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# Loneliness and psychosocial predictors of psychosis-proneness during COVID-19: Preliminary findings from Croatia

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## ARTICLE INFO

### Keywords:

COVID-19  
Loneliness  
Psychosis  
Trauma  
Mental health  
Croatia

## ABSTRACT

The present study investigated psychosocial predictors of psychosis-risk, depression, anxiety, and stress in Croatia during the COVID-19 pandemic. Given Croatia's recent transgenerational war trauma and the relative lack of available prodromal data, this study presents a unique opportunity to examine the impact of loneliness and other psychosocial factors on psychosis-risk and mental health in this population. 404 Croatian participants completed an anonymous online survey of physical and mental health questions. 48 participants met the criteria for elevated psychosis-risk on prodromal questionnaire (PQ-16). Loneliness had a significant impact on psychosis-risk. Exposure to trauma was associated with psychosis-risk and loneliness, while domestic abuse/violence was associated only with the distress surrounding psychotic-like symptoms. COVID concern was also associated with psychosis-risk. Lastly, the associations between psychosis-risk and depression, anxiety, and stress were robust. These findings highlight the important role of loneliness in psychosis-proneness in Croatia. Depression, anxiety, and stress were also closely related to elevated psychosis-risk. Loneliness is a highly salient issue for individuals with psychosis and it is important to target loneliness within a multi-faceted psychosocial intervention for those at risk for schizophrenia.

## 1. Introduction

The survival and flourishing of social species such as humans depends largely on close-knit social networks and cooperation. Existing evidence indicates that social connectedness supports good health outcomes (Holt-Lunstad, 2018; Ehsan et al., 2019) including mental health (Degnan et al., 2018; Nitschke et al., 2021). However, in the last two years there have been significant social changes brought about by the global COVID-19 pandemic and consequential public health measures. Increased unemployment, financial insecurity, and poverty are likely to have long-lasting impacts on mental health outcomes (Holmes et al., 2020) but disrupted social connectedness due to the pandemic may have an even broader impact on mental health across all age groups, socio-economic strata, and cultures (e.g., Dean et al., 2021). The pandemic necessitated social distancing measures to control the spread of the virus. These public health strategies may have had detrimental effects on mental health including increased feelings of loneliness, isolation, and anxiety (Carvalho et al., 2020).

Deterioration of mental health among the general public may be as severe as effects found among the survivors of SARS-CoV-2. About 34% of patients infected with SARS-CoV-2 were diagnosed with psychiatric disorders in the 6 months following their illness (Taquet et al., 2021), most commonly, mood and/or anxiety disorders (Butler et al., 2020). Although there is relatively low incidence of psychotic disorder after COVID-19 infection (1.4%), there have been reports of sudden onset of psychosis in individuals with no psychiatric history (Kozato et al., 2021). Among the general population, the prevalence of mental health conditions during the COVID-19 may be just as alarming. Dean et al. (2021) reported overall increase in psychosocial distress across four countries. Importantly, Lee et al. (2021) found depression in 36.8%, anxiety in 29.5%, stress in 24.5% and prodromal psychosis signs in 12.8% of the general Korean population despite the very low COVID infection rate in the country.

Despite the shift towards studying the consequences of the pandemic on mental health, there is still a lack of data from the general population. Social distancing and enforced social isolation may exacerbate

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<https://doi.org/10.1016/j.psychres.2022.114900>

Received 2 August 2022; Received in revised form 5 October 2022; Accepted 8 October 2022

Available online 9 October 2022

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**Table 1**  
Demographic information.

	N (Total)	M (SD)	Range
<b>Age</b>	404	39.6 (13.7)	17–73
	<b>N</b>	<b>%</b>	<b>p*</b>
<b>Gender</b>			
Male	84	20.8	
Female	317	78.5	<0.001
Prefer not to answer	3	0.7	
<b>Education</b>			
Elementary school	3	0.7	
High school	75	18.6	
Technical school	27	6.7	
Bachelor's degree	56	13.9	
Master's degree	189	46.8	<0.001
Doctoral degree	47	11.6	
Other	5	1.2	
Prefer not to answer	2	0.5	
<b>Employment status</b>			
Full time (including full time students)	309	76.5	
Part time ((including part time students)	16	4.0	
Unemployed	40	9.9	<0.001
Retired	11	2.7	
Other	28	6.9	
<b>Healthcare Worker</b>			
Yes	91	22.5	
No	269	66.6	<0.001
n/a	44	10.9	
<b>Current Living situation</b>			
Living alone	59	14.6	
Living with friends/roommates	8	2.0	
Living with partner	49	12.1	
Living with family	282	69.8	<0.001
Homeless	1	0.2	
Other	4	1.0	
Prefer not to answer	1	0.2	
<b>General Health</b>			
Poor	5	1.2	
Fair	25	6.2	
Good	71	17.6	
Very good	161	39.9	<0.001
Excellent	83	20.5	
n/a	59	14.6	
<b>COVID-19 concern</b>			
Not concerned	60	14.8	
Somewhat concerned	228	56.3	
Moderately concerned	51	12.6	<0.001
Extremely concerned	6	1.5	
<b>Traumatic experience</b>			
Yes	185	45.8	
No	152	37.6	
n/a	67	16.6	

