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A two-wave matched-control study

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Empirical Article

Symptoms of anxiety and depression in Denmark during the first year of the COVID-19 pandemic: A two-wave matched-control study

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Strizzi, J. M., Pavan, S., Frederiksen, E. L., Andersson, M., Graugaard, C., Frisch, M. & Hald, G. M. (2023). Symptoms of anxiety and depression in Denmark during the first year of the COVID-19 pandemic: A two-wave matched-control study. *Scandinavian Journal of Psychology*, 64, 563–573.

Subsequent to the restriction measures taken to curb the COVID-19 infection rate, researchers theorized these would have detrimental mental health consequences. This two-wave matched-control study investigates depression and anxiety symptoms during the first 12 months of the pandemic (March 2020–March 2021) in Denmark with data from the I-SHARE and Project SEXUS studies. The I-SHARE study includes 1,302 (Time period 1 only $n = 914$, Time period 2 only $n = 304$, both time periods 1 and 2 $n = 84$) Danish participants, and the sex and birth year-matched control participants from the Project SEXUS study comprise 9,980 Danes. During the first year of the pandemic, the study populations' anxiety and depression symptom mean levels did not significantly differ from pre-pandemic matched controls. Younger age, female gender, fewer children in the same household (depression only), lower education level, and not being in a relationship (depression only) were associated with increased anxiety and depression symptom scores. The key COVID-19-related variable linked with significantly higher anxiety and depression symptom scores was COVID-19-related loss of income. Contrary to initial concerns, we did not find a significant effect of the pandemic on anxiety and depression symptom scores. However, the results underscore the importance of structural resources to prevent income loss to safeguard mental health during crises such as a pandemic.

Key words: Anxiety, depression, mental health, COVID-19, vaccine hesitancy.

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INTRODUCTION

Now into what many consider to be post-pandemic times, the question of how mental health has been impacted by this unprecedented global event continues to capture the attention of researchers, policymakers, and the media (Holmes *et al.*, 2020; O'Connor *et al.*, 2020; Robinson, Sutin, Daly, & Jones, 2022).

During the first wave of the coronavirus disease (COVID-19) pandemic, researchers theorized a subsequent echo pandemic of mental health consequences including increased stress, anxiety, and depression (Ren *et al.*, 2020; Vahia, Jeste, & Reynolds, 2020; Dozois, 2021; El-Gabalawy & Sommer, 2021). This was primarily because of the similarity in governmental action taken in response to previous experiences with epidemics, including implementing social distancing, lockdown, and isolation (Lonergan & Chalmers, 2020; Li *et al.*, 2020a; Henssler *et al.*, 2021; Sønderskov, Dinesen, Vistisen, & Østergaard, 2021; Danish Health Authority, 2021a, 2021b) and the concern about the impact these measures would have on psychological health and well-being (e.g., Holmes *et al.*, 2020; O'Connor *et al.*, 2020; Cavicchioli *et al.*, 2021). Systematic reviews and meta-analyses of initial cross-sectional studies indicated that the pandemic and

related restrictions increased the risk of developing symptoms of anxiety and depression (Luo, Guo, Yu, Jiang, & Wang, 2020; Salari *et al.*, 2020; Xiong *et al.*, 2020; Phiri *et al.*, 2021). However, longitudinal studies showed that while there was agreement on an increase in anxiety and depression rates during the initial stages of the pandemic, these same levels decreased and stabilized soon after and throughout the lengthy pandemic period, underlining individuals' adaptation to the new circumstances (Fancourt, Steptoe, & Bu, 2021). Furthermore, longitudinal analyses showed that the increase in distress experienced by all demographic groups at the onset of the pandemic significantly decreased over time, to the point that mental health status was indistinguishable from pre-pandemic levels, across all groups (Daly & Robinson, 2021). Longitudinal research also highlighted that groups at risk for poor mental health before the pandemic, remained at risk throughout the pandemic (Fancourt, Steptoe, & Bu, 2021) and evidence of worsening symptoms among those with pre-existing mental health diagnoses was not found (Robinson, Sutin, Daly, & Jones, 2022).

As the pandemic transitioned into a long-term crisis, it was expected that anxiety and depression symptom levels would increase also as a result of unemployment and economic stress, social isolation, and loneliness, as these conditions have previously been found to be associated with poor or deteriorating mental health (Heinrich & Gullone, 2006; Strandh, Winefield, Nilsson, & Hammarstrom, 2014; Elovainio *et al.*, 2017; Matthews *et al.*, 2019; Torales, O'Higgins, Castaldelli-Maia, & Ventriglio, 2020). However, contradicting these expectations,

This study was done in the context of the I-SHARE study (International Sexual Health And REproductive Health), which examines the impact of the COVID-19 crisis on sexual and reproductive health in diverse low-income, middle-income, and high-income countries. The full list of consortium members and their roles can be found here (<https://ishare.web.unc.edu/>).

