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Effect of the COVID-19 pandemic on the well-being of middle-aged and older Europeans

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The COVID-19 pandemic has been associated with a general decline in well-being. However, there is limited evidence on the effect of the pandemic on the general population, and especially among the ageing population. We assessed the overall impact of the pandemic on the well-being of middle-aged and older adults residing in 27 European countries, focusing on the time-period before summer 2021. We used a sample of 46,209 respondents from the two population-based longitudinal Corona Surveys collected during summer 2020 and summer 2021. To test our hypotheses, we used latent change score models. All analyses were stratified by sex. The COVID-19 pandemic affected middle-aged and older Europeans' well-being irrespective of their sex. Being infected by the COVID-19 virus at the start of the pandemic had a negative impact on well-being. As expected, adults with Long COVID experienced the most pronounced decline in well-being. A novel finding was the decline in the level of well-being among adults not infected by the COVID-19 virus. Support should be provided at community levels with specific attention towards individuals with Long COVID symptoms and those infected with COVID-19 at earlier stages of the pandemic.

Keywords Well-being, COVID-19 pandemic, Elderly, SHARE, Longitudinal study, Latent score change

The coronavirus disease (COVID-19) outbreak, a global pandemic declared in early 2020, resulted in a substantial increase in morbidity and mortality with more than 277 million confirmed cases and over two million deaths reported in Europe before the end of 2023[1]. In our previous study, we estimated that 71.6% of Europeans who contracted the SARS-CoV-2 virus continued to experience symptoms in a phenomenon referred to as Long COVID[2].

Acquiring COVID-19 illness has been associated with poorer mental health and well-being[3,4]. Plausible explanations for this relationship have been brought forward including biological vulnerabilities to mental health disorders and behavioural factors[5]. In addition, the pandemic impacted on psychological pathways through enhancement of population stress and anxiety arising from fear of contracting the virus, concern about relatives' health, bereavement of loved ones along with the unpredictability of the pandemic[6–10]. The imposed economic stress along with social isolation could have also triggered these psychological pathways[8]. The shift to remote working was a psychological trigger for some, resulting in anxiety and depression[11]. In addition, the pandemic impacted on the social pathways resulting in negative consequences on mental health and wellness. The pandemic widened existing social disparities through unemployment, racial discrimination, and food insecurity among other impacted social determinants of health affecting both adolescents and adults alike with a consequential negative impact on their mental health and wellbeing[12–14].

Individuals suffering from Long COVID have also been reported to have poorer well-being[3,15]. It is also expected that the COVID-19 pandemic, partially due to various containment and restriction measures, had a negative effect on the well-being of all individuals, regardless of whether or not they were infected by the SARS-CoV-2 virus[16,17]. A longitudinal cohort study conducted in England reported a significant increase in depressive and anxiety symptoms, loneliness, as well as deterioration in the quality of life when comparing participants' health outcomes before and during the first year of the pandemic[18]. Studies conducted in Belgium as well as in the Middle East and North Africa presented similar results[19,20]. Despite this, there is limited evidence on the effect of the COVID-19 pandemic on well-being in the general population, especially among middle-aged and older adults[18,21–23]. Europe has an ageing population[24] that brings forward the need for a deeper understanding of the effect of the pandemic on the well-being of its residents across different pandemic

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phases while considering socioeconomic characteristics and underlying morbidities. Such evidence is needed for post-pandemic strategic health planning.

In this study, we aimed to assess the overall impact of the COVID-19 pandemic on the well-being of middle-aged and older adults residing in 27 European countries, focusing on the time-period before summer 2021. Specifically, we estimated the level of well-being in summer 2020 and the change in well-being between summer 2020 and summer 2021 in four groups: (i) adults infected by the SARS-CoV-2 virus before summer 2020, (ii) adults infected after summer 2020 but before summer 2021, (iii) adults who reported symptoms associated with Long COVID in summer 2021, and (iv) adults who did not report having COVID-19 illness at both time points.

We hypothesized that (H1) adults who were infected by the SARS-CoV-2 virus before summer 2020 had poorer well-being at that time than individuals who were not infected before summer 2020. We also predicted that (H2) all adults, regardless of whether or not they were infected by the SARS-CoV-2 virus, experienced a decline in well-being between summer 2020 and summer 2021. Finally, in terms of the across-group differences, we predicted that, compared to individuals who were not infected at both time points, (H3) adults infected after summer 2020 experienced a stronger decline in well-being, (H4) with this decline being even more pronounced among those who reported Long COVID symptoms.

There is overwhelming evidence of prominent sex differences in the prevalence and expression of numerous mental health outcomes. In addition, taking into account that levels of well-being[25] and the likelihood of COVID-19 illness and Long COVID[26–32] differ for females and males, we conducted sex stratified analysis and tested our hypotheses separately for females and males. We also controlled for age, pre-existing chronic conditions[2,26,33–40], and socioeconomic characteristics[2,34,36,41–44] that are commonly associated with well-being and the risk of COVID-19 illness.

Results

The unweighted frequencies and weighted descriptive statistics for the repeated binary indicators of the well-being construct, as well as for the baseline confounders, are presented in Table 1. The average age at baseline was 68.3 years for females and 67.9 years for males; 59.3% of females and 79.0% of males lived with a partner while 66.4% of females and 67.6% of males reported having at least one chronic condition. Compared to males, females were less likely to have a post-secondary or higher level of education (24.6% versus 28.1%) and to be employed (21.1% versus 28.1%); they also had lower relative household income (5.6 versus 6.4).

At baseline, 2.2% of females and 1.9% of males reported that they were infected by the SARS-CoV-2 virus before summer 2020 and an additional 2.2% of females and 2.7% of males had COVID-19 illness between summer 2020 and summer 2021 but did not report any of the lingering symptoms. There were also 5.9% of females and 5.0% of males in the general population of middle-aged and older Europeans who, at the follow-up, reported at least one persistent symptom associated with Long COVID. However, the majority of females (87.8%) and males (88.5%) were not affected by the SARS-CoV-2 virus at both time points. Finally, 1.9% of females and 2.0% of males did not provide sufficient information to allow us to assess their COVID-19 illness status.

At baseline and at the follow-up, a significantly ($p < 0.001$) higher proportion of females reported that they: felt *nervous*, anxious, or on edge (t_1 34.9% versus 23.3%, t_2 37.3% versus 25.9%); were *sad* or depressed (t_1 33.5% versus 19.2%, t_2 36.6% versus 22.6%); had trouble *sleep*ing (t_1 32.4% versus 20.9%, t_2 36.2% versus 24.3%); and felt *lonely* (t_1 34.6% versus 21.1%, t_2 36.8% versus 23.5%). Tests of across-time differences in these four repeated indicators suggested that, for both females and males, the likelihood of feeling *nervous*, *sad*, *lonely*, or having trouble *sleep*ing increased over time ($p < 0.001$).

