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## Depression and anxiety in later COVID-19 waves across Europe: New evidence from the European COvid Survey (ECOS)

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### ABSTRACT

We aimed to investigate the prevalence of probable depression and anxiety and their correlates during later stages of the COVID-19 pandemic in eight European countries. Longitudinal data (wave 7 in June/July 2021: n=8,032; wave 8 in September 2021: n=8,250; wave 9 in December 2021/January 2022: n=8,319) were used from the European COvid Survey – a representative sample of community-dwelling adults from several European countries (Germany, United Kingdom, Denmark, Netherlands, France, Portugal, Italy and Spain). In wave 7 (wave 8; wave 9), 23.8% (22.0%; 24.3%) of all respondents had probable depression and 22.6% (22.1%; 23.7%) had probable anxiety. These prevalence rates substantially differed between the European countries. Regressions showed that emerging difficulties with the income were associated with both increases in depressive symptoms and anxiety symptoms. An increase in one's own perceived risk of getting infected with the SARS-CoV-2, the birth of a child and an increase in the Covid-19 stringency index were associated with increases in depressive symptoms. The significance of probable depression and anxiety during later stages of the COVID-19 pandemic in eight European countries was highlighted. Avoiding income difficulties may also contribute to mental health.

### 1. Introduction

Various countries have reported high prevalence rates of depression and anxiety in recent decades [Alonso et al., 2004](#). The current Covid-19 pandemic confronts individuals with several challenges for their mental well-being including financial hardship (e.g., with a particular high risk for certain professional groups such as the event industry) and social distancing. A recent meta-analysis showed a prevalence of anxiety of 38.1% (depression: 34.3%) among general populations in different countries during the pandemic [Necho et al., 2021](#). However, thus far, most of the existing studies examined the prevalence during earlier stages of the pandemic and only in one specific country (as an overview: [Necho et al., 2021](#)). Only some studies compared two countries. For example, one study compared representative data from the United Kingdom and Austria [Budimir et al., 2021](#) and another study compared representative data from the United States and Australia [Czeisler et al.,](#)

2021.

Additionally, there is limited knowledge using data from representative longitudinal studies in times of the COVID-19 pandemic (e.g., [Daly and Robinson, 2021](#); [Hyland et al., 2021](#); [Gilbar et al., 2022](#)). Consequently, the purpose of our current study was to show data on the prevalence of probable depression and anxiety and to identify the correlates in eight European countries during later stages of the COVID-19 pandemic (i.e., June 2021 to January 2022) longitudinally. For this purpose, longitudinal data from the European COvid Survey (ECOS) covering Germany, the United Kingdom, Denmark, the Netherlands, France, Portugal, Italy and Spain were used. Knowledge of the factors that were linked to probable depression and anxiety over time during the COVID-19 pandemic may aid health professionals in identifying people at risk for these mental illnesses. Moreover, such knowledge may help to mitigate the projected rise in mental illnesses ([Riedel-Heller and Richter, 2020](#)).

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## 2. Methods

### 2.1. Sample

Longitudinal data were collected from the European COvid Survey (ECOS) (wave 7 in June/July 2021:  $n=8,032$ ; wave 8 in September 2021:  $n=8,250$ ; wave 9 in December 2021/January 2022:  $n=8,319$ ), which included Germany, the United Kingdom, Denmark, the Netherlands, France, Portugal, Italy, and Spain.

Data from a sample of about 1,000 adult individuals was collected in each country by the market research firm Dynata. Several recruiting techniques were used to reach the general population (open recruitment, affiliate networks, mobile apps or loyalty programs). Quotas were used to ensure gender, age, region, and education representation (based on national census data) within each country. Sabat et al. provided additional information [Sabat et al., 2020](#).

Dynata obtained written informed consent from each individual participant. The participants' confidentiality and anonymity were protected. The University of Hamburg in Germany provided ethical approval for this study (clearance approved at 10th July 2020; under the umbrella project "Countering COVID-19: A European survey on the acceptability and commitment to preventive measures"). It was not necessary to obtain ethical approval from all countries because patients were not involved, among other things.

### 2.2. Dependent variables

The validated Patient Health Questionnaire-4 (PHQ-4, 2-item depression scale, PHQ-2 [Kroenke et al., 2003](#); [Löwe et al., 2005](#) and 2-item anxiety scale, Generalized Anxiety Disorder-2 (GAD-2)) [Kroenke et al., 2007](#) were used to assess probable depression and anxiety. While the PHQ-2 includes the two DSM-V diagnostic main criteria for depressive disorders [Association AP 2013](#), the GAD-2 includes the two main criteria for GAD [Association AP 2013](#). The GAD-2 has been shown to be a screening tool for post-traumatic stress disorder (specificity: 0.81; sensitivity: 0.59), social anxiety disorder (specificity: 0.81; sensitivity: 0.70), and panic disorder (specificity: 0.81; sensitivity: 0.76) [Kroenke et al., 2007](#). The PHQ-2 can be used to screen for major depressive disorder (specificity: 0.78; sensitivity: 0.87) and any depressive disorder (specificity: 0.86; sensitivity: 0.79) [Löwe et al., 2005](#).

These two measures are combined into a four-item scale by the PHQ-4. As previously recommended [[11,10](#)], sum scores of 3 (for both tools, PHQ-2 and GAD-2) were used as cut-off points for probable depression and anxiety, respectively. More information is provided elsewhere [Kroenke et al., 2009](#); [Löwe et al., 2010](#). In our study, Cronbach's alpha was 0.91 (GAD-2: 0.87; PHQ-2: 0.83) in wave 7. It was 0.90 (GAD-2: 0.87; PHQ-2: 0.81) in wave 8 and also 0.90 (GAD-2: 0.87; PHQ-2: 0.82) in wave 9. In sum, a good internal consistency was demonstrated. Additionally, for the PHQ-4, McDonald's omega [McDonald, 1999](#) was .91 in wave 7, .90 in wave 8, and .91 in wave 9, respectively [Shaw, 2021](#).

### 2.3. Independent variables

The following time-varying factors were used in regressions: age, family status (married/registered partnership; living together (relationship); living alone (single); living alone (in a relationship); widowed; other), education (low education; medium education; high education; using the country specific education system; see [Varghese et al. Varghese et al., 2021](#)), professional group (health-related sector; education; food retail; research; other), perceived difficulties with income ("Thinking of your household's total monthly income, would you say that your household is able to make ends meet...": with great difficulty; with some difficulties; fairly easily; easily), having children (absence of a child below 18 years; having one or more children aged below 18 years), infection with the novel coronavirus (no; yes,

confirmed; yes, but not yet confirmed; don't know), one's own perceived risk of getting infected with the coronavirus (single item from 1 = no risk at all to 5 = very high risk), perceived risk to one's own health from Covid-19 (single item from 1 = no risk at all to 5 = very high risk), perceived risk to the health of one's own family members from Covid-19 (single item from 1 = no risk at all to 5 = very high risk), perceived risk to the health of people in one's own community from Covid-19 (single item from 1 = no risk at all to 5 = very high risk) and the country-specific Oxford Covid-19 stringency index [Hale et al., 2021](#). It consists of 19 indicators focusing on actions and behavioral interventions referring to health system, economic response, closure and containment. In this index, each indicator is scored based on an ordinal score (0 – 2, 3, 4 or 5), resulting in a sum score ranging from 0 to 100 (strictest).

Moreover, for descriptive purposes, the time-constant factors (which means factors that do not vary within individuals over time) sex (men; women) and country (Germany; United Kingdom; Denmark; Netherlands; France; Portugal; Italy; Spain) were used.

### 2.4. Statistical analysis

First, we showed the prevalence rates for probable depression and anxiety in the total sample and for various subgroups. Subsequently, the longitudinal correlates of depressive symptoms (first outcome measure) and anxiety symptoms (second outcome measure) were estimated using linear fixed effects (FE) regressions. This assists in exploiting within-information (i.e., changes within individuals over time) [Cameron and Trivedi, 2005](#). Contrary to other popular methods such as linear random effects (RE) regressions, such linear FE regressions deliver consistent estimates even when time-constant factors (both, unobserved and observed) are systematically correlated with time-varying regressors (under the assumption of strict exogeneity) [Cameron and Trivedi, 2005](#). This analytical choice was backed up by Sargan-Hansen tests (which corresponds to Hausman-tests with cluster-robust standard errors: Sargan-Hansen statistic was 207.6,  $p<.001$  with depressive symptoms as outcome measure and it was 283.4,  $p<.001$  with anxiety symptoms as outcome measure) [Schaffer and Stillman, 2006](#).

Such linear FE regressions exclusively exploit changes within individuals over time such as intraindividual transitions in depressive symptoms from wave 7 to wave 9. Thus, the estimates only refer to individuals with such intraindividual changes over time. Nevertheless, it should be stressed that this is not a weakness of FE estimates rather it mirrors the fact that only some individuals had these changes over time [Cameron and Trivedi, 2005](#). The significance level was set at  $=.05$ . To conduct statistical analysis, Stata 16.1 was used.

## 3. Results

### 3.1. Prevalence of probable depression and anxiety stratified by various characteristics

In [Table 1](#), prevalence rates of probable depression and probable anxiety are given. In wave 7, (wave 8; wave 9), 23.8% (22.0%; 24.3%) of all respondents had probable depression and 22.6% (22.1%; 23.7%) had probable anxiety. Both probable depression and probable anxiety had 16.8% (15.6%; 17.4%) of the individuals. No consistent trend could be identified regarding the prevalence rates from wave 7 to wave 9.

Particularly individuals aged 18 to 29 years, individuals being infected with the SARS-CoV-2 and individuals with great income difficulties reported very high prevalence rates for probable depression and probable anxiety in all three waves. Some examples: In wave 7, 41.2% of the individuals aged 18 to 29 years had probable depression (probable anxiety: 40.3%), 42.3% of individuals with a confirmed infection with the novel coronavirus had probable depression (probable anxiety: 43.9%) and 41.8% of the individuals with great income difficulties had probable depression (probable anxiety: 45.6%). Bivariate (cross-

**Table 1**

Prevalence rate for probable depression and probable anxiety stratified by various groups in wave 7 in June/July 2021, wave 8 in September 2021, and wave 9 in December 2021/January 2022 (N and %).

	Wave 7 Sample size	Presence of probable depression	Presence of probable anxiety	Wave 8 Sample size	Presence of probable depression	Presence of probable anxiety	Wave 9 Sample size	Presence of probable depression	Presence of probable anxiety
Total sample	N=8032	23.8%	22.6%	N=8250	22.0%	22.1%	N=8319	24.3%	23.7%
Gender									
Male	N=3888	21.0%	20.0%	N=3970	20.1%	19.8%	N=3999	22.1%	21.1%
Female	N=4144	26.4%	25.0%	N=4280	23.7%	24.3%	N=4320	26.4%	26.0%
Country									
Germany	N=1015	23.6%	22.8%	N=1027	20.8%	19.5%	N=1007	24.5%	22.6%
United Kingdom	N=1019	30.0%	26.6%	N=1038	28.7%	28.0%	N=1023	29.4%	28.7%
Denmark	N=1008	28.6%	22.2%	N=1035	24.1%	20.5%	N=1016	27.2%	22.3%
Netherlands	N=1004	19.2%	17.0%	N=1037	18.8%	17.4%	N=1022	18.1%	14.7%
France	N=1013	19.8%	21.4%	N=1011	21.4%	19.9%	N=1139	23.6%	23.7%
Portugal	N=1001	19.7%	20.9%	N=1045	19.0%	22.5%	N=1036	21.2%	24.3%
Italy	N=1013	23.2%	24.5%	N=1039	21.1%	25.5%	N=1057	28.2%	28.3%
Spain	N=959	26.2%	25.1%	N=1018	21.8%	23.9%	N=1019	22.4%	24.3%
Age group									
18-29	N=1311	41.2%	40.3%	N=1363	38.3%	40.2%	N=1228	44.6%	45.6%
30-49	N=3080	28.1%	27.6%	N=3071	25.3%	26.1%	N=3138	28.6%	27.9%
50-64	N=2066	17.1%	15.8%	N=2115	16.4%	15.5%	N=2181	16.6%	15.7%
65-74	N=1441	11.0%	8.4%	N=1431	8.8%	8.7%	N=1473	12.2%	10.7%
75+	N=243	8.3%	4.5%	N=262	13.7%	9.2%	N=299	13.0%	10.7%
Children									
No children aged below 18	N=5581	20.2%	18.8%	N=5689	18.6%	18.8%	N=5820	20.9%	20.7%
Yes, one or more aged below 18	N=2451	31.9%	31.0%	N=2561	29.4%	29.5%	N=2499	32.3%	30.6%
Education									
Low education	N=1348	24.0%	23.0%	N=1296	21.6%	21.1%	N=1232	22.2%	22.1%
Middle education	N=3173	21.7%	20.8%	N=3179	20.3%	21.8%	N=3157	23.4%	22.9%
High education	N=3511	25.6%	24.0%	N=3775	23.5%	22.8%	N=3930	25.7%	24.8%
Professional group									
Health-related sector	N=576	30.4%	30.6%	N=614	29.8%	28.0%	N=640	28.8%	29.1%
Education	N=551	28.7%	27.0%	N=543	25.8%	25.6%	N=594	29.6%	27.6%
Food retail	N=246	30.9%	28.9%	N=239	30.5%	31.4%	N=216	36.6%	34.3%
Research	N=151	30.5%	25.8%	N=137	28.5%	32.1%	N=142	32.4%	35.2%
Other	N=6508	22.4%	21.2%	N=6717	20.5%	20.8%	N=6727	22.9%	22.2%
Infection with the novel coronavirus									
Yes, confirmed	N=617	42.3%	43.9%	N=737	38.5%	39.2%	N=1021	34.9%	36.1%
Yes, but not yet confirmed	N=243	35.8%	35.0%	N=209	39.2%	37.3%	N=220	41.4%	43.6%
No	N=6804	21.6%	20.1%	N=6897	19.6%	19.7%	N=6657	21.9%	20.8%
Don't know	N=368	25.3%	24.7%	N=407	23.6%	24.6%	N=421	27.8%	27.6%
Income									
With great difficulty	N=660	41.8%	45.6%	N=646	39.5%	42.6%	N=640	43.6%	46.4%
With some difficulty	N=2783	27.9%	26.4%	N=2861	26.7%	26.3%	N=3024	28.6%	28.9%
Fairly easily	N=3374	19.7%	18.1%	N=3458	17.0%	17.9%	N=3449	19.9%	18.4%
Easily	N=1215	15.9%	13.6%	N=1285	16.1%	14.1%	N=1206	15.9%	13.6%
Vaccination status (Covid-19)									
No	N=1441	24.6%	22.4%	N=931	20.8%	22.1%	N=775	23.1%	19.7%
Not yet, but intended to vaccinate	N=1211	32.0%	31.5%	N=284	29.2%	32.4%	N=159	30.2%	33.3%
Yes, at least one shot	N=5380	21.8%	20.6%	N=7035	21.8%	21.7%	N=7385	24.3%	23.9%

Notes: In bivariate (cross-sectional) analysis, probable depression and probable anxiety were significantly associated with all variables listed in each of the three waves, except for the (non-significant) association between educational level and probable anxiety (in wave 8 and 9) and the (non-significant) association between vaccination status and probable depression (wave 9).

sectional) analysis revealed that both outcome measures were associated with nearly all independent variables. Further details are shown in [Table 1](#).

In [Fig. 1](#) (probable depression) and [Fig. 2](#) (probable anxiety), we displayed the prevalence rates in the eight European countries from wave 7 to wave 9. In most of these countries, the prevalence rates for both probable depression and probable anxiety decreased from wave 7

to wave 8 and increased from wave 8 to wave 9.

### 3.2. Longitudinal regression analysis

Results of linear FE regressions are depicted in [Table 2](#). These regressions showed that an increase in depressive symptoms was associated with changes from 'easily' to 'some' ( $\beta=.20$ ,  $p<.01$ ) or 'great'

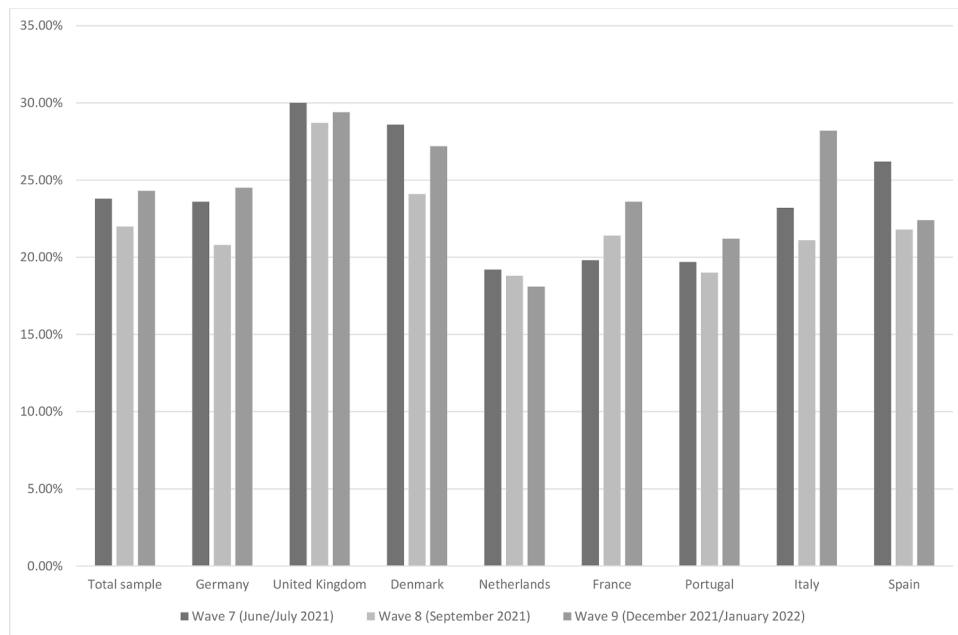


Fig. 1. Prevalence of probable depression among European countries from June/July 2021 to December 2021/January 2022.

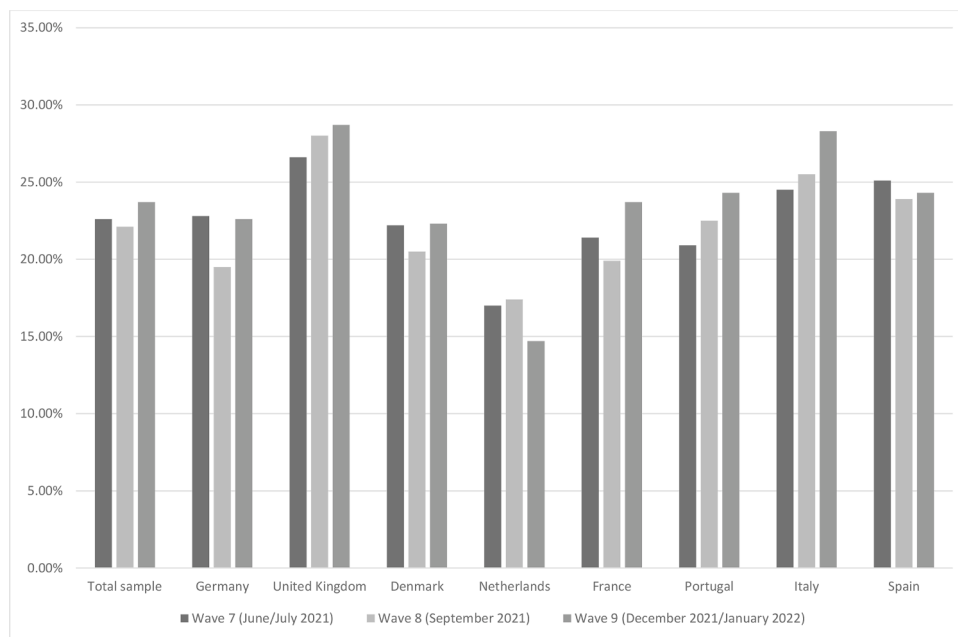


Fig. 2. Prevalence of probable anxiety among European countries from June/July 2021 to December 2021/January 2022.

income difficulties ( $\beta=.21, p<.05$ ), an increase in one’s own perceived risk of getting infected with the coronavirus ( $\beta=.04, p<.05$ ), a change from no child below 18 years to at least one child below 18 years ( $\beta=.19, p<.05$ ) and an increase in the Covid-19 stringency index ( $\beta=.003, p<.001$ ).

Additionally, an increase in anxiety symptoms was associated with changes from ‘easily’ to ‘some’ ( $\beta=.14, p<.05$ ) or ‘great’ income difficulties ( $\beta=.24, p<.05$ ), whereas it was not associated with any of the other time-varying independent variables.

#### 4. Discussion

##### 4.1. Main findings

The main goal of this study, which used longitudinal data from the ECOS, was to investigate the prevalence of probable depression and probable anxiety and their correlates - in eight European countries during later stages of the COVID-19 pandemic. Our study revealed the extent of probable depression and anxiety in June/July 2021, September 2021 and December 2021/January 2022 - with some notable differences between these European countries. Particularly, individuals in specific countries such as the United Kingdom, individuals aged 18 to 29 years, individuals with an infection with the SARS-CoV-2 and individuals with great income difficulties had high prevalence rates for probable

**Table 2**  
Determinants of depressive symptoms and anxiety symptoms. Results of linear FE regressions (ECOS; wave 7 to wave 9).

Independent variables	Depressive symptoms	Anxiety symptoms
Age	0.01 (0.01)	0.01 (0.01)
Marital status: - Living together (relationship) (Ref.: - married / registered partnership)	-0.00 (0.09)	0.05 (0.09)
- Living alone (single)	0.07 (0.13)	-0.08 (0.14)
- Living alone (in a relationship)	-0.09 (0.13)	-0.15 (0.14)
- Widowed	-0.03 (0.22)	-0.14 (0.21)
- Other	0.10 (0.14)	0.05 (0.14)
Children: Having one or more children aged below 18 years (Ref.: Absence of a child aged below 18 years)	0.19* (0.08)	-0.00 (0.09)
Education: - Middle (Ref.: low education)	0.06 (0.07)	0.05 (0.07)
- High	0.08 (0.10)	0.03 (0.10)
Professional group: - Education (Ref.: Health- related sector)	-0.06 (0.13)	-0.06 (0.12)
- Food retail	-0.02 (0.16)	0.11 (0.16)
- Research	-0.11 (0.18)	0.00 (0.17)
- Other	-0.12 (0.10)	-0.02 (0.09)
Own risk of getting infected with the coronavirus (from 1 = no risk at all to 5 = very high risk)	0.04* (0.02)	0.04+ (0.02)
Risk to one's own health from Covid-19 (from 1 = no risk at all to 5 = very high risk)	0.03 (0.02)	0.01 (0.02)
Risk to the health of one's own family members from Covid-19 (from 1 = no risk at all to 5 = very high risk)	-0.00 (0.02)	0.00 (0.02)
Risk to the health of people in one's own community from Covid-19 (from 1 = no risk at all to 5 = very high risk)	-0.01 (0.02)	0.01 (0.02)
Income (ability to make ends meet): - With great difficulty (Ref.: easily)	0.21* (0.10)	0.24* (0.10)
- With some difficulty	0.20** (0.06)	0.14* (0.06)
- Fairly easily	0.05 (0.05)	0.03 (0.05)
Infection with the novel coronavirus: - Yes, confirmed (Ref.: no)	0.11 (0.08)	0.02 (0.08)
- Yes, but not yet confirmed	0.10 (0.10)	-0.08 (0.11)
- Don't know	-0.02 (0.06)	-0.04 (0.06)
Covid-19 Stringency Index (from 0 to 100, with 100 = strictest)	0.003*** (0.00)	0.00 (0.00)
Covid-19 vaccination: - Intention to vaccinate against Covid-19 (Ref.: not vaccinated against Covid-19)	0.03 (0.07)	0.12 (0.07)
- At least one vaccination against Covid-19	-0.03 (0.06)	0.08 (0.06)
Observations	15,410	15,410
Number of Individuals	6,153	6,153
Pseudo R <sup>2</sup>	0.008	0.005

Comments: Unstandardized beta-coefficients are reported; 95% confidence intervals in parentheses; \*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$ , +  $p < 0.10$

depression and probable anxiety in all of these waves. Linear FE regressions revealed that emerging difficulties with the income are associated with both increases in depressive symptoms and anxiety symptoms. Moreover, an increase in one's own perceived risk of getting infected with the coronavirus, the birth of a child and an increase in the Covid-19 stringency index were also associated with increases in depressive symptoms.

#### 4.2. Previous research and possible explanations

Our study showed that probable depression and anxiety are quite common in the general adult population in eight European countries from Mid-2021 to early 2022. In comparison to the pre-pandemic era (e.g., [Alonso et al., 2004](#)), the prevalence rates identified in our study were considerably higher. For example, based on data from the European Study of the Epidemiology of Mental Disorders (covering six European countries; data collection from 2001 to 2003), [Alonso et al., 2004](#) showed that 3.9% of the individuals reported a major depressive disorder in the past 12 months (lifetime prevalence: 12.8%) and 1.0% of the individuals reported a generalized anxiety disorder in the past 12 months (lifetime prevalence: 2.8%). Another example: Based on data from the German health interview and examination survey for adults (data collection from 2008 to 2011), [Jacobi et al., 2014](#) reported that 6.0% of the individuals had a major depressive disorder in the preceding 12 months and 2.2% of the individuals had a generalized anxiety disorder in the preceding 12 months among the general adult population in Germany (aged 18 to 79 years).

Such increase (prior compared to during the pandemic) is often explained by social distancing, income difficulties and concerns about one's own health as well as the health of others [Hajek et al., 2022](#). It should be noted that higher prevalence rates during the pandemic were already reported by various other studies (e.g., [Hajek et al., 2022](#); [MacDonald et al., 2022](#); [Lee et al., 2022](#) and were thus in accordance with our expectations. Nevertheless, our study adds to our current knowledge by using (i) representative and (ii) longitudinal data from (iii) various European countries collected during (iv) later stages of the pandemic.

With regard to the prevalence rates of probable depression and anxiety, quite large cross-country differences were identified, for instance, when comparing the United Kingdom with the Netherlands. Such notable discrepancies were also identified prior to the pandemic (e.g., [Alonso et al., 2004](#)) and are frequently explained by cultural differences [Simon et al., 2002](#). Differences in locus of control [Steptoe et al., 2007](#); [Steptoe and Wardle, 2001](#) or changes in cultural and wealth may also contribute to cross-country differences [Juhász et al., 2012](#). Moreover, discrepancies in recognition or identification of mental illnesses between the countries may exist [Kirmayer, 2001](#).

While the prevalence rates for both probable depression and probable anxiety decreased from wave 7 (June/July 2021) to wave 8 (September 2021) in most countries, they often increased from wave 8 to wave 9 (December 2021/January 2022). The identified drop in prevalence rates from wave 7 to wave 8 may be mainly explained by improvements in vaccination coverage, whereas the rise in prevalence rates from wave 8 to wave 9 could be the result of increasing incidence rates (Winter 2021/2022), pandemic fatigue and a frequently higher Covid-19 stringency index.

In accordance with recent research [Hajek et al., 2022](#), particularly high prevalence rates for both probable depression and probable anxiety have been identified among individuals aged 18 to 29 years in our study. We assume that being confronted with several challenges including financial obstacles, entering the labor market, worries about the future and filling multiple roles could explicate such remarkably high prevalence rates [Hajek et al., 2022](#). Moreover, factors such as feelings of not

really having experienced formative years may also explain the prevalence rates among individuals aged 18 to 29 years.

Additionally, individuals being infected with the SARS-CoV-2 also reported quite high prevalence rates in our study. While we assume that discrimination or Covid-19 related stigma [Bagcchi, 2020](#); [Duan et al., 2020](#) may only play a minor or negligible role more than one year after the beginning of the pandemic, we do assume that concerns about long-term health consequences of Covid-19 and concerns about (already) infecting relative or acquaintances may explain these prevalence rates in this group.

Moreover, individuals with great income difficulties reported very high prevalence rates in our study. Worsening living conditions, nutritional deficiencies, or harmful housing conditions [Heflin and Iceland, 2009](#) caused by these income difficulties may explain these prevalence rates. Furthermore, worries about one's own future and the future of one's own family may also heavily contribute to these prevalence rates. Another way to explain such findings is that such individuals compare their income with others who are better off during the pandemic. These negative income comparisons may also explain these high prevalence rates [Ferrer-i-Carbonell, 2005](#).

Our longitudinal regression analyses also confirmed that increasing income difficulties can contribute to both increases in depressive symptoms and in anxiety symptoms – which may be explained by the aforementioned factors. Furthermore, our regressions showed that an increase in one's own perceived risk of getting infected with the coronavirus, the birth of a child and an increase in the Covid-19 stringency index were associated with increases in depressive symptoms. While an increase in the number of children (i.e., birth of a child) – at least in the short-term - commonly increases well-being (among women) prior to the pandemic [Clark et al., 2008](#), the increase in depressive symptoms in our study may be explained by factors such as worries about infecting the child or feelings of overload due to the missing grandparents as a consequence of social distancing. Additionally, the association between an increase in the Covid-19 stringency index and increases in depressive symptoms could be explained by the perceived loss of freedom (and associated restrictions in social life or feelings of loneliness) due to the government measures. Lastly, the association between an increase in one's own perceived risk of getting infected with the coronavirus and increases in depressive symptoms in our study may be explained by the factors associated with such an infection (e.g., concerns about infecting others, or feelings of guilt when they may have already infected others).

#### 4.3. Strengths and limitations

This current study substantially extends our knowledge regarding the prevalence of probable depression and anxiety during the later stages of the COVID-19 pandemic in various European countries. We used longitudinal data from the established and representative ECOS. The challenge of unobserved heterogeneity was reduced using linear FE regressions [Cameron and Trivedi, 2005](#). It should be noted that good psychometric properties of the PHQ-4 have been shown by various studies [[Kroenke et al., 2007](#); [Kroenke et al., 2007](#); [Kroenke et al., 2007](#); [Löwe et al., 2005](#); [Löwe et al., 2005](#)]. Additionally, Kroenke et al. declared that “because of its excellent operating characteristics, the PHQ-4 may well substitute for its parent scales (the GAD-7 and PHQ-9)” [Kroenke et al., 2007](#). However, future research using clinical interviews would be useful to confirm our results. Moreover, future studies examining the prevalence of depression and anxiety among institutionalized individuals during later stages of the pandemic would be desirable. Moreover, it should be noted that the high risk group of individuals aged 80 years and above is underrepresented in such an online sample. In the present study, it was only distinguished between women and men. Future research among other gender identities (“diverse”) may be of great interest during and after the COVID-19 pandemic.

#### 4.4. Conclusion

Our study is the first cross-country comparative analysis of mental health burden of COVID-19, with particular focus on later stages of the pandemic. In addition to shedding light on geographical differences, we find that younger individuals, those with income difficulties as well as infected cases report major rates. These findings provide useful insights to inform policies aimed to heal fractures exacerbated by the pandemic.

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#### CRedit authorship contribution statement

**André Hajek:** Conceptualization, Data curation, Writing – original draft. **Sebastian Neumann-Böhme:** Conceptualization, Data curation, Writing – review & editing. **Iryna Sabat:** Conceptualization, Data curation, Writing – review & editing. **Aleksandra Torbica:** Conceptualization, Data curation, Writing – review & editing. **Jonas Schreyögg:** Conceptualization, Data curation, Writing – review & editing. **Pedro Pita Barros:** Conceptualization, Data curation, Writing – review & editing. **Tom Stargardt:** Conceptualization, Data curation, Writing – review & editing. **Hans-Helmut König:** Conceptualization, Data curation, Writing – review & editing, Supervision.

#### Declaration of Competing Interest

The authors have no competing interests to declare that are relevant to the content of this article.

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