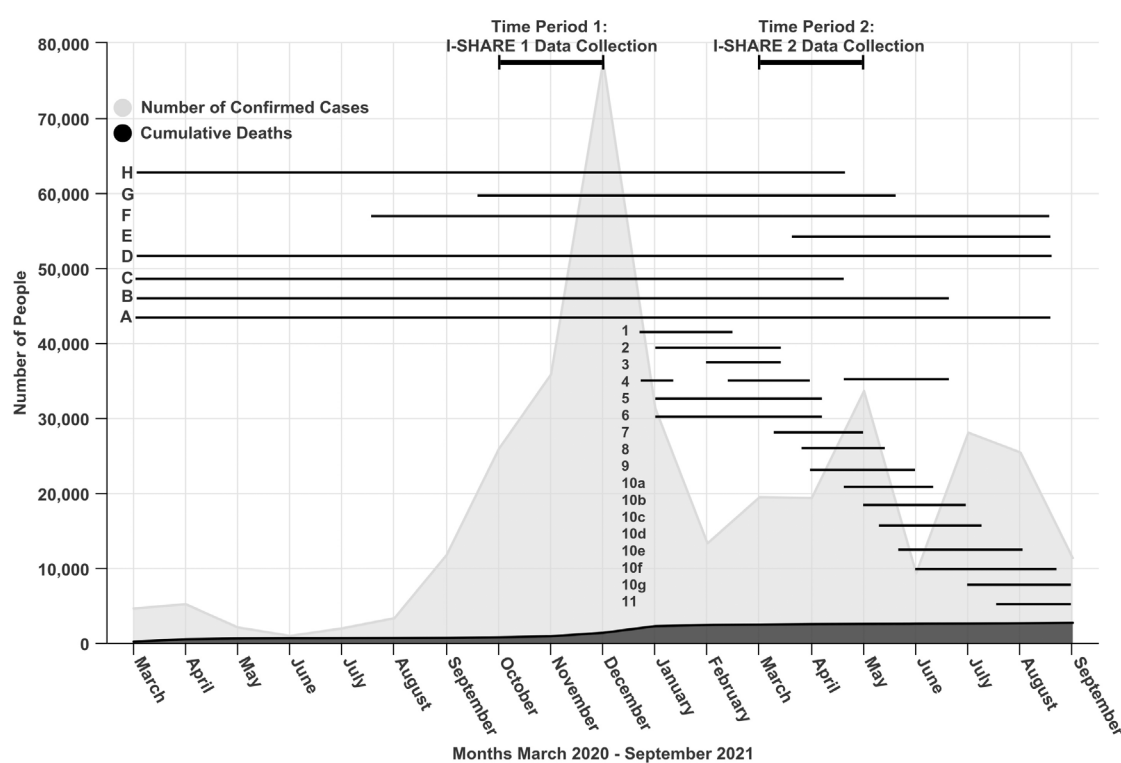
some studies have found evidence of no overall increases in anxiety and depression symptoms during the pandemic (Clotworthy *et al.*, 2021; Finstad *et al.*, 2021; Kowalski, Carroll, & Britt, 2021), while others have observed oscillating patterns and trends that often follow the strictness and release of certain restrictions (Landi, Pakenham, Crocetti, Tossani, & Grandi, 2022). In some studies, some individuals even experienced a positive attitude towards the pandemic, appreciating the slowed-down pace of life, having more time to reconsider their priorities and dedicate to partners, family, and friends, and experiencing consequences of posttraumatic re-orientation such as personal growth and appreciation of life (Clotworthy *et al.*, 2021; Finstad *et al.*, 2021; Kowalski, Carroll, & Britt, 2021). These positive experiences during the pandemic, together with adaptation abilities and psychological flexibility, may be protective factors for mental health (Kowalski, Carroll, & Britt, 2021; Landi, Pakenham, Crocetti, Tossani, & Grandi, 2022; Robinson, Sutin, Daly, & Jones, 2022). In addition, these could be factors explaining the findings of longitudinal studies of symptoms of general anxiety and depression measured with the Generalized Anxiety (GAD-7) and the Patient Health Questionnaire (PHQ-9) instruments which demonstrated no statistically significant changes in symptom severity among populations over the course

of the pandemic (Batterham Caele *et al.*, 2021; Bendau, Plag, Kunas, Wyka, Ströhle & Petzold, 2021; Maggi *et al.*, 2021).

Overall, there is no consensus on what the effect of the COVID-19 pandemic on the population's mental health has been. While initial cross-sectional studies reported adversely affected mental health, longitudinal studies report a positive change or no significant change at all, specifically in terms of symptoms of anxiety and depression. As a result, understanding precisely how the COVID-19 pandemic and associated restrictions are related to mental health and which populations may be particularly vulnerable is a priority for public health (Holmes *et al.*, 2020; O'Connor *et al.*, 2020). This is especially important as many countries are currently still experiencing a rise in infection rates and are subjected to lockdowns and related restriction measures.

The Danish context

Denmark declared lockdown due to the pandemic on March 12, 2020 (Brown, 2020) (see Fig. 1). Prior to the pandemic (before 2020), the Danish Health Authorities observed that the Danish population's mental health levels had been deteriorating, showing that young female populations (aged 16–24), people with lower education levels, being unemployed or a student, separated,



COVID-19 Restrictions Time Frame
 A - Social Distancing Measures
 B - (Indoor) Assembly Bans
 C - (Outdoor) Assembly Bans
 D - Restricted Access to Restaurants/Cafés
 E - Proof of Vaccination/Negative COVID-19 Test Required to Access Restaurants/Cafés
 F - Face Masks Required on Public Transportation
 G - Face Masks Required in Stores/Cinemas/Secondary Education
 H - Schools Closed/Online Education

COVID-19 Vaccination Calendar
 1- Residents in nursing homes, etc.
 2- Residents over 65 years who receive practical help & care
 3- Residents over 85 years of age
 4-Frontline healthcare staff
 5- Selected patients with increased risk
 6-Relatives of persons with increased risk
 7-Residents aged 80-84 years
 8- Residents aged 75-79 years
 9-Residents aged 65-74 years
 10a- Residents aged 60-64 years
 10b-Residents aged 55-59 years
 10c-Residents aged 50-54 years
 10d-Residents aged 16-19 & 45-49 years
 10e- Residents aged 20-24 & 40-44 years
 10f- Residents aged 25-29 & 35-39 years
 10g-Residents aged 30-34 years
 11- Residents aged

Fig. 1. COVID-19 confirmed cases, cumulative deaths, restrictions timeline, and vaccination calendar for Denmark, March 2020–September 2021, and present study data collection periods (Time period 1 and Time period 2).

divorced, or unmarried were associated with poorer mental health (Sønderskov, Dinesen, Santini, & Østergaard, 2020a, 2020b). Furthermore, a national report found an increase (from 2019 to 2020) in the prevalence of individuals with depression symptoms (Møller, Ekholm, & Thygesen, 2021).

During the initial phase of the pandemic and the implementation of the social distancing measures, individuals reported feeling worried and lonely (Clotworthy *et al.*, 2021; Varga *et al.*, 2021; Wang, Di, Ye, & Wei, 2021). However, longitudinal studies revealed that symptoms of anxiety and depression in Denmark diminished over the course of March to December 2020 (Sønderskov, Dinesen, Santini, & Østergaard, 2020a, 2020b; Sønderskov, Dinesen, Vistisen, & Østergaard, 2021). This could possibly be ascribed to the more liberal and flexible nature of restrictions imposed in Denmark, compared to guidelines implemented in other countries (Clotworthy *et al.*, 2021; Varga *et al.*, 2021).

The equivocal results mentioned above reflect the status of the available literature. To date, research has shown that increases in anxiety and depression rates were indeed observed during the initial months of the pandemic, but that these tended to decrease relatively rapidly returning to pre-pandemic levels (Daly & Robinson, 2021; Landi, Pakenham, Crocetti, Tossani, & Grandi, 2022), similarly to the symptoms trend seen in Denmark. It was also noticed that the patterns identified in the increase and decrease of mental health symptoms mimicked the strictness levels of restrictions (Landi, Pakenham, Crocetti, Tossani, & Grandi, 2022), where a more flexible set of restrictions resulted in improved mental health, as was also observed in Denmark. The current body of literature examines trends in anxiety and depression symptoms across the different waves of the pandemic, often accounting for sociodemographic factors and a number of COVID-19 related factors such as experiencing lockdown and isolation (Cao *et al.*, 2020; Hyland *et al.*, 2020; Lebel, MacKinnon, Bagshawe, Tomfohr-Madsen, & Giesbrecht, 2020; Lei *et al.*, 2020; Li *et al.*, 2020b; Clotworthy *et al.*, 2021; Dozois, 2021; El-Gabalawy & Sommer, 2021; Henssler *et al.*, 2021). However, the current study aims to further explore these factors: (1) within the Danish context; and (2) including other indicators such as restriction compliance, loss of income due to the pandemic, vaccine uptake, and vaccine hesitancy, which have yet to be explored.

This paper aims to assess the following two research questions (RQ) employing a matched-control two-wave (Time period 1: October–November 2020; Time period 2: March–May 2021) longitudinal study design.

RQ1: Did symptoms of anxiety and depression change during the first 12 months (from Time period 1 to Time period 2) of the COVID-19 pandemic in Denmark, and are there any differences compared to matched control individuals' symptom levels before the pandemic?

RQ2: After controlling for sociodemographic factors, what is the added predictive value of COVID-19 factors (pandemic duration/time period, COVID-19-related loss of income, social distancing compliance, [self]-isolation, COVID-19 testing, vaccination status, and vaccine hesitancy) on anxiety and depression symptoms over the first 12-months of the pandemic in Denmark?

MATERIALS AND METHODS

Participants

This two-wave study included 1,302 (Time period 1 $n = 914$, Time period 2 $n = 304$, both time periods 1 and 2 $n = 84$) participants (see Fig. 1 and procedure subsection). The study population had a mean age of approximately 51 years (Time period 1) and 56 years (Time period 2). 51%–54% of the study population identified as women and 46%–49% identified as men. Forty-five percent of individuals had completed a university degree and the majority of participants were in a relationship (74%–78%). Specific to Time period 2, 88% stated no hesitancy towards COVID-19 vaccination but only 17% had received the COVID-19 vaccine (see Table 1; see Fig. 1 for the vaccination schedule for Denmark; Danish Health Authority, 2021a, 2021b).

To assess the representativeness of the samples, we compared our respondents to the general Danish population over 18 years of age on core sociodemographic variables. These analyses revealed that the respondents of Time period 1 were representative in terms of the number of children. However, the sample included more men ($\chi^2[1] = 6.49$, $p = 0.011$), were older, ($t[998] = 18.29$, $p < 0.001$), had higher income ($t[985] = 4.21$, $p < 0.001$; mean difference 2,308 DKK/month), and were more highly educated ($\chi^2[1] = 27.52$, $p < 0.001$) than the overall Danish population. Time period 2 respondents were representative in terms of gender and number of children, but they were older ($t[388] = 17.48$, $p < 0.001$), had higher incomes ($t[985] = 3.40$, $p < 0.001$; mean difference 2,991 Danish Kroner/month), and were more highly educated ($\chi^2[1] = 55.49$, $p < 0.001$) than the overall Danish population data were obtained from Statistics Denmark (Statistics Denmark, 2022a, 2022b, 2022c, 2022d). A rake weight was constructed and applied before conducting the main regression analyses to account for sociodemographic differences between the study sample and the general Danish population.

The matched control comparison sample from the Project SEXUS cohort comprised 5,390 women and 4,590 men with a mean age of 51 years drawn from that study's total of 62,675 participants (<https://www.projektsexus.dk/>). Specifically, controls were matched in terms of gender and birth year in a manner aimed to ensure identical gender and age distributions among participants and controls (see below).

Procedure

The data was collected as part of the International Sexual Health and Reproductive Health Survey in the time of COVID-19 (I-SHARE; <https://ishare.web.unc.edu/>), a 33-country study designed to assess a wide range of parameters including: sociodemographics, compliance with social distancing measures, sexual and reproductive health (for more information, please see Michielsen *et al.*, 2021). In Denmark, a two-wave design was employed (see Fig. 1). A nationally representative sample of 5,000 Danish residents over the age of 18 was drawn by The Danish Health Data Authority with the criteria of equal gender representation of Danish residents over the age of 18. These 5,000 individuals were sent invitation letters at both time periods (Time period 1: October–November 2020; Time period 2: March–May 2021) with a link to the online anonymous survey through e-boks (an electronic email service). The survey was administered using Open Data Kit software (version 1.16) and was structured to take participants around 15 min to complete. Inclusion criteria included having to be a Danish resident at the time of survey completion, 18 years or older, and being able to provide informed consent online. Participants provided a 6-digit self-generated code, which enabled the anonymous data from both waves of the study to be matched. The study was approved by the University of Copenhagen's Research Ethics Committee for Science and Health and the University of Copenhagen's Data Protection Office.

Furthermore, a collaboration between the I-SHARE Denmark research team at the University of Copenhagen and the Project SEXUS research team at the Statens Serum Institut and Aalborg University enabled a matched-control study design to compare the participants' scores on GAD-7 and PHQ-2. The baseline data in Project SEXUS were collected before COVID-19 in 2017–2018 and constitute a national study of sexual

Table 1. Participant sociodemographic information ($N=1,302$, Time Period 1 $n=914$, Time Period 2 $n=304$, participants who responded in both Time Periods 1 and 2 $n=84$)

Variable	Time Period 1	Time Period 2	Both Time Periods 1 & 2
Age, years, mean (<i>SD</i>)	51.29 (16.67)	56.38 (15.82)**	52.22 (14.05)* ^{T1}
Gender, %			
Woman	53.9	50.7	55.7
Man	46.1	49.3	44.3
Education level, %			
Below university	54.7	54.8	47.6
Completed university	45.3	45.2	52.4
Income, %			
Below the average national monthly salary	35.5	35.6	22.6** ^{T1} , ** ^{T2}
Average	18.6	15.4	29.8
Above the average national monthly salary	45.9	49.0	47.6
Relationship status, %			
Single	13.8	9.0	12.5
In a relationship/married	73.8	77.7	72.6
Divorced/widowed	7.2	9.0	8.3
Other	5.2	4.3	6.5
Number of children, mean (<i>SD</i>)	1.64 (1.17)	1.76 (1.11)	1.55 (1.15)
Number of children under 18 living in the house during COVID, %			
0	62.1	68.4	60.9
1	16.3	13.0	21.9
2	17.1	14.3	14.1
3	3.8	3.5	3.1
4 or more	0.7	0.9	0.0
COVID-19-related loss of income, %			
Total loss of income	1.2	1.0	1.2
Partial loss of income	7.2	7.0	7.7
No loss of income	89.8	91.7	89.9
No income before COVID-19	1.8	0.3	1.2
Social distancing compliance, %			
Low	7.6	11.2*	7.7
Moderate	69.3	61.7	60.7
High	23.1	27.1	31.5
(Self)-isolation experience, %			
No	84.6	82.6	83.3
Yes	15.4	17.4	16.7
COVID-19 testing, %			
No	45.3	13.2**	29.2** ^{T1} , ** ^{T2}
Yes, always negative	53.1	82.9	70.2
Yes, tested positive at least once	1.5	3.9	0.6
COVID-19 vaccination, %			
No	–	82.6	84.1
Yes	–	17.4	15.9
COVID-19 vaccine hesitancy, %			
No	–	87.8	92.8
Yes	–	12.2	7.2

Notes: NS = Non-Significant; ^{T1} = Significant differences between participants of both Time Periods 1 & 2 and Time Period 1 only participants; ^{T2} = Indicates significant differences between Both Time Period 1 and 2 and Time Period 2 only participants.

* $P < 0.05$.

** $P < 0.001$, for time period differences.

attitudes, preferences, experiences, and behaviors in Denmark (Frisch, Moseholm, Andersson, Andresen, & Graugaard, 2019).

The University of Copenhagen provided the SEXUS team with the reported sex and birth year distribution of the 998 I-SHARE Denmark

participants from Time period 1 and, in turn, the SEXUS team selected 10 sex- and age-matched controls per I-SHARE participant for the study. Specifically, to ensure comparable age distributions and account for approximately 3 years earlier data collection in Project SEXUS than in I-SHARE, controls were matched on birth year among I-SHARE participants minus 3.

Measures

Sociodemographic variables. (A) Age was obtained by asking participants their ages on a continuous scale. (B) Sex was determined by asking participants “What sex were you assigned at birth?” with the response options 1 (male) or 2 (female). (C) Educational level was reported as the highest level of schooling with eight response options: 1 = no formal education, 2 = some primary school, 3 = complete primary school, 4 = some secondary school, 5 = complete secondary school, 6 = some college or university, 7 = complete college or university, 8 = other. These responses were dichotomized as follows: 0 = less than college or university-educated (1–6 and 8), and 1 = completed college or university (7). (D) Income was determined by asking participants “What is your current monthly income before tax?” with the response options ranging from 1 ($\leq 10,000$) to 9 ($\geq 80,000$) on a scale with 10,000 Danish Kroner intervals. In 2019, the average national Danish income was 28,301 Danish Kroner before tax (Danmarks Statistik, 2021), and the response options were subsequently categorized for Table 1 into three categories in account to this average: 1 = below the national average (1–2; $\leq 20,000$ Danish Kroner), 2 = national average (3; 20,001–30,000 Danish Kroner), and 3 = above the national average (4–9; $> 30,000$ Danish Kroner). For the regression analysis, monthly income was used on a continuous scale. (E) Relationship status was determined by asking participants “What best describes your relationship status?” with response options 1 = single, and never had a partner, 2 = single, but had a partner previously or currently dating, 3 = in a relationship but not living together, 4 = not legally married but living together, 5 = legally married and living together, 6 = legally married and not living together, 7 = legally married and separated, 8 = widowed, 9 = divorced, 10 = other. For Table 1, the responses were categorized into four categories: 1 = single (1–2), 2 = in a relationship (3–7), 3 = widowed and divorced (8–9), and 4 = other (10). For the regression analysis, the response options were dichotomized as follows: 0 = not in a relationship (1–2, 8–10) and 1 = in a relationship (3–7). (F) Number of children was obtained by asking participants how many children they had, if any. Participants reported the number of children on a continuous scale, responses ranged from 0 to 5. (G) Number of children under 18 was ascertained with three questions: (1) “How many people lived in your house in the 3 months before the COVID-19 social distancing measures?”; (2) “How many people lived/live in your house during the COVID-19 social distancing measures?”; and (3) “Was/is your family composition different during the COVID-19 social distancing measures?”. Respondents indicated the number of adults over 18 years, the number of children aged 0–9 years, and the number of adolescents aged 10–18 years. We employed the responses corresponding to the number of children under 18 living in the household during the COVID-19 social distancing measures.

COVID-19-related variables. (A) COVID-19-related loss of income was assessed by asking participants “Since the COVID-pandemic, have you personally experienced a loss of income?” with response options 1 = yes, a total loss of income, 2 = yes, a partial loss of income, 3 = no loss of income, 4 = I had no personal income before COVID-19. For the regression analysis, the response options were dichotomized as follows: 0 = no loss of income (3–4) and 1 = a loss of income (1–2). (B) Social distancing compliance was determined by asking participants, “How much would you say that you’re following recommended COVID-19 social distancing measures?” with response options 1 = not at all, 2 = a little bit, 3 = a lot, and 4 = very strictly. For Table 1, the response options were categorized into three compliance categories: 1 = low compliance (1–2), 2 = moderate compliance (3), and 3 = high compliance (4). For the regression analysis, the recoded variable was dummy coded with “low compliance” used as a reference category. (C) (Self)-isolation was determined by asking participants “Were you ever in (self)-isolation

because of symptoms or because you were in close contact with someone with COVID-19 or because you returned from a country that had a large number of cases?”. Response options were 1 = no, and 2 = yes. (D) COVID-19 testing was assessed with the following item and corresponding response options “Were you ever tested for COVID-19?” 1 = No, 2 = Yes, I tested positive at least once, 3 = Yes, I have always tested negative. (E) Vaccination coverage was evaluated with the question “I have received a vaccine for COVID-19.” 1 = Yes, 2 = No. (F) Vaccine hesitancy was assessed with “I am likely to be vaccinated when a vaccine for COVID-19 becomes available.” The response options were 1 = Yes, 2 = No, 3 = Unsure/Do not know. The responses No or Unsure/Do not know were recoded into 1 = Vaccine hesitancy, and Yes was recoded into 0 = No vaccine hesitancy. Both questions E and F were posed to all participants during data collection at Time Period 2.

Anxiety. The Generalized Anxiety Disorder 7-item (GAD-7) scale was used in the present study and for the matched-control population to assess anxiety symptoms (Spitzer, Kroenke, Williams, & Löwe, 2006). The scale consists of seven items (e.g., “Over the last 2 weeks, how often have you been bothered by the following problems?: Feeling nervous, anxious or on edge?”) and responses are given on a four-point Likert-type scale (0 = Not at all, 3 = Nearly every day). The scores are calculated by summing responses where higher scores denote higher levels of symptoms and a higher probability of a Generalized Anxiety Disorder diagnosis. The total score of the GAD-7 ranges from 0 to 21 with cut-off scores of 5, 10, and 15, representing mild, moderate, and severe anxiety, respectively (Spitzer, Kroenke, Williams, & Löwe, 2006). The instrument demonstrated strong internal reliability in the present study (Time period 1, $\alpha = 0.91$; Time period 2, $\alpha = 0.93$).

Depression. The Patient Health Questionnaire 9-item (PHQ-9) scale was used to assess depression symptoms (Kroenke & Spitzer, 2002). The 9-item scale helps evaluate the presence of symptoms of a major depressive disorder (MDD) with items like “Over the past 2 weeks, how often have you been bothered by any of the following problems: Feeling down, depressed or hopeless?” with responses given on a four-point Likert-type scale (0 = Not at all, 3 = Nearly every day). The scores are computed by summing responses and higher scores denote higher levels of symptoms and an increased probability of a depressive disorder. The PHQ-9 total score ranges from 0 to 27 with the cut-off scores 5, 10, 15, and 20, representing mild, moderate, moderately severe, and severe levels of depression symptoms, respectively (Kroenke, Spitzer, & Williams, 2001; Kroenke & Spitzer, 2002). To compare with matched controls from the Project SEXUS study, we used the 2-item Patient Health Questionnaire (PHQ-2) comprising the first two items of the PHQ-9 with a total score ranging from 0 to 6. The recommended cut-off point is 3 or greater as it has been found to have the greatest sensitivity and specificity for

determining depression (Kroenke, Spitzer, & Williams, 2003). The instrument demonstrated good internal reliability in the present study (Time period 1, $\alpha = 0.87$; Time period 2, $\alpha = 0.86$).

Statistical analyses

To contextualize participants' self-reported anxiety and depression symptom levels during the COVID-19, each I-SHARE participant's mean scores on GAD-7 and PHQ-2 were compared to the mean scores of 10 matched controls from Project SEXUS (individually matched on sex and birth year minus 3 to ensure identical age distributions because Project SEXUS preceded the I-SHARE study by approximately 3 years) with a one-sample *t* tests. To explore the association between the social distancing measures, sociodemographic factors, and poor mental health in the Danish public, a two-step hierarchical multiple linear regression analysis was conducted with the sociodemographic variables of age, sex, number of children under age 18 living in the same residence, educational level, and relationship status in the first step (model 1) and the COVID-19-related variables of the duration of the pandemic (Time period 1 and Time period 2), loss of income, (self-)isolation experience, social distancing measure compliance, COVID-19 vaccination status, and vaccine hesitancy in the second step (model 2). The analyses were conducted using SPSS 27.0. As the representativeness analyses revealed differences between the study samples at Time periods 1 and 2 (see the Participants section) and the general Danish population, a rake weight based on gender, age, educational attainment, and income, was constructed and applied for the regression analyses.

RESULTS

Regarding RQ1, the one-sample *t* tests comparing anxiety and depression symptoms over the first 12 months of the pandemic in Denmark to the matched controls' symptoms before the pandemic showed no statistically significant results (see Figs. 2 and 3). These results indicate no differences in symptom scores among Danish populations at Time period 1, Time period 2, and matched controls prior to the times of COVID-19. Between 89% and 94% of the participants reported none to mild symptoms of anxiety or depression at both time points (see Table 2).

Pertaining to RQ2, the overall two-step hierarchical regression model for depression symptoms accounted for 13.7% of the variance in the first step, and COVID-19-related variables accounted for 2.2% of the variance in the second step with both

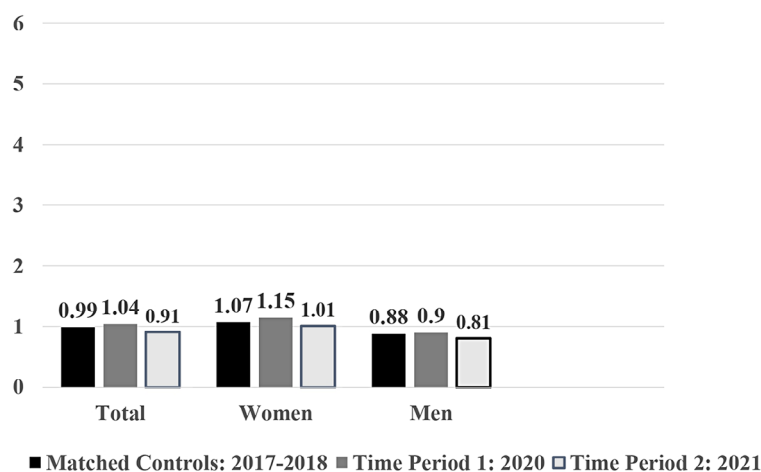


Fig. 2. Depression scores for PHQ-2 comparing mean scores for Time period 1 participants in 2020 ($n = 998$), Time period 2 participants in 2021 ($n = 390$), and matched controls in 2017–2018 ($n = 9,980$).

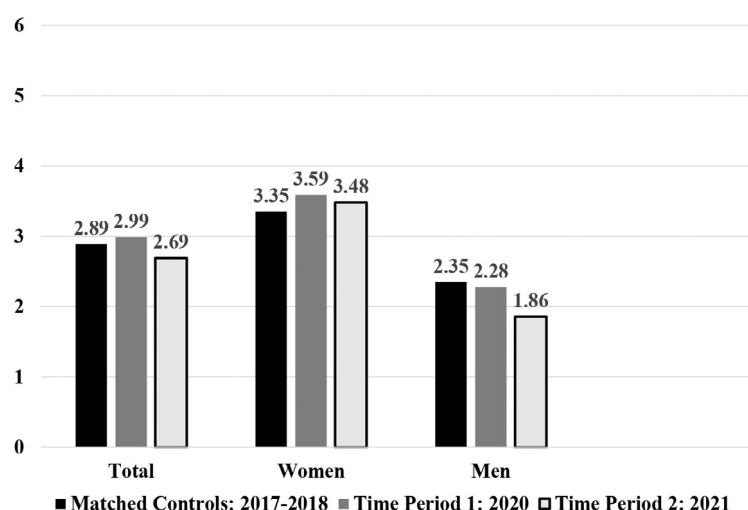


Fig. 3. Anxiety scores for GAD-7 comparing mean scores for Time period 1 participants in 2020 ($n = 998$), Time period 2 participants in 2021 ($n = 390$), and matched controls in 2017–2018 ($n = 9,980$).

Table 2. Anxiety and depression symptoms score descriptive information

Variable	Time Period 1 ($n = 998$)	Time Period 2 ($n = 390$)
Anxiety symptoms (0–21), mean (SD)	2.99 (3.98)	2.69 (3.90)
Anxiety symptoms: clinical cut-off scores		
None/mild (0–9), %	92.9	94.5
Moderate/severe (10–21), %	7.2	5.5
Depression symptoms (0–27), mean (SD)	3.93 (4.48)	3.44 (4.25)*
Depression symptoms: clinical cut-off scores		
None/mild (0–9), %	89.0	90.8
Moderate/severe (10–27), %	11.0	9.2

Notes: NS = Non-Significant.

* $P < 0.05$.

** $P < 0.001$, for time period differences. The sample sizes for time period 1 and time period 2 differ from Table 1 as participants who responded at both data collection periods are incorporated into the corresponding time periods in the present table. Table 1 presents the sociodemographic characteristics of the 3 groups whereas this table focuses on potential temporal differences in anxiety and depression symptoms at the two data collection periods.

steps being significant. Younger age ($\beta = -0.28$), female gender ($\beta = 0.14$), having achieved a lower level of education ($\beta = -0.10$), and not being in a relationship ($\beta = -0.10$) were each associated with higher levels of depression symptoms (see Table 3). In the second step of the hierarchical regression model, the same sociodemographic variables and having fewer children under the age of 18 were significantly associated with higher PHQ-9 scores ($\beta = -0.05$, $p = 0.04$). After adjusting for sociodemographic variables (i.e., in the second step of the hierarchical regression model), statistical analysis showed that the only COVID-19-related variable that was significantly associated with higher depression symptoms was COVID-19-related loss of income ($\beta = 0.14$) (see Table 3).

Table 3. Hierarchical linear regression analysis of sociodemographic and COVID-19-related variables on depression symptoms

Variable	Model 1			Model 2		
	<i>B</i>	SE <i>B</i>	β	<i>B</i>	SE <i>B</i>	β
Age	-0.08	0.01	-0.29**	-0.08	0.01	-0.28**
Gender	1.31	0.25	0.13**	1.40	0.25	0.14**
Children under 18	-0.43	0.29	-0.04	-0.61	0.30	-0.05*
Educational level	-1.00	0.27	-0.10**	-1.08	0.27	-0.10**
Relationship status	-1.20	0.28	-0.11**	-1.08	0.28	-0.10**
Time period				0.05	0.04	0.04
Loss of income				1.89	0.35	0.14**
Self-isolation experience				0.90	0.33	0.01
Social distancing compliance: moderate vs. low				-0.75	0.45	-0.07
Social distancing compliance: high vs. low				0.50	0.50	-0.04
Vaccinated				0.73	0.61	0.03
Vaccine hesitancy				0.82	0.74	0.03
<i>R</i>					0.399	
<i>R</i> ²		0.371			0.1594	
<i>F</i>		0.137			43.39**	
ΔR^2		43.39**			0.022	
<i>F</i> Change <i>R</i> ²					5.08**	

Notes: * $P < 0.05$.

** $P < 0.001$.

The two-step hierarchical regression model for anxiety symptoms accounted for 13.6% of the variance in step one, and COVID-19-related variables accounted for 3.1% of the variance in step two, both steps were significant. Younger age ($\beta = -0.27$), female gender ($\beta = 0.21$), and having achieved a lower educational level ($\beta = -0.13$) were each associated with higher anxiety symptoms (see Table 4). In the second step, these same variables were significant. After adjusting for sociodemographic variables, COVID-19-related loss of income ($\beta = 0.15$), moderate social distancing compliance (when compared to low compliance) ($\beta = 0.03$), and having received the vaccine ($\beta = 0.06$) were the only COVID-19-related variables associated with higher anxiety symptoms (see Table 4).

DISCUSSION

The present paper is the first research that addresses the mental health status of individuals during the first 12 months of the pandemic in Denmark compared to the mental health status of matched controls before the pandemic, specifically with respect to anxiety and depression symptoms. The present study's design

inquired about symptoms of anxiety and depression over two periods during the first 12 months of the pandemic. The study found no statistically significant differences in symptoms of anxiety and depression between our sample during the first 12 months of the pandemic and data collected from matched controls in 2017–2018 before the COVID-19 pandemic. While it was hypothesized by other authors that mental health would deteriorate during the pandemic (e.g., Holmes *et al.*, 2020; O'Connor *et al.*, 2020; Cavicchioli *et al.*, 2021), our matched-control study design revealed that for the sample population in this study, symptom scores of anxiety and depression did not significantly differ from that of matched controls levels assessed before the pandemic. These results may seem counter-intuitive as they do not reflect the hypotheses put forth at the beginning of the pandemic (e.g., Holmes *et al.*, 2020; O'Connor *et al.*, 2020; Cavicchioli *et al.*, 2021). However, they align with existing literature as other longitudinal studies of symptoms of general anxiety and depression measured with the same instruments as used in the present study only found slight and insignificant changes in symptom score levels or no change over the course of the pandemic (Batterham Calcar *et al.*, 2021; Bendau *et al.*, 2021; Maggi *et al.*, 2021). We think the result may reflect that, for many, the slower pace of life during social distancing measures could imply emotional, relational and/or psychosocial changes that may result in lifestyle changes protecting against anxiety and depression symptoms (Clotworthy *et al.*, 2021; Finstad *et al.*, 2021; Kowalski, Carroll, & Britt, 2021; Robinson, Sutin, Daly, & Jones, 2022). Furthermore, the psychological flexibility profiles hypothesis put forward by Landi, Pakenham, Crocetti, Tossani, & Grandi (2022) and the ability to adapt to new circumstances suggested by Robinson *et al.* (2022) provide plausible explanations for the changing trends in mental health symptoms over the course of the pandemic.

With our second research question, we aimed to evaluate which sociodemographic and COVID-19-related factors were associated with increased symptom level scores of anxiety and depression. In reference to sociodemographic variables, our findings indicated that being younger, female, having achieved a lower level of education, and not being in a relationship (only applicable for depression) may be risk factors for more severe anxiety and depression symptoms. Our results are in line with the findings of previous research in Denmark (Sønderskov, Dinesen, Santini, & Østergaard, 2020a, 2020b).

However, having fewer children under the age of 18 years in the same household was only associated with higher levels of depression symptoms only in the second step. These results are not in line with the existing literature, as the presence of children in the home (especially more than one child) has been found to be associated with higher symptoms of anxiety and depression (Amin, Sharif, Saeed, Durrani, & Jilani, 2020; Shevlin *et al.*, 2020; Khubchandani, Sharma, Webb, Wiblishauser, & Bowman, 2021). This is possibly due to having children at home for a consecutively larger amount of time (with online schooling during the pandemic), the fear of infecting children, who are considered a high-risk group (Amin, Sharif, Saeed, Durrani, & Jilani, 2020) and possibly having a higher number of people to take care of within the same household while also carrying out usual daily parental tasks and work. As our findings run counter

Table 4. Hierarchical linear regression analysis of sociodemographic and COVID-19-related variables on anxiety symptoms

Variable	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Age	-0.07	0.01	-0.28**	-0.07	0.01	-0.27**
Gender	1.68	0.21	0.20**	1.75	0.21	0.21**
Children under 18	-0.28	0.25	-0.03	-0.44	0.25	-0.05
Educational level	-1.08	0.22	-0.12**	-1.15	0.22	-0.13**
Relationship status	-0.09	0.24	-0.01	-0.04	0.24	-0.00
Time period				0.00	0.03	0.00
Loss of income				1.80	0.30	0.15**
Self-isolation experience				0.32	0.28	0.03
Social distancing compliance: moderate vs. low				-0.74	0.42	-0.03*
Social distancing compliance: high vs. low				-0.24	0.42	-0.03
Vaccinated				1.17	0.51	0.06*
Vaccine hesitancy				0.75	0.62	0.03
<i>R</i>					0.404	
<i>R</i> ²					0.163	
<i>F</i>					22.57**	
ΔR^2					0.031	
<i>F</i> Change <i>R</i> ²					7.10**	

Notes: * $P < 0.05$.

** $P < 0.001$.

to this, we speculate if having fewer children in a Danish context evokes higher levels of symptoms of depression due to it possibly being associated with fewer social interactions during social restriction measures. Conversely, this finding may be a statistical artefact and was only significant in the second step of the regression analysis ($p = 0.041$).

It is worth highlighting that even during a health crisis that extended globally and for a prolonged period of time, the factors that were most decisive on mental health were not COVID-19 related. While the pandemic may have provided the ideal circumstances for exacerbation of anxiety and depression symptoms, but only for an initial short period of time, it is underlined that the sociodemographic factors are far more determining for individuals' mental health outcomes. While a younger age and lacking a partner may be explained by an absence of an external support system that can be found in companionship, respectively; the gender disparity that becomes evident from the analysis aligns with the literature. Gender is a widely recognized social determinant of health (Commission on Social Determinants of Health, 2008; World Health Organization, WHO, 2021), and is reflected in our results as a determining factor of mental health status. Similarly, education level is also well-known to be a social determinant of mental health as supported by our findings (Commission on Social Determinants of Health, 2008; World Health Organization, 2021). The results of this study highlight the public health implications of the sociodemographic factors that increase the risk of poor mental health.

We assessed whether six unique COVID-19-related variables (pandemic duration: Time period 1 vs. Time period 2), COVID-19-related loss of income, self-isolation experience, social distancing compliance, vaccination status, and vaccine hesitancy were associated with increased symptom severity of anxiety and depression. Our null findings in terms of self-isolation experiences are likely due to the study location as the nature of the restrictions and their implementation have been more liberal and flexible than in other countries (Clotworthy *et al.*, 2021; Varga *et al.*, 2021). Further, our null findings could be explained by the fact that the COVID-19-related variables assessed may affect the population in heterogeneous ways. In the two-step regression analysis for symptoms of anxiety, moderate compliance with social distancing measures when compared to low compliance and having received the COVID-19 vaccine were associated with higher symptom level scores. The increased compliance with COVID-19 social distancing recommendations could reflect that those with higher symptom level scores are more likely to strictly adhere to government recommendations out of anxiety/fear related to contracting SARS-CoV-2 (Harper, Satchell, Fido, & Latzman, 2020). Due to the cross-sectional nature of the data collection during the second time period of this study, it is impossible to determine causality. Did receiving the COVID-19 vaccine lead to increased anxiety symptom level scores, or did higher anxiety symptom scores lead to vaccine uptake? We cannot definitively answer these questions with these data. However, these results can provide insight into the relationships between vaccine uptake and general symptoms of anxiety. Having received the vaccine was associated with higher levels of anxiety, which may be explained by the timing of the data collection, as