As indicated in Table 2, the goodness-of-fit indices for the initial configural models for the well-being construct indicate that the proposed model fits the data fairly well in the sample of females (χ^2=206.68 [df=15], CFI=0.996, TFI=0.992, RMSEA=0.022) and in the sample of males (χ^2=126.49 [df=15], CFI=0.995, TFI=0.992, RMSEA=0.020). There were no substantial modification indices justifying adjustments to the proposed model and all indicators had relatively high standardized factor loadings (from 0.533 to 0.933 for females and from 0.586 to 0.918 for males). The strongest relationship at both time points and for both sexes was between the latent factor and the *sad* indicator, followed by the *nervous* indicator, the *lonely* indicator, and the *sleep* indicator.

The changes in the goodness-of-fit indices between the nested measurement models (configural versus scalar and scalar versus strict) suggest across-time measurement invariance in the well-being construct for females (ΔCFI, ΔTLI, ΔRMSEA < 0.001) and for males (ΔCFI, ΔTLI, ΔRMSEA < 0.002). Based on these results, the final measurement model with strong (scalar) invariance was used for the latent change score (LCS) analyses as our objective was to compare the means of latent factors.

Having established measurement invariance for the well-being construct, we fitted multigroup LCS models to test our hypotheses related to the effects of the COVID-19 pandemic on well-being and across-group differences in these effects. Table 3 presents the parameter estimates from the multigroup LCS models, separately for females and males as well as for the five COVID-19 illness groups ('No COVID illness', 'COVID illness at baseline', 'COVID illness at follow-up', 'Long COVID at follow-up', 'COVID illness unknown'). Specifically, the table presents the means of latent factor score at baseline (μWB_{t1}), the means of latent change factor (μWB_{Δ}), and variances in and covariance between these two latent factors ($\sigma 2WB_{t1}$,$\sigma 2WB_{\Delta}$, $covWB_{t1-\Delta}$) with their standard errors [SEs] and p-values. We also depicted trajectories of change in the well-being construct (see Fig. 3a for females and 3b for males) to allow for a more intuitive interpretation of the estimated across-group differences in the effect of the pandemic on well-being. Finally, the lower part of Table 3 shows the parameter estimates for the impact of the confounding variables on the latent factor scores (μWB_{t1}) and the latent change factors (μWB_{Δ}) and goodness-of-fit indices.

		Females ($n = 27,032$)		Males ($n = 19,177$)		Females vs. Males	
Categorical variables	**Category**	**Frequency**	**Percent**	**Frequency**	**Percent**	**Chi-square**	***p*-value**
		(Unweighted)	(Weighted)	(Unweighted)	(Weighted)		
COVID-19 illness group	No COVID illness	23,707	87.8	16,931	88.5	33.9	< 0.0001
	COVID illness at baseline	472	2.2	284	1.9		
	COVID illness at follow-up	580	2.2	499	2.7		
	Long COVID at follow-up	1,709	5.9	1,062	5.0		
	COVID illness unknow	564	1.9	401	2.0		
$nervous_{t1}$	Yes	9,263	34.9	4,458	23.3	716.8	< 0.0001
	No	17,716	65.1	14,683	76.7		
	Missing	53		36			
$nervous_{t2}$	Yes	9,934	37.3	4,984	25.9	660.5	< 0.0001
	No	16,984	62.7	14,102	74.1		
	Missing	114		91			
sad_{t1}	Yes	8,408	33.5	3,434	19.2	1,153.9	< 0.0001
	No	18,560	66.5	15,687	80.9		
	Missing	64		56			
sad_{t2}	Yes	9,519	36.6	4,204	22.6	1,025.9	< 0.0001
	No	17,388	63.4	14,862	77.4		
	Missing	125		111			
$sleep_{t1}$	Yes	8,736	32.4	4,059	20.9	736.4	< 0.0001
	No	18,259	67.7	15,098	79.1		
	Missing	37		20			
$sleep_{t2}$	Yes	9,872	36.2	4,749	24.3	743.5	< 0.0001
	No	17,093	63.8	14,377	75.7		
	Missing	67		51			
$lonely_{t1}$	Yes	8,906	34.6	3,904	21.1	743.5	< 0.0001
	No	18,039	65.5	15,181	78.9		
	Missing	87		92			
$lonely_{t2}$	Yes	9,677	36.8	4,385	23.5	927.2	< 0.0001
	No	17,205	63.2	14,650	76.6		
	Missing	150		142			
Age	< 65	9,256	39.8	6,056	40.7	3.5	0.0619
	>= 65	17,776	60.2	13,121	59.3		
Partner	Yes	16,456	59.3	15,724	79.0	1,973.9	< 0.0001
	No	10,576	40.7	3,453	21.0		
Chronic conditions	Yes	18,602	66.4	13,489	67.7	7.8	0.0053
	No	8,404	33.6	5,673	32.3		
	Missing	26		15			
Education	Secondary or lower	19,598	75.3	13,373	71.7	74.7	< 0.0001
	Post-secondary or higher	7,307	24.7	5,718	28.3		
	Missing	127		86			
Employment	Yes	5,153	22.1	4,273	28.1	218.4	< 0.0001
	No	21,879	77.9	14,904	71.9		
Proxy	Yes	1,095	4.4	1334	6.2	73.9	< 0.0001
	No	25,920	95.6	17,838	93.8		
	Missing	17		5			
Continuous Variables		**Mean**	**SD**	**Mean**	**SD**	**t-test**	***p*-value**
		(Weighted)	(Weighted)	(Weighted)	(Weighted)		
Age		68.3	9.8	67.9	8.9	4.4	< 0.0001
Income (in deciles)		5.6	2.9	6.4	2.8	27.8	< 0.0001
Across-time Differences		**Chi-square**	***p*-value**	**Chi-square**	***p*-value**		
		(Weighted)	(Weighted)	(Weighted)	(Weighted)		
$nervous_{t1\ vs.\ t2}$		2,686	< 0.0001	1,919	< 0.0001		
$sad_{t1\ vs.\ t2}$		3,308	< 0.0001	2,297	< 0.0001		
$sleep_{t1\ vs.\ t2}$		3,932	< 0.0001	2,759	< 0.0001		
$lonely_{t1\ vs.\ t2}$		5,769	< 0.0001	3,434	< 0.0001		

Table 1. Descriptive statistics for the study variables by sex. Source: SHARE, Corona Survey 1 (summer 2020) and Corona Survey 2 (summer 2021); SHARE main surveys, Wave 7 (2017) and Wave 8 (2019-2020); n = 46,209 (27,032 females and 19,177 males). Frequency: unweighted frequency distribution; Percent: calibrated individual cross-sectional sampling weights from the Corona Survey 1 were used to compute percentages; n: sample size; SD: standard deviation; t_1: summer 2020 (baseline); t_2: summer 2021 (the follow-up).

The multigroup LSC models showed good overall fit as the goodness-of-fit indices for females (χ^2=2,423.10 [df = 430], CFI = 0.962, TFI = 0.953, RMSEA = 0.029) and for males (χ^2=1,364.82 [df = 430], CFI = 0.965, TFI = 0.957, RMSEA = 0.024) indicate that the proposed model fits the data well. Inspection of the means of latent factor score at baseline suggests that, as hypothesized (H1), females (μWB_{t1}=0.524, p = 0.002) and males (μWB_{t1}=0.743, p < 0.001) who were infected by the COVID-19 virus before summer 2020 had, on average, poorer well-being than individuals who did not experience COVID-19 illness at both time points (females: $\Delta\chi^2[1] = 8.843$, p = 0.003; males: $\Delta\chi^2[1] = 10.344$, p = 0.001) or who were infected after summer 2020 (females: $\Delta\chi^2[1] = 12.062$, p < 0.001; males: $\Delta\chi^2[1] = 4.396$, p = 0.036); they also had poorer well-being than males ($\Delta\chi^2[1] = 4.091$, p = 0.043), but not females ($\Delta\chi^2[1] = 3.100$, p = 0.078), who reported Long COVID symptoms after summer 2021. We also observed that females ($\Delta\chi^2[1] = 0.669$, p = 0.414) and males ($\Delta\chi^2[1] = 0.014$, p = 0.906) who did not provide information on their COVID-19 illness did not differ, on average, from individuals who were infected by the COVID-19 virus before summer 2020.

In terms of the rate of change in well-being, as hypothesized (H2), females (μWB_{Δ}=0.173, p < 0.001) and males (μWB_{Δ}=0.221, p < 0.001) who did not report COVID-19 illness at both time points as well as females (μWB_{Δ}=0.583, p < 0.001) and males (μWB_{Δ}=0.770, p < 0.001) who reported Long COVID symptoms experienced, on average, a statistically significant decline in well-being. However, contrary to what we expected, there was no statistically significant decline in well-being among females and males in the remaining three COVID-19 illness groups ('COVID illness at baseline' [p_f=0.985, p_m=0.874]; 'COVID illness at follow-up' [p_f=0.775, p_m=0.353]; and 'COVID illness unknown' [p_f=0.115, p_m=0.753]). The tests for the remaining two hypotheses related to group differences suggest that, as expected (H4), both females ($\Delta\chi^2[1] = 23.066$; p < 0.001) and males ($\Delta\chi^2[1] = 17.390$; p < 0.001) with Long COVID symptoms had a significantly more pronounced decline in well-being than those who did not have COVID-19 illness across the two time points. However, contrary to our prediction (H3), adults infected after summer 2020 did not experience a more pronounced decline in well-being than adults who did not have COVID-19 illness across the two time points (females: $\Delta\chi^2[1] = 0.784$, p = 0.376; males: $\Delta\chi^2[1] = 3.736$, p = 0.053).

The results for the variances in and covariances between latent factors suggest that there was a statistically significant level of inter-individual differences in well-being in all five groups and in both samples. We also found statistically significant inter-personal variability in the rate of change in well-being among females and males in all groups, except for males from the 'COVID illness at baseline' group. Finally, statistically significant covariances between the latent factors were reported among females and males from the 'No COVID illness', 'Long COVID at follow-up', and 'COVID illness unknown' groups as well as among females from the 'COVID illness at baseline' group. The negative values for these covariances suggest that adults who had poorer well-being at baseline experienced, on average, a lower rate of change in well-being across time.

The results for the impact of the confounders on the latent factor score at baseline suggest that, for both females and males, adults 65 years and older (b_f=-0.142, p = 0.005; b_m=-0.303, p < 0.001), individuals living with a partner (b_f=-0.727, p < 0.001; b_m=-0.894, p < 0.001), those with post-secondary education (b_f=-0.302, p < 0.001; b_m=-0.181, p = 0.003), employed (b_f=-0.343, p < 0.001; b_m=-0.589, p < 0.001), and those with higher relative household income (b_f=-0.045, p < 0.001; b_m=-0.060, p < 0.001) had a higher level of well-being than their counterparts while adults living with chronic conditions (b_f=0.621, p < 0.001; b_m=0.759, p < 0.001) had poorer well-being, comparing to those without chronic conditions. In terms of the impact of the confounders on the rate of change in well-being, our results imply that age was the only predictor that had a statistically significant effect in both samples (b_f=0.136, p = 0.009; b_m=0.185, p < 0.008); that is, older adults experienced a higher level of decline in well-being, compared to individuals under the age of 65. In addition, females living with a partner (b_f=0.176, p < 0.001), having post-secondary education (b_f=0.141, p = 0.003), and living with chronic conditions (b_f=0.091, p < 0.047) experienced a higher level of decline in well-being than their counterparts. Among males, those who were employed (b_m=0.186, p = 0.030) experienced a higher level of decline in well-being while those with higher household income had a lower level of decline in well-being (b_m=-0.026, p = 0.014).

Discussion

Our study aimed to explore the overall effect of the COVID-19 pandemic on the well-being of middle-aged and older Europeans before summer 2021. This was carried out through testing four hypotheses to assess the overall impact of the pandemic among females and males who were or were not infected by COVID-19 virus at different waves of the pandemic. Our results suggest that in summer 2020, individuals infected with COVID-19 virus during the first wave of the pandemic, irrespective of their sex, were found to have experienced a more pronounced well-being burden, possibly due to acquiring the COVID-19 illness at an early stage[4]; another possibility could be the uncertainty on the disease's pathophysiology and management with limited knowledge of the disease outcome at the time[45,46]. It needs to be noted that the reported high mortality rate, with an excess mean global mortality per capita of 0.06% for 2020, would have further impacted the well-being of those infected with COVID-19 and their relatives[47]. Sudden deaths due to COVID-19 have contributed to "emotional shock" among relatives and families, as well as the "fear of the future", which inevitably impacted the well-being[48]. However, we cannot exclude that other unmeasured factors such as the mask mandates could have affected both the well-being and the risk of acquiring the infection during this period[49]. Our study further identified that individuals infected by COVID-19 virus prior to summer 2020 continued having poorer well-being until the end of the follow-up in summer 2021 which might be due to long-term psychological distress originating from being infected early in the pandemic, coinciding with previous literature[3,50]. This could also be due to the sensitization effect, where the ongoing COVID-19 pandemic acted as a stressful stimulus, resulting in the reinforcement of negative effects on mental health[51].

In terms of the well-being trajectories between summer 2020 and summer 2021, as expected, our results indicate that middle-aged and older adults experiencing lingering symptoms following their acute COVID

	Females ($n = 27{,}032$)					Males ($n = 19{,}177$)				
Model	**Goodness-of-fit statistics**					**Goodness-of-fit statistics**				
	Chi-sq. [df]	***p*-value**	**CFI**	**TLI**	**RMSEA**	**Chi-sq. [df]**	***p*-value**	**CFI**	**TLI**	**RMSEA**
Configural (weak)	206.68 [15]	0.000	0.996	0.992	0.022	126.49 [15]	0.000	0.995	0.992	0.020
Scalar (strong)	209.99 [17]	0.000	0.996	0.993	0.020	125.07 [17]	0.000	0.996	0.993	0.018
Strict	235.53 [21]	0.000	0.995	0.993	0.019	131.45 [21]	0.000	0.995	0.994	0.017
	Chi-sq. [df]	***p*-value**	**ΔCFI**	**ΔTLI**	**ΔRMSEA**	**ΔChi-sq. [df]**	***p*-value**	**ΔCFI**	**ΔTLI**	**ΔRMSEA**
Scalar vs. Configural	2.33 [2]	0.312	0.000	0.001	0.001	1.66 [2]	0.436	0.001	0.001	0.002
Strict vs. Scalar	36.59 [4]	0.000	-0.001	0.000	0.001	14.36 [4]	0.000	-0.001	0.001	0.001
Model	**Factor Loadings**					**Factor Loadings**				
Configural	**Estimate**	**SE**	**Threshold**	**R square**	**Stand**	**Estimate**	**SE**	**Threshold**	**R square**	**Stand**
WB_{t1}										
sad_{t1}	1.000	0.000	0.983	0.812	0.901	1.000	0.000	2.200	0.843	0.918
$nervous_{t1}$	0.540	0.035	0.583	0.558	0.747	0.498	0.049	1.113	0.571	0.756
$sleep_{t1}$	0.318	0.019	0.549	0.304	0.551	0.312	0.027	1.000	0.343	0.586
$lonely_{t1}$	0.355	0.021	0.494	0.352	0.593	0.320	0.028	0.999	0.354	0.595
WB_{Δ}										
sad_{t2}	1.000	0.000	0.954	0.871	0.933	1.000	0.000	1.847	0.834	0.913
$nervous_{t2}$	0.470	0.037	0.512	0.598	0.774	0.599	0.051	1.084	0.644	0.802
$sleep_{t2}$	0.243	0.017	0.416	0.284	0.533	0.324	0.024	0.862	0.345	0.588
$lonely_{t2}$	0.287	0.021	0.420	0.357	0.598	0.339	0.026	0.910	0.366	0.605
Scalar	**Estimate**	**SE**	**Threshold**	**R square**	**Stand**	**Estimate**	**SE**	**Threshold**	**R square**	**Stand**
WB_{t1}										
sad_{t1}	1.000	0.000	0.982	0.814	0.902	1.000	0.000	2.176	0.838	0.915
$nervous_{t1}$	0.535	0.034	0.585	0.556	0.746	0.513	0.043	1.112	0.575	0.759
$sleep_{t1}$	0.317	0.019	0.545	0.306	0.553	0.321	0.025	0.998	0.347	0.589
$lonely_{t1}$	0.351	0.021	0.500	0.350	0.591	0.324	0.026	1.001	0.352	0.593
WB_{Δ}										
sad_{t2}	1.000	0.000	0.982	0.869	0.932	1.000	0.000	2.176	0.838	0.915
$nervous_{t2}$	0.535	0.034	0.585	0.599	0.774	0.513	0.043	1.112	0.640	0.800
$sleep_{t2}$	0.317	0.019	0.545	0.282	0.531	0.321	0.025	0.998	0.343	0.585
$lonely_{t2}$	0.351	0.021	0.500	0.359	0.599	0.324	0.026	1.001	0.369	0.607
Strict	**Estimate**	**SE**	**Threshold**	**R square**	**Stand**	**Estimate**	**SE**	**Threshold**	**R square**	**Stand**
WB_{t1}										
sad_{t1}	1.000	0.000	1.078	0.838	0.915	1.000	0.000	2.141	0.832	0.912
$nervous_{t1}$	0.508	0.028	0.605	0.572	0.756	0.546	0.039	1.164	0.597	0.772
$sleep_{t1}$	0.280	0.014	0.513	0.288	0.537	0.318	0.020	0.969	0.335	0.579
$lonely_{t1}$	0.321	0.016	0.493	0.347	0.589	0.329	0.021	0.994	0.350	0.591
WB_{Δ}										
sad_{t2}	1.000	0.000	1.078	0.846	0.920	1.000	0.000	2.141	0.844	0.919
$nervous_{t2}$	0.508	0.028	0.605	0.586	0.766	0.546	0.039	1.164	0.618	0.786
$sleep_{t2}$	0.280	0.014	0.513	0.300	0.548	0.318	0.020	0.969	0.355	0.596
$lonely_{t2}$	0.321	0.016	0.493	0.361	0.601	0.329	0.021	0.994	0.371	0.609

Table 2. Estimates from the binary CFA model by sex. Source: SHARE, Corona Survey 1 (summer 2020) and Corona Survey 2 (summer 2021); SHARE main surveys, Wave 7 (2017) and Wave 8 (2019-2020); $n = 46{,}209$ (27,032 females and 19,177 males). n: sample size; df: degrees of freedom; SE: standard error; CFI: comparative fit index; TLI: Tucker–Lewis index; RMSEA: root mean square error of approximation; Stand: standardized factor loading; WB_{t1}: latent factor score for the well-being construct at baseline; WB_{Δ}: the latent change factor for change in the well-being construct; t_1: summer 2020 (baseline); t_2: summer 2021 (the follow-up); * Statistically significant change across waves ($p < 0.05$).

infection, referred to as Long COVID[52], also suffered from a decline in their well-being, irrespective of their sex. Indeed, it has been reported that Long COVID is associated with increased anxiety, depressive symptoms as well as decreased life satisfaction[53,54]. These findings bring forward the recommendation that action plans focusing on individuals experiencing lingering COVID-19 effects (as opposed to those with the acute COVID-19 illness) should be established as the presence of Long COVID symptoms appears to have a negative effect on the future trajectories of well-being and potentially on trajectories of other health outcomes.

	Females ($n = 27,032$)					Males ($n = 19,177$)				
No COVID illness	**Estimate**	**SE**	**t-value**	***p*-value**	**Stand**	**Estimate**	**SE**	**t-value**	***p*-value**	**Stand**
Means of latent factors										
μWB_{t1}	0.000	0.000	999.000	999.000	0.000	0.000	0.000	999.000	999.000	0.000
μWBΔ	0.173	0.023	7.470	0.000	0.105	0.221	0.040	5.558	0.000	0.127
Variance										
$\sigma 2WB_{t1}$	3.578	0.256	13.959	0.000	0.906	3.891	0.391	9.959	0.000	0.897
μWB_{Δ}	2.698	0.200	13.484	0.000	0.993	3.000	0.307	9.777	0.000	0.996
COV	-1.217	0.112	-10.879	0.000	-0.392	-1.287	0.164	-7.833	0.000	-0.377
COVID illness at baseline										
Means of latent factors										
μWB_{t1}	0.524	0.173	3.032	0.002	0.238	0.743	0.223	3.333	0.001	0.364
μWB_{Δ}	0.003	0.180	0.019	0.985	0.002	0.036	0.226	0.159	0.874	0.034
Variances and covariance										
$\sigma^2 WB_{t1}$	4.414	0.943	4.682	0.000	0.913	3.620	1.258	2.878	0.004	0.869
$\sigma^2 WB_{\Delta}$	3.274	0.862	3.797	0.000	0.994	1.074	0.773	1.389	0.165	0.991
$covWB_{t1-\Delta}$	-2.639	0.767	-3.442	0.001	-0.694	-0.008	0.628	-0.012	0.990	-0.004
COVID illness at follow-up										
Means of latent factors										
μWB_{t1}	-0.247	0.136	-1.820	0.069	-0.134	0.158	0.174	0.909	0.364	0.078
μWB_{Δ}	0.042	0.146	0.286	0.775	0.026	-0.185	0.199	-0.929	0.353	-0.122
Variances and covariance										
$\sigma^2 WB_{t1}$	2.992	0.570	5.251	0.000	0.884	3.563	0.765	4.655	0.000	0.875
$\sigma^2 WB_{\Delta}$	2.515	0.558	4.510	0.000	0.990	2.292	0.631	3.630	0.000	0.995
$covWB_{t1-\Delta}$	-0.589	0.364	-1.616	0.106	-0.215	-0.946	0.548	-1.725	0.085	-0.331
Long COVID at follow-up										
Means of latent factors										
μWB_{t1}	0.190	0.079	2.406	0.016	0.096	0.249	0.125	1.992	0.046	0.120
μWB_{Δ}	0.583	0.083	7.007	0.000	0.322	0.770	0.133	5.803	0.000	0.403
Variances and covariance										
$\sigma^2 WB_{t1}$	3.557	0.424	8.385	0.000	0.911	3.907	0.631	6.187	0.000	0.906
$\sigma^2 WB_{\Delta}$	3.246	0.409	7.936	0.000	0.994	3.635	0.668	5.441	0.000	0.997
$covWB_{t1-\Delta}$	-1.508	0.297	-5.076	0.000	-0.444	-1.692	0.402	-4.212	0.000	-0.449
COVID illness unknow										
Means of latent factors										
μWB_{t1}	0.508	0.142	3.570	0.000	0.242	0.796	0.196	4.061	0.000	0.369
μWB_{Δ}	0.226	0.144	1.575	0.115	0.143	0.058	0.184	0.315	0.753	0.036
Variances and covariance										
$\sigma^2 WB_{t1}$	4.022	0.724	5.555	0.000	0.908	4.124	0.941	4.383	0.000	0.884
$\sigma^2 WB_{\Delta}$	2.483	0.690	3.596	0.000	0.993	2.514	0.760	3.308	0.001	0.996
$covWB_{t1-\Delta}$	-1.422	0.531	-2.676	0.007	-0.450	-1.884	0.738	-2.554	0.011	-0.585
Confounders	**Estimate**	**SE**	**t-value**	***p*-value**		**Estimate**	**SE**	**t-value**	***p*-value**	
μWB_{t1}<--										
Age	-0.142	0.050	-2.818	0.005		-0.303	0.074	-4.090	0.000	
Chronic conditions	0.621	0.048	12.976	0.000		0.759	0.071	10.758	0.000	
Education	-0.302	0.047	-6.447	0.000		-0.181	0.060	-3.015	0.003	
Employment	-0.343	0.064	-5.352	0.000		-0.589	0.089	-6.595	0.000	
Income	-0.045	0.008	-5.858	0.000		-0.060	0.010	-5.732	0.000	
Partner	-0.727	0.048	-15.273	0.000		-0.894	0.077	-11.638	0.000	
Proxy	0.184	0.099	1.861	0.063		0.705	0.103	6.835	0.000	
μWBΔ <--										
Age	0.136	0.053	2.597	0.009		0.185	0.070	2.639	0.008	
Chronic conditions	0.091	0.046	1.983	0.047		-0.054	0.064	-0.839	0.401	
Education	0.141	0.048	2.957	0.003		0.023	0.062	0.378	0.705	
Employment	-0.066	0.068	-0.980	0.327		0.186	0.085	2.171	0.030	
Income	-0.015	0.008	-1.933	0.053		-0.026	0.011	-2.462	0.014	
Partner	0.176	0.044	3.997	0.000		0.036	0.063	0.568	0.570	
Continued										

	Females ($n = 27,032$)					Males ($n = 19,177$)				
Proxy	0.279	0.102	2.747	0.006		-0.105	0.103	-1.024	0.306	
Goodness-of-fit indices										
Chi-Square [df; p-valye]	2,423.10	[430; < 0.001]				1,364.82	[430; < 0.001]			
CFI	0.962					0.965				
TLI	0.953					0.957				
RMSEA	0.029					0.024				

Table 3. Goodness-of-fit statistics, likelihood ratio tests, and parameter estimates from the multigroup LCS model by COVID-19 illness status and sex. Source: SHARE, Corona Survey 1 (summer 2020) and Corona Survey 2 (summer 2021); SHARE main surveys, Wave 7 (2017) and Wave 8 (2019–2020); $n = 46,209$ (27,032 females and 19,177 males). n: sample size; df: degrees of freedom; SE: standard error; CFI: comparative fit index; TLI: Tucker–Lewis index; RMSEA: root mean square error of approximation; μWB_{t1}: mean of latent factor score for the well-being construct at baseline; μWB_{Δ}: mean of the latent change factor for change in the well-being construct; $\sigma^2 WB_{t1}$: variance of latent factor score for the well-being construct at baseline; $\sigma^2 WB_{\Delta}$: variance of the latent change factor for change in the well-being construct; $covWB_{t1-\Delta}$: covariance between these two latent factors; t_1: summer 2020 (baseline); t_2: summer 2021 (the follow-up).

A novel finding in our study was the fact that females and males who were not infected by COVID-19 virus before summer 2021 also reported a decline in their well-being between summer 2020 and summer 2021. This group consisted of close to 90% of all middle-aged and older adults in our sample making this finding substantial. There are several potential reasons for this finding including the psychological toll due to "fear of the unknown" that the COVID-19 pandemic has imposed on all segments of the population irrespective of the COVID-19 illness status[7,55]. The various mitigation measures such as lockdowns, "stay at home" mandates, closure of institutes, business as well as travel restrictions implemented across countries[56,57], and the pandemic fatigue could also explain our findings[58,59]. These changes in normal daily routine have been reported to influence sleep behaviours in response to the emotional turmoil (stress, depression, anxiety) that was brought by the pandemic[60]. The impact of the pandemic could have also exacerbated underlying chronic conditions such as mental disorders, resulting in decline in well-being[61,62]. The disruptions to healthcare services could also have played a role in the overall well-being of individuals living with different chronic conditions[63]. During this time period (summer 2020 – summer 2021), COVID-19 vaccination rollouts initiated across European countries[64], with vaccination hesitance and concerns about the safety of the vaccines possibly impacting well-being of their residents[65,66].

Interestingly, females and males who were infected between summer 2020 and summer 2021 but did not develop Long COVID, did not exhibit a significant decline in well-being. This requires further investigation although one can speculate that, unlike those that developed Long COVID, these adults were more resilient to the effect of COVID-19 illness on their well-being. The learning process of habituation could be a potential explanation, where the ongoing pandemic (stimulus) resulted in a decreased level of individualized response with lower impact on mental health[51].

Asymptomatic or unreported COVID-19 illness could still have an impact on an individual's well-being[67]. This would explain the findings among females and males for whom we could not assess their COVID-19 illness status as they did not respond to all questions. These respondents were observed to have very similar well-being trajectories to females and males who were affected by COVID-19 illness before summer 2020. This finding supports our initial assumption that individuals with missing information on their COVID-19 illness status should not be treated as missing at random as their trajectories resemble more closely trajectories of one group (infected at baseline), rather than the average of all groups.

It has been reported that females sustained a higher pandemic-induced socioeconomic burden than males, especially considering that most single parents are females, females tend to have lower paying jobs than males as well as make up a larger proportion of the healthcare workforce with higher COVID-19 infectivity risk[21,68,69]. However, a systematic review that compared the pre-pandemic mental health to the first COVID-19 year reported similar mental health burden between females and males, coinciding with our observed well-being patterns[21]. This suggests that both males and females sustained similar pandemic hardship that led to a negative impact on their well-being; however, it is recommended that these hypotheses on how the pandemic impacted health and well-being of females and males be further tested. Such evidence brings forward the need for population-wide support for all middle-aged and older adults affected by the pandemic, irrespective of their sex.

Implications for future practice and research

The COVID-19 pandemic impacted most adults in Europe resulting in a substantial burden on their well-being. It is evident that psychological support should be provided at community levels with specific attention towards individuals that report Long COVID and those infected with COVID-19 virus at earlier stages of the pandemic. However, there is a need for more prospective studies with longer follow-up to determine long-term effects of the pandemic on well-being, particularly among adults infected during the first stage of the pandemic, those with Long COVID symptoms, and individuals not directly affected by COVID-19 illness. Our assessment of the across-country differences in the four indicators of the well-being construct (see Supplementary Table S1) suggests that future research should explore cross-country differences in the

change in well-being and the role of country-level characteristics (e.g., burden of the COVID-19 pandemic, responses to the pandemic, or socioeconomic profile) as there were some substantial across-county differences in the responses undertaken to contain the spread of the COVID pandemic. We recommend that these cross-country studies should validate the proposed here measurement instruments for the well-being construct. It is also important to explore the potential modifying role of pre-pandemic mental health status and various social determinants of health as the pandemic could have a disproportionally stronger negative effect on the well-being of some individuals.

Study strengths and limitations

To the authors' knowledge, this is the first multi-country population-based study to explore the impact of the COVID-19 pandemic on the change in well-being among the middle-aged and older population living in Europe. The use of LSC models, testing across-time measurement invariance of our novel measurement instrument for the well-being construct, and sex-stratified analysis are other important strengths of our study design. However, some limitations of our study warrant mentioning. Although we used several key confounders to estimate the level of well-being at baseline and the rate of change in well-being, there is still a substantial degree of intra-individual variability in the estimates for these parameters. Thus, more research is needed to account for these intra-individual differences. Selection bias could have affected the representation of the study sample. It is known that individuals with low socioeconomic status or poor health are less likely to be represented in self-reported surveys as well as more likely to drop out before the end of the study period. To compensate for this, we used sampling weights, controlled for key socioeconomic factors, and introduced statistical adjustments for missing data. Moreover, 15.8% of respondents from our original sample who did not participate in Corona Survey 2 had, in general, worse mental health outcomes than those who participated in the follow-up, potentially underestimating the true negative effect of the COVID-19 pandemic on well-being (see Supplementary Table S2). The relatively small sample size in three COVID-19 illness groups (i.e., 'COVID illness at baseline', 'COVID illness at follow-up', and 'COVID illness unknown') might affect statistical power and prevent us from detecting potentially significant across-group differences in the change in well-being. SHARE data were collected through survey interviews and are prone to self-reporting bias and recall bias. However, it needs to be noted that self-reported data are commonly used in large population-based studies[48]. In addition, previous sensitivity analysis of the SHARE data reported a very strong concordance in measuring the same chronic conditions across time[22].

Conclusion

The COVID-19 pandemic negatively affected the well-being of most middle-aged and older Europeans, irrespective of their sex. Females and males infected at the start of the pandemic experienced a longer negative impact of COVID-19 illness on their well-being than others. Similarly, adults who reported Long COVID symptoms experienced the most pronounced decline in well-being between summer 2020 and summer 2021. A novel finding was the decline in the level of well-being among adults not directly affected by COVID-19 illness. This finding suggests that psychological support should be implemented at community levels with specific attention towards individuals that report Long COVID and females and males affected by COVID-19 illness at earlier stages of the pandemic.

Methods

Data

We used data from two Survey of Health, Ageing and Retirement in Europe's (SHARE) Corona Surveys, collected during summer 2020 and then during summer 2021[70,71], as well as data from waves 7 (2017) and 8 (2019–2020) of the main SHARE survey[72]. SHARE is a large population-based prospective survey of middle-aged and older Europeans (50 years and older) from 27 countries across Europe that was initiated in 2004 (wave 1)[72]. SHARE offers nationally representative samples and standardized questionnaires collecting information on respondents' demographic, socioeconomic, and health characteristics[73]. More information about the survey design, data structure, and response rates has been previously published[72]. The Corona Surveys were implemented in response to the COVID-19 pandemic, and they provide an opportunity to examine the impact of the pandemic over a one-year period on the well-being of middle-aged and older Europeans.

This study used anonymous secondary data from SHARE and ethics approval was granted through a data sharing agreement with SHARE. The SHARE studies were conducted according to the Declaration of Helsinki guidelines and all participants gave their informed consent.

Study sample

Our sample consisted of 46,209 respondents who: were aged 50 years and older at the time of Corona Survey 1 (t_1; baseline), participated in Corona Survey 2 (t_2; the follow-up), and provided responses in wave 7 or 8 of the main SHARE surveys (see Fig. 1). In both Corona Surveys, respondents were asked if they either had a positive test for the SARS-CoV-2 virus or experienced symptoms that they attributed to COVID-19 illness. In Corona Survey 2, they were also asked if they experienced at least one of the following nine long-term or lingering effects that they attributed to their COVID-19 illness: fatigue, cough, congestion, shortness of breath, loss of taste or smell, headache, body aches, joint pain, chest or abdominal pain, diarrhea, nausea, confusion, or any other symptoms. Based on the responses to these questions, we divided our sample into four mutually exclusive groups: (i) 'No COVID illness' (no COVID-19 illness in both Corona Surveys [n = 40,638; 87.9%]); (ii) 'COVID illness at baseline' (COVID-19 illness in Corona Survey 1 [n = 756; 1.6%]); (iii) 'COVID illness at follow-up' (COVID-19 illness in Corona Survey 2, but no Long COVID symptoms [n = 1,079; 2.3%]); and (iv) 'Long COVID at follow-up' (COVID-19 illness in Corona Survey 2 with Long COVID symptoms [n = 2,771;

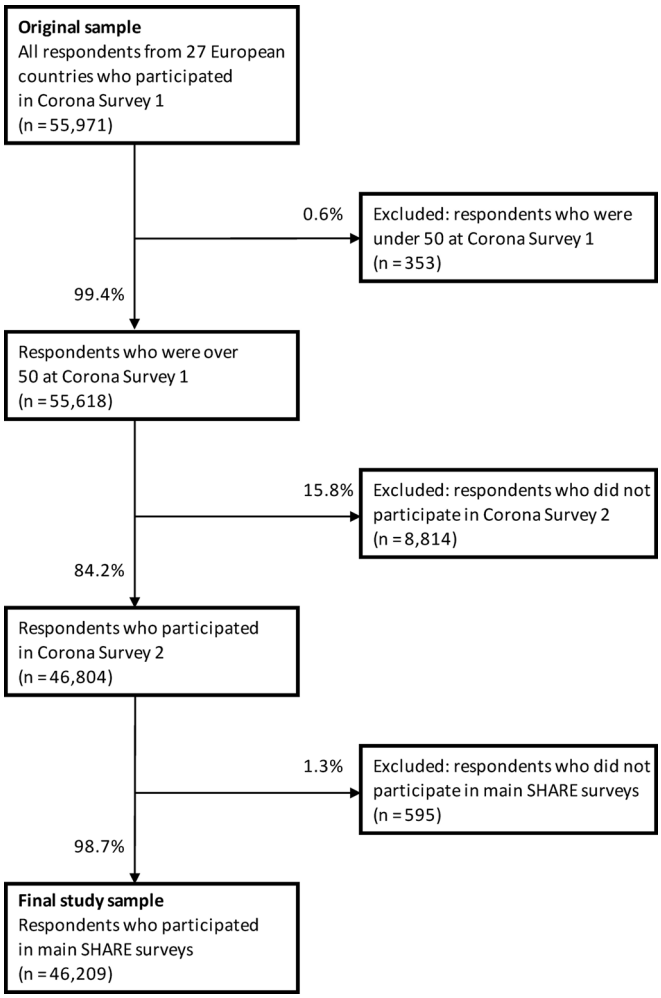

Fig. 1. Flowchart with the exclusion criteria for the selected study sample. Source: SHARE, Corona Survey 1 (summer 2020) and Corona Survey 2 (summer 2021); SHARE main surveys, Waves 7 (2017) and Wave 8 (2019-2020); $n = 46{,}209$ (27,032 females and 19,177 males).

6.0%]). There were also 965 respondents for whom we could not assess their COVID-19 illness status as they did not respond to all questions; we retained these individuals in the analysis by creating a separate group, 'COVID illness unknown'.

Measurement instruments

Well-being Well-being at baseline (t_1) and at the follow-up (t_2) was assessed by four binary repeated variables available in both Corona Surveys, *nervous*, *sad*, *sleep*, and *lonely* based on respondents' answers to the following four questions: (1) "In the last month, have you felt *nervous*, anxious, or on edge (yes versus no)?"; (2) "In the last month, have you been *sad* or depressed (yes versus no)?"; (3) "Have you had trouble *sleep*ing recently (yes versus no)?"; and (4) "How much of the time do you feel *lonely* (often versus sometimes/never)?". These observed variables (*nervous*, *sad*, *sleep*, and *lonely*) have been associated in previous published literature with negative wellness and mental health consequences[74–77].

Our goal was to estimate a baseline score and a change score in the well-being construct, not in each of these variables. Thus, the well-being construct was operationalized as a continuous latent factor (*WB*) with the above four binary variables as its indicators. Since responses indicating poorer well-being were coded as '1' while responses representing better well-being were coded as '0', a higher latent factor score indicates poorer (or lower level of) well-being.

Confounders *Age* (50 to 64 versus 65 and over), living with a *Partner*, and *Chronic condition* at baseline were operationalized as binary variables; information on chronic conditions (i.e., heart diseases, hypertension, diabetes, lung diseases) was derived from responses to waves 7 and 8 of the main SHARE survey or Corona Survey 1. To control for socioeconomic factors at baseline, we created two binary variables, *Education* (secondary or lower versus post-secondary or higher) and *Employment* (employed versus not employed), and a continuous variable *Income* (the lowest monthly household income; converted into deciles). Finally, we included a binary variable *Proxy* to control for interviews conducted by someone else.

Analysis

The univariate descriptive statistics (frequencies, percentages, means, standard deviations [SD]) were produced to describe indicators of the well-being construct and the baseline confounders. To assess the effect of the COVID-19 pandemic on well-being, we used LCS models with multiple observed indicators of a latent construct[78,79] and general structural equation modeling techniques[80]. LCS models are designed to assess inter- and intra-individual differences in change across time while accounting for measurement error and establishing across-time measurement invariance. The key parameters of interest in these models were the means of latent factor score for well-being at baseline (μWB_{t1}) and the means of latent change factor (μWB_{Δ}), which captures the average rate of change in well-being between baseline and the follow-up. To assess how COVID-19 illness status affected the change in well-being, we employed a multigroup modeling framework and tested across group differences in the two parameters of interest. We also estimated variances in the latent factor scores at baseline and in the latent change factor ($\sigma^2 WB_{t1}$, $\sigma^2 WB_{\Delta}$), as well as covariances between these two latent factors ($covWB_{t1-\Delta}$). All parameters were estimated while controlling for the baseline confounders (*Age*, *Partner*, *Chronic conditions*, *Education*, *Income*, *Proxy*). Figure 2 shows our generic LCS model. Since we assumed that our sample of middle-aged and older adults consists of a mixture of sub-populations of females ($n = 27{,}032$; 58.5%) and males ($n = 19{,}177$; 41.5%), all analyses were stratified by sex.

Before estimating the LCS models, we assessed factorial validity and across-time measurement invariance of the postulated measurement model for the well-being construct by conducting a confirmatory factor analysis (CFA) for binary indicators[81]. First, we specified and assessed the fit of a model with a configural invariance for the well-being construct at baseline and at the follow-up. Then, we imposed progressively stricter measurement constraints on factor loadings (weak/metric invariance), thresholds (strong/scalar invariance), and residuals (strict invariance). We conducted this assessment separately for females and males (Fig. 3).

All models were estimated using robust weighted least squares (WLSMV) and Theta parametrization[80,82]. To assess model fit at different stages of our analyses, we used standard goodness-of-fit indices: chi-square test (χ^2), comparative fit index (CFI, 0.95 cut-off), Tucker-Lewis index (TLI, 0.95 cut-off); and root mean square error of approximation (RMSEA, 0.05 cut-off)[83]. To evaluate the measurement invariance in the well-being construct, we used standard assessment criteria (i.e., ΔCFI, ΔTLI, and ΔRMSEA)[84]. To test our hypotheses related to the across-group differences in the impact of the pandemic on well-being, we employed likelihood ratio tests for nested models with binary variables ($\Delta\chi^2$)[80].

Repeated binary indicators for the well-being construct and some of the confounders had missing data due to item non-response (between 0.1% and 0.8% and between 0.1% and 3.3%, respectively). We used full information maximum likelihood to model missing data points as a function of the baseline confounders and all available

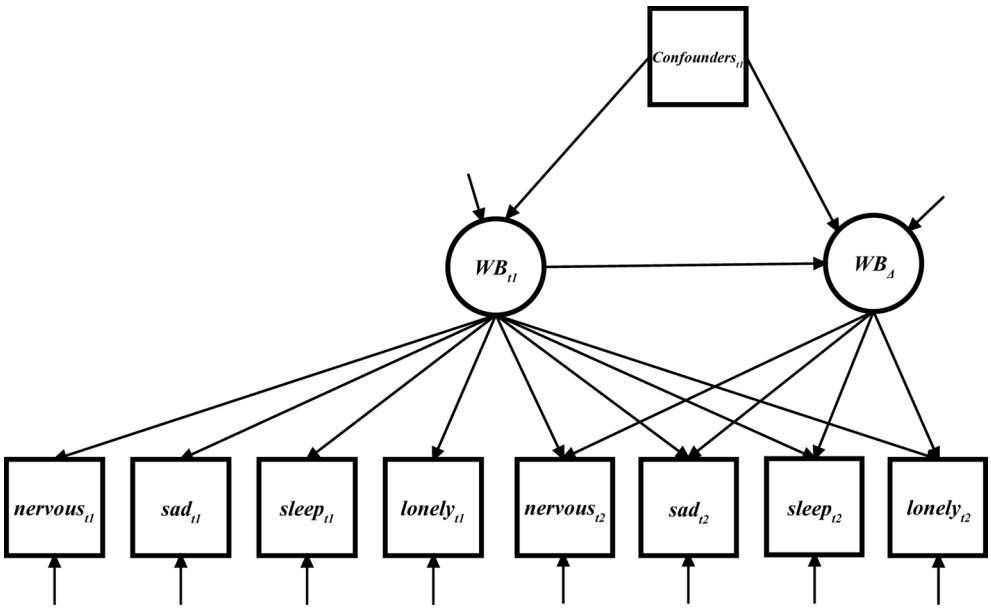

Fig. 2. Outline of generic latent change score (LCS) model.

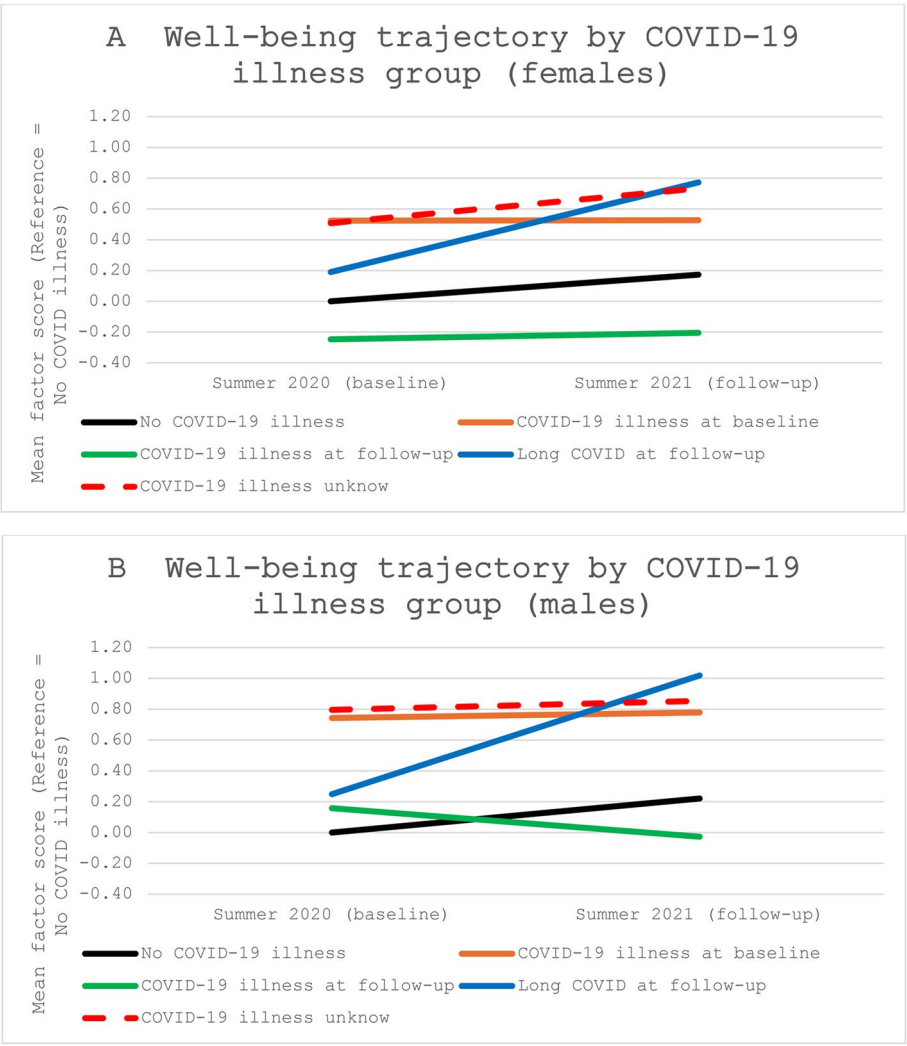

Fig. 3. Trajectories of change in the well-being construct between summer 2020 and summer 2021 by COVID-19 illness status and sex. Source: SHARE, Corona Survey 1 (summer 2020) and Corona Survey 2 (summer 2021); SHARE main surveys, Wave 7 (2017) and Wave 8 (2019-2020); n = 46,209 (27,032 females and 17,177 males). Solid black line (—): Estimated trajectories for respondents who did not report COVID-19 illness at baseline and at the follow-up; Solid orange line (—): Estimated trajectories for respondents who reported COVID-19 illness at baseline; Solid green line (—): Estimated trajectories for respondents who reported COVID-19 illness at the follow-up; Solid blue line (—): Estimated trajectories for respondents who reported Long COVID symptoms at the follow-up; Dotted red line (---): Estimated trajectories for respondents with unknown COVID-19 illness status.

repeated measures, based on the assumption that the missing data are missing at random[85,86]. Finally, we employed calibrated cross-sectional sampling weights from the Corona Survey 1. We used SAS 9.4[87] to prepare the analytical file; all analyses were conducted in Mplus 8.10[80].

Data availability

Data is available from the SHARE project's website: https://share-eric.eu/.

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Author contributions

PW and SC designed the study. PW performed the statistical analysis and interpreted the data analysis. PW and SC drafted the first version of the manuscript. SC was responsible for revising the manuscript. SC and PW reviewed and approved the final version.

Declarations

Competing interests

The authors declare no competing interests.

Additional information

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