**Table 2**  
General health items (n = 345).

	Mean	SD	Range
Physical health was not good <sup>n</sup>	3.09	4.83	0–30
Mental health was not good <sup>n</sup>	5.97	8.05	0–30
Feeling happy (positive) <sup>p</sup>	17.02	9.10	0–30
Feeling hopeful <sup>p</sup>	14.00	10.58	0–30
Feeling love <sup>p</sup>	18.62	19.06	0–30
Usual activities were affected due to health problems <sup>n</sup>	5.59	8.30	0–30
Usual activities were affected due to pain <sup>n</sup>	3.67	7.03	0–30
Feeling worried, anxious, or tense <sup>n</sup>	7.52	8.92	0–30

p=positive direction, n=negative direction.

Note1: Number of days (over the past 30 days) in which health problems occurred; SD=standard deviation.

psychosocial stress related to the pandemic, potentially contributing to psychosis onset (Javed and Shad, 2021). Moreover, while social stress and social withdrawal are often regarded as prodromal symptoms of psychosis (van Winkel et al., 2008; Mäki et al., 2014), growing evidence

**Table 3**  
Descriptive data for the main psychosocial predictors. .

	Mean	SD	Range
<b>DASS (N = 331)</b>			
Depression	6.72	7.21	0–39
Anxiety	4.44	5.52	0–32
Stress	8.46	6.98	0–35
<b>PQ</b>			
Items endorsed	2.90	3.17	0–16
Distress endorsed	3.12	5.48	0–36
<b>SNI</b>			
High-Contact Roles	4.32	2.98	0–11
People in Social Network	3.80	2.65	0–10
Embedded Networks	2.23	1.92	0–8
<b>Loneliness</b>	39.74	8.83	22–66

Note: DASS=Depression, Anxiety and Stress; PQ= prodromal questionnaire; SNI=Social Network Index; Loneliness= the UCLA Loneliness scale.

identifies loneliness itself as a reliable risk factor for psychosis onset (da Rocha et al., 2018; Mäki et al., 2014), especially during the COVID-19 pandemic (Tso and Park, 2020). Research increasingly highlights the impact of loneliness on psychosis symptom expression, especially in non-clinical population (da Rocha et al., 2018).

Loneliness is defined as a discrepancy between an individual's preferred and actual social relations (Peplau and Perlman, 1982; Cacioppo et al., 2015). Increased loneliness is associated with lower education level, lower income, unemployment, single-status and history of psychiatric diagnosis (Cacioppo et al., 2015). There are significant mental health consequences of loneliness. For example, higher levels of loneliness is associated with sensitivity to stress and threats (Nowland et al., 2018) and the severity of post-traumatic stress disorder (PTSD) (Solomon et al., 2015). Compared to the pre-pandemic period, there has been a three-fold increase in severe loneliness brought about by COVID-19 (O'Sullivan et al., 2021). This exacerbation of loneliness might be partially attributed to various public health interventions that were implemented to impede the spread of coronavirus including lockdowns, curtailing of social gatherings, and restricted travel. Consequently, social isolation has been associated with depression, anxiety, and increased rates of suicide attempts among the general population (Elovainio et al., 2017). With respect to the COVID-19 pandemic, the risk for psychiatric disorders appears to be significantly increased by loneliness (Tso and Park, 2020; Park et al., 2020). Moreover, the impact of existing PTSD symptomatology on perceived stress was mediated by loneliness (Jeftić et al., 2021): individuals might experience post-traumatic stress reactions (e.g., trauma-related fear and heightened physiological arousal) when triggered by traumatic reminders like lockdown and severe restrictions (Tsur et al., 2018).