the vaccine was available primarily for high-risk groups during that period and this finding may be more reflective of increased anxiety among those populations at that time. Conversely, the finding may be a spurious association. Our null findings regarding vaccine hesitancy contradict previous research revealing that higher anxiety symptom scores were associated with COVID-19 vaccine hesitancy (Jayakumar *et al.*, 2022; Sekizawa, Hashimoto, Denda, Ochi, & So, 2022) and that COVID-19 vaccine hesitancy is driven by anxiety (Palgi, Bergman, Ben-David, & Bodner, 2021; Bullock, Lane, & LeRon, 2022).

The only variable that was significant in our hierarchical linear regression analyses for both anxiety and depression was COVID-19-related loss of income. Our results are in line with previous research, which shows that experiencing any form of financial insecurity is a risk factor for the development of depression and anxiety symptoms (Heinrich & Gullone, 2006; Strandh, Winefield, Nilsson, & Hammarstrom, 2014; Elovainio *et al.*, 2017; Matthews *et al.*, 2019; Shevlin *et al.*, 2020; Torales, O'Higgins, Castaldelli-Maia, & Ventriglio, 2020; Sønderskov, Dinesen, Santini, & Østergaard, 2020a, 2020b). This may be due to the increased challenges of meeting daily life needs and the emotional instability and stress that come with uncertainty about the future (Mistry & Elenbaas, 2021; Spiro *et al.*, 2021).

In the Danish welfare state, the healthcare system is effective, reliable, and resilient, even during the COVID-19 pandemic, and is free of charge to residents (OECD/European Observatory on Health Systems and Policies, 2021). This might have contributed to decreased mental adversity compared to countries without similar support in place. Moreover, the government ensured paid sick leave and unemployment benefits and COVID-19 relief packages for small business owners that resulted in a relatively stable work economy as compared to other countries during the lockdown (e.g., Soested & Videbaek Munkholm, 2020; Yang, Briar-Lawson, & Urbaeva, 2020; Bariola & Collins, 2021). Thus, the impact of the pandemic on national and household economies could have been less than in other countries. As a result, this finding is especially important as it suggests that the key COVID-19-related factor driving the deteriorated mental health during the times of COVID-19 could have been economic. However, all of the COVID-19-related variables together only accounted for approximately 1% of the variance for both depression and anxiety. Our finding that the key COVID-19-related variable that contributed to poorer mental health in terms of symptoms of anxiety and depression was a loss of income is of particular relevance to policymakers. It provides a clear indication that structural measures to minimize loss of income in events like a pandemic may be a crucial strategy for protecting mental health from a public health perspective.

It is important to understand the impact of the pandemic and its restrictions on the population's mental health for several reasons. First, it is of scientific interest to understand what factors affect mental health, and it is of clinical and public health concern to identify risk factors to inform clinicians, public health promoters, policymakers, researchers, and other stakeholders to counteract possible negative and detrimental influences and to promote protective and supporting factors. Most consequential, seeing sociodemographic factors that are commonly recognized as being significantly associated with poor mental health be once again

underlined as such, of high value to those acting to safeguard mental health. There are several strengths of this study. It is the first to investigate anxiety and depression symptoms in the Danish population during the first year of the pandemic using validated measures, namely GAD-7 and PHQ-9/PHQ-2. This study was also the first study in Denmark to examine the association between anxiety and depression symptoms, sociodemographic factors, and factors related to the COVID-19 pandemic and social distancing measures. Further, it is, to the knowledge of the authors, the first globally to evaluate the associations between vaccination status and vaccine hesitancy with mental health during the COVID-19 pandemic.

However, this study also presents limitations. The generalizability of the study is limited, as the factors under study are only investigated in a small population sample, and the participants were not representative of the general Danish population (see Participants section). Second, we were unable to assess mental health among the same participants at Time period 1 and Time period 2 which would have added to the study findings, as assessing change over time for the same individuals would have provided richer and more decisive information related to the research questions. Thus, these results can only speak to the change at a sample level, not at an individual level.

CONCLUSIONS

This two-wave matched-control study indicated that anxiety and depression symptom mean levels among Danish populations did not change during the first year of the COVID-19 pandemic and did not significantly differ from those of matched controls assessed before the pandemic. These findings could indicate resilience among the Danish population or reflect less severe social distancing restrictions and epidemiological conditions as compared with other contexts. In terms of sociodemographic variables, we found that younger age, being female, having fewer children under the age of 18 years in the same household (only applicable for depression and only in the second step), lower level of education, and not being in a relationship (only applicable for depression) were associated with increased symptom scores of anxiety and depression over the first year of the pandemic. The key COVID-19-related variable linked with significantly higher anxiety and depression symptom scores was a loss of income due to the pandemic. This finding highlights the importance of structural measures to ensure income stability during events such as pandemics to protect populations' mental health. We found associations between higher symptom level scores of anxiety and having received the COVID-19 vaccine and high social distancing recommendation compliance. These findings suggest that targeted outreach among these populations may be beneficial for reducing COVID-19 vaccine hesitancy.

CONFLICT OF INTEREST

The authors report there are no competing interests to declare. This research received no specific grant from any funding agency, commercial, or not-for-profit sectors.

ETHICAL STANDARDS

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

ETHICAL APPROVAL

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

INFORMED CONSENT

Informed consent was obtained from all individual participants included in the study.

DATA AVAILABILITY STATEMENT

The current study was not pre-registered prior to data collection or data analysis. The data represent original data, collected by the corresponding author, JMS, for which there is no citation. The data is not shared within a repository, as consent for such sharing was not obtained from participants at the time of data collection, and the data is of a sensitive nature. To obtain access to the data, please contact the first author via e-mail to request access.

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