Denmark	1.4	0.6	1.5	2.3	1	1.5	0	2.5	56.7
Estonia	20.1	21	19.8	21.8	17	21.2	29.1	1.8	41.0
Finland	3.8	5.2	3.5	7.9	2.2	1.8	11.1	2.2	49.0
France	9.6	10.5	9.3	11.7	7.2	13	18.8	2.3	57.8
Germany	5.9	7.8	5.4	7.6	5.2	4.8	10.3	2.3	72.8
Greece	15.5	16.1	15.1	17.7	11.8	20.1	22.5	1.7	72.8
Hungary	11.2	9.5	11.7	7	12.9	12.7	11.8	2.0	57.1
Israel	5	10.2	2.3	7.4	2.3	6.2	12.5	1.8	52.3
Italy	6.2	7.1	5.6	6.3	4.6	7.3	11.9	1.7	70.3
Latvia	45.4	49.6	42.9	43.8	44.1	50.7	50.8	1.4	51.6
Lithuania	28.9	34.2	26.8	28	26.5	33.8	35.3	1.6	50.4
Luxembourg	4.8	8	3.7	4.9	4.4	4.7	8.1	1.4	47.6
Malta	1.9	1.9	1.9	1.5	1.1	3.4	0	1.3	56.0
Netherlands	3	4.5	2.6	6.4	0.8	0	18.2	2.3	64.3
Poland	20.3	23.9	18.8	21.2	16.3	21.8	31.2	1.7	60.5
Portugal	1.7	2.4	1.3	3.4	0.4	1.8	3	2.2	69.4
Romania	63	70.5	60.1	70.3	54.9	67.2	76.6	1.8	57.7
Slovakia	27.1	30.3	24.8	37.7	20	27.6	49.2	1.5	59.8
Slovenia	23.8	27	22.9	26.7	19.9	24.8	35	1.8	57.4
Spain	1.8	1.4	1.9	1.1	1.6	2.1	3.6	2.2	61.8
Sweden	2	0.9	2.3	2.9	1.7	0	0	2.2	58.3
Switzerland	14.7	16.5	14.2	14.7	14.1	15.6	24.4	2.1	51.5
Total Countries									
Stringency Index (0–100) - Mean (SD)	58.5 (9.3)								
Excess Mortality - Mean (SD)	10.6 (7.7)								

Data Source: SHARE Corona Survey 2; release version 9.0.0.
SD: Standard Deviation.

Table 3
Bivariate associations between psychosocial factors and COVID-19 vaccine hesitancy among adults aged 50+ in 28 European countries and Israel, based on SHARE Corona Surveys 1 (2020) and 2 (2021), with background variables from Waves 6 (2015), 7 (2017), and 8 (2019/2020) (N = 36,890).

	Women				Men			
	COVID-19 Vaccine hesitancy				COVID-19 Vaccine hesitancy			
	Hesitant	Not Hesitant	Effect Size	*p*-value	Hesitant	Not Hesitant	Effect Size	p-value
Loneliness - (%) - Φ			0.0	<0.001			0.0	<0.001
Lonely	17.7	82.3			16.7	83.3		
Not lonely	15.1	84.9			13.1	86.9		
Social connectedness (0–4) - Mean (SD) - d	1.9 (0.9)	2.1 (0.9)	0.9	<0.001	1.7 (0.9)	1.9 (0.9)	0.9	<0.001
Household composition - (%) - V			0.1	<0.001			0.1	<0.001
Living alone	16.5	83.5			15.3	84.7		
Living with a partner	12.6	87.4			11.1	88.2		
Living with a partner and others	18.5	81.5			17.7	82.3		
Living with others than a partner	27.4	72.6			21.8	78.2		

Data Source: SHARE waves 6, 7 and 8; SHARE Corona Surveys 1 and 2; release version 9.0.0.
SD: Standard Deviation, Φ: Phi, d: Cohen's d, V: Cramer's V.
Note. Percentages and means with standard deviations (SD) are reported. Group differences were assessed using chi-square tests (χ^2) for categorical variables and independent samples t-tests for continuous variables. Effect sizes are reported as Phi and Cramér's V for categorical variables and Cohen's d for continuous variables.

positively associated with higher *COVID-19 vaccine hesitancy* for both men (OR = 1.09, p < 0.01) and women (OR = 1.08, p < 0.001), irrespective of social circumstances.

Thereafter, we examined whether the effects of *living alone, social isolation* and *loneliness* varied across countries but did not reveal meaningful moderation effects.

Table 4
Odds ratios and 95 % confidence intervals for COVID-19 vaccine hesitancy among adults aged 50+, presented separately for women and men in 28 European countries and Israel, based on SHARE Corona Surveys 1 (2020) and 2 (2021), with background variables from Waves 6 (2015), 7 (2017), and 8 (2019/2020) (N_{women} = 21,912; N_{men} = 14,978).

	Women		Men	
Variables	OR	CI	OR	CI
Fixed effects	0.22	0.15, 0.32	0.18	0.11, 0.29
Loneliness (ref cat: not lonely)	1.03	0.91, 1.16	1.24	1.05, 1.48
Social isolation				
Social connectedness	0.87	0.83, 0.92	0.88	0.83, 0.94
Household composition (ref cat: living alone)				
Living with a partner	0.65	0.55, 0.76	0.65	0.50, 0.84
Living with a partner and others	0.78	0.64, 0.95	0.81	0.64, 1.02
Living with other(s) than a partner	1.45	1.24, 1.70	1.11	0.81, 1.52
Stringency Index	0.98	0.93, 1.02	0.95	0.90, 1.01
Random effects				
Residual variance (σ^2)	3.3		3.3	
Intercept (τ_{00})	0.8		1.2	
ICC	0.2		0.3	
Loneliness (τ_{11} - ρ_{01})	0.0	0.8	0.0	−0.1
Living with a partner (τ_{11} - ρ_{01})	0.1	0.7	0.2	0.2
Living with a partner and others (τ_{11} - ρ_{01})	0.1	0.8	0.0	0.6
Living with others than a partner (τ_{11} - ρ_{01})	0.0	−0.1	0.0	0.1
Model Fit				
Marginal R^2/Conditional R^2	0.1	0.3	0.2	0.4

Data Source: SHARE waves 6, 7 and 8; SHARE Corona Surveys 1 and 2; release version 9.0.0.
Models were controlled for: health conditions, number of children, retired and others (ref cat: employed), education level (ref cat: low, middle, high) and age categories (ref cat: 50–64, 65–79, 80+) and excess mortality (country level).
Estimates derived from multilevel logistic regression models.
OR: Odds Ratio, CI: Confidence Interval.
Note: only fixed effects were transformed into OR.

Robustness checks confirmed the stability of findings (Appendices *E*-K). First, stepwise inclusion of predictors showed consistent effects. Second, changes in household composition between the two SHARE Corona Surveys were minimal (<3 %), unlikely to bias results. Third, when examining pandemic-induced rather than *loneliness*, the effect disappeared, suggesting that vaccine hesitancy is tied to long-term loneliness over short-term shifts. An additional check comparing *loneliness* between SHARE Corona Survey 1 and 2 was carried out. A categorical variable capturing persistent loneliness, persistent absence of loneliness, and changes in loneliness revealed slight variations, however, the main results largely persisted. Therefore, the baseline *loneliness* measure was retained to ensure temporal consistency and comparability across variables.

Fourth, to account for increased social isolation during the pandemic, we controlled for pandemic-related contact frequency, but effect sizes remained unchanged. Fifth, cross-level interactions were tested individually and jointly, yielding similar results and no added explained variance. Sixth, country-level GDP per capita was excluded due to high collinearity with the *stringency index*. Seventh, a sensitivity analysis using a three-category outcome (vaccinated/willing, undecided, refusing) largely confirmed the main findings. Notably, for men, household composition predicted refusal rather than indecision, while for women, loneliness was related to indecision but not refusal. We retained the binary outcome for theoretical coherence with the SAGE (MacDonald, 2015) definition of vaccine hesitancy, which encompasses both refusal and indecision, and comparability with prior research. Finally age-stratified models (50–65, 65–80, 80+) showed consistent effect sizes and directions.

6. Discussion

This study explored how living alone, social isolation and loneliness separately relate to COVID-19 vaccine hesitancy among older Europeans, offering insights into the interplay between psychosocial vulnerabilities and preventive health decisions, within the context of the pandemic.

A key finding was the protective role of living with a partner. Older adults living with partners were less COVID-19 vaccine hesitant than those living alone, supporting the first hypothesis. This aligns with research emphasising partners as crucial for support and encouraging positive health decisions among older adults (Arpino et al., 2023; Jackson et al., 2015; Liu et al., 2023; Vozikaki et al., 2017). In crises, partners can encourage vaccination, protecting both themselves and others (Brandt et al., 2023). For men, partners particularly serve as a

primary health motivators, whereas women may be less exclusively influenced by their partner, due to broader networks.

Other household compositions added complexity. Women, unlike men, were more COVID-19 vaccine hesitant when living with others than a partner, adult children for example, compared to those living alone, contradicting the first hypothesis. While broader networks can benefit women, they can also act as conduits for conflicting or inaccurate information, potentially increasing uncertainty and hesitancy (Brandt et al., 2023). Men's attitudes seemed less shaped by wider household dynamics, reinforcing the centrality of the partner in men's health decisions.

Moreover, hegemonic masculinity ideals, particularly self-reliance, independence, and invulnerability, are known to discourage preventive health behaviours among men, especially older men, who may resist network influence to preserve a masculine identity (Christy et al., 2014; Springer and Mouzon, 2011). This identity often involves avoidance, denial, and viewing health discussions or help-seeking as 'feminine', fostering hesitancy (Jolidon et al., 2024). Our findings suggest that men may be especially reluctant to seek information or discuss COVID-19 vaccination with peers other than their partner.

Social isolation was associated with COVID-19 vaccine hesitancy for women and men. Older adults with lower social isolation were notably less hesitant, supporting the second hypothesis. This supports the idea that social isolation may limit sufficient and adequate information access and weaken civic responsibility, undermining preventive healthcare use among older populations (Jaspal and Breakwell, 2022; Ukai and Tabuchi, 2023; Vozikaki et al., 2017).

Feeling lonely was only associated with higher COVID-19 vaccine hesitancy among men, partially confirming the third hypothesis. This echoes research suggesting that loneliness is associated with heightened anxiety, mistrust, worry, and paranoia, factors that may discourage vaccination (Galgali et al., 2023; Schultz and Newman, 2023; Stickley et al., 2021; Ukai and Tabuchi, 2023). The finding also reflects the gendered nature of loneliness and masculinity. Older men, often with more limited social networks, may struggle to express emotional distress due to dominant masculine norms emphasising self-reliance, invulnerability, emotional restraint, and distinct coping mechanisms (Christy et al., 2014; Springer and Mouzon, 2011; Willis and Vickery, 2022). This can limit support-seeking, discussing health concerns, and processing loneliness in constructive ways, thereby reinforcing vaccine hesitancy. Pursuing 'successful ageing' through independence can intensify disconnection, mistrust, and detachment from broader societal expectations, including preventive health behaviours like vaccination (Stickley et al., 2021; Willis and Vickery, 2022). In contrast, the absence of this effect among women may reflect different coping strategies and a greater willingness to addressing loneliness through health-seeking behaviour and social support.

Lastly, contrary to hypothesis four, stricter lockdown policies did not intensify the negative association between psychosocial factors and COVID-19 vaccine hesitancy among older adults. One explanation is that the stringency index does not consider how people evaluate and respond to the restrictions. As Waterschoot et al. (2023) argue, the effects of restrictive measures depend on their perceived proportionality to the epidemiological situation. Individuals may view the same policy measures differently depending on how justified or necessary they perceive them to be. Perceived proportionality, both across and within countries, may vary across populations, masking consistent moderating effects of policy stringency at the macro level. In some contexts, strict policies may be accepted and reassuring; in others, they may feel overly harsh or demotivating. This variability likely complicates detecting clear and uniform patterns. Future research should therefore consider objective policy measures, and how they are perceived by different populations.

This study has limitations. First, social desirability bias may have led to under- and misreporting vaccine hesitancy (Wolter et al., 2022), potentially affected by respondents' level of social connection. Second, we did not empirically assess the mediating pathways, which went beyond the study's scope. Third, while the stringency index is valuable for macro-level analysis, it does not capture restrictions specifically addressing unvaccinated individuals (Hale et al., 2021). Therefore, we cannot assess whether such directed policies potentially influenced vaccine hesitancy in either direction. Moreover, although the index did not moderate psychosocial effects, vaccine attitudes remain highly context-dependent (Dubé and MacDonald, 2022), shaped by social, economic, historical, political, organisational, and cultural factors. Future research could examine how societal levels of individualism–collectivism shape COVID-19 vaccine hesitancy and its psychosocial determinants (Hofstede, 2011). Fourth, although key sociodemographic and health-related confounders were included, other unmeasured factors, such as trust in governments, may have influenced the associations. Residual confounding should be considered when interpreting findings. Fifth, while using baseline measures of psychosocial helps reduce reverse causality, it may miss pandemic-induced shifts in psychosocial factors. However, robustness checks using alternative indicators and timing support the stability of results.

Furthermore, findings should not be overgeneralised to other vaccination contexts. COVID-19 vaccine hesitancy emerged during a unique public health crisis marked by high uncertainty, strong government measures, and politicised debate, unlike routine vaccination settings, where other factors me be at play. For instance, the crisis evoked political debate about the appropriateness of far-reaching distancing measures and COVID-19 vaccination campaigns, with concerns around independence, freedom, privacy, rights and responsibilities (Settersten Jr et al., 2020). Future research should examine whether similar patterns appear in less crisis-driven contexts, like seasonal vaccinations or other preventive health domains.

Nevertheless, this study has several strengths. First, SHARE data enabled precise timing, helping to address time lags and reducing risk of reversed causality, though definitive causal claims remain premature. Second, while previous research has examined the impact of the COVID-19 crisis on loneliness and social isolation (Cohn-Schwartz et al., 2022; Heidinger and Richter, 2020; Krendl and Perry, 2021; Peng and Roth, 2022; Van Tilburg et al., 2021), this paper advances understanding of psychosocial factors in preventive health behaviour. Lastly, following Victor et al. (2000), it offers a novel contribution by distinguishing between living alone, social isolation, and loneliness among older adults during the pandemic.

7. Conclusion

This paper confirms that psychosocial factors shape COVID-19 vaccine hesitancy among older adults. Future health policies should move beyond solely epidemiological threats and address psychosocial dimensions of health crises. Compassionate and effective measures must consider the unique social contexts of older adults to ensure equitable health outcomes. Evidence-based interventions include providing clear, accessible vaccine information, physician recommendations (Okubo et al., 2021; Sabat et al., 2020; Stickley et al., 2021; Zhang et al., 2022); offering outreach initiatives and follow-up services, for example, checkups, phone calls, and home visits (Zhang et al., 2022); and providing practical support, including accessible vaccination services and walk-in assistance, to overcome logistical barriers (Zhang et al., 2022). Additionally, routine loneliness screenings in primary care could also support socially vulnerable individuals (Schultz and Newman, 2023; Stickley et al., 2021). These strategies can strengthen confidence in vaccination efforts and foster greater trust in public health initiatives.

However, community outreach alone is insufficient. The pandemic revealed the need for broader structural reorganisation of social life. Loneliness, isolation and their health consequences during crises are not merely individual experiences but symptoms of deeper societal fragmentation and excessive emphasis on individual autonomy. Building resilience for future health crises requires collective solidarity beyond micro-acts of kindness. Instead, long-term societal rearrangements that

support interdependence, such as multigenerational housing, community-oriented urban design, and inclusive social policies, should reflect health's social nature. The pandemic underscored that health and wellbeing are fundamentally public and relational, not purely individual. Without structural change, existing systems risk perpetuating or deepening health inequalities, particularly among older adults.

Addressing the psychosocial roots of vaccine hesitancy is not just key to managing this pandemic, but also provides a blueprint for a more resilient, inclusive approach to future health crises.

Data sharing declaration

The SHARE data are distributed by SHARE-ERIC (Survey of Health, Ageing and Retirement in Europe – European Research Infrastructure Consortium) to registered users through the SHARE Research Data center. Access to the data collected and generated in the SHARE projects is provided free of charge for scientific use globally, subject to European Union and national data protection laws as well as the publicly available conditions of use (http://www.share-project.org).

CRediT authorship contribution statement

Valentien Taeldeman: Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis, Conceptualization. **Maaike Paredis:** Writing – review & editing, Project administration. **Elise Braekman:** Writing – review & editing. **Kirsten A. Verhaegen:** Writing – review & editing. **Piet Bracke:** Writing – review & editing, Supervision. **Katrijn Delaruelle:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used ChatGPT in order to improve language. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2025.108325.

Data availability

Data from SHARE are freely available for scientific use upon registration, subject to EU and national data protection laws and SHARE's publicly available conditions of use.

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