Although trauma triggers lose their intensity over time (Howell et al., 2015), it is important to examine how they may be associated with risk for psychiatric disorders following recent war experiences in Croatia. The impact of war-related trauma in Croatia has had detrimental effects on mental health and quality of life in this population (Babić-Banaszak et al., 2002; Vukojević et al., 2020). Similarly, the survivors of the war in Bosnia and Herzegovina were found to suffer from severe trauma even after 25 years. This study concluded that war experiences and reminders have devastating mental health consequences (Jeftić et al., 2021).

In the first study on mental health in Croatia conducted during the first national lockdown (May 2020), between 17.8% and 19.1% of participants reported severe depression, anxiety, and stress (Jokić Begić et al., 2020). A second study in Croatia (Ajduković et al., 2020) conducted during July 2020, when the restrictions had been partially relaxed, reported that between 7.7% and 7.8% of participants were at risk for either depression or anxiety disorder, with high levels of stress in 7.2% of participants; these findings may show high levels of adaptability and resilience during the pandemic. Interestingly, in comparison to mental health data emerging from other European countries and some parts of Asia, Croatia seems to have relatively lower incidences of stress,

## DASS Subscale Scores: Severity Distribution

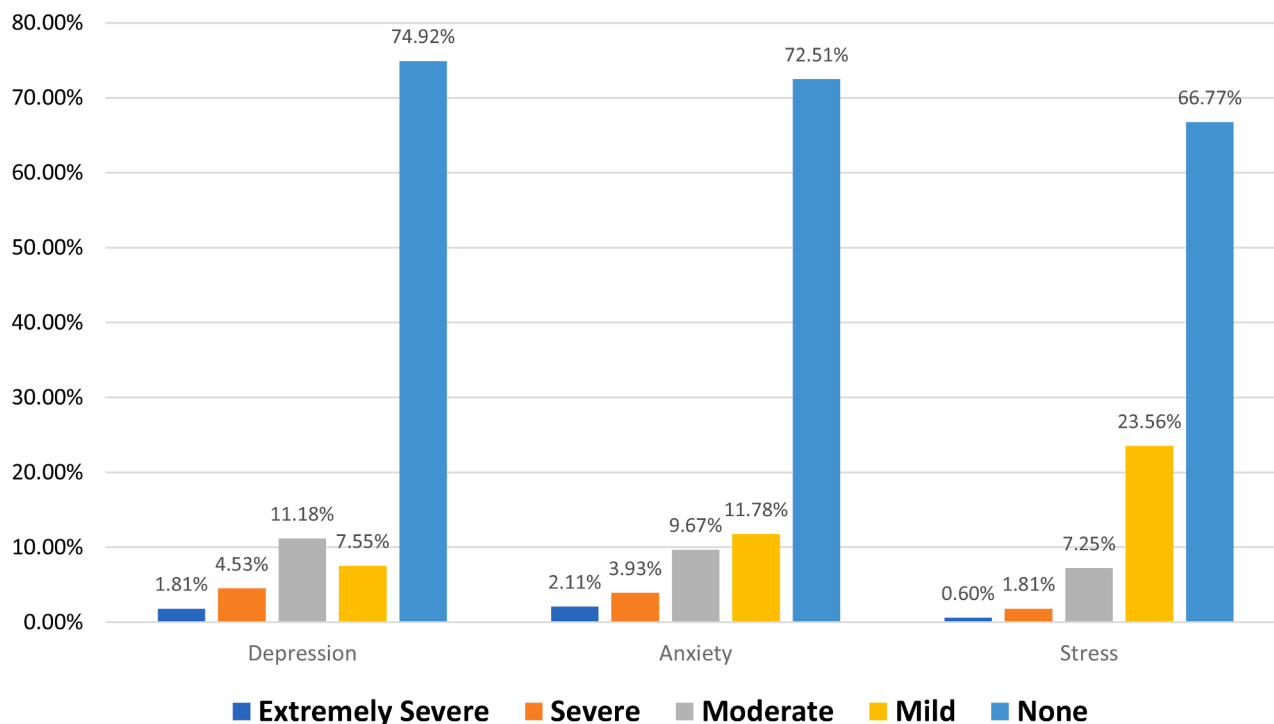


Fig. 1. Levels of depression, anxiety, and stress among 331 respondents.

anxiety, and depression disorders (Newby et al., 2020; Park et al., 2020; Rossi et al., 2020). Studies have also shown that the prevalence of PTSD among individuals in Croatia who had experienced at least one traumatic event during the COVID-19 pandemic was 14% (Ajduković et al., 2020), which is similar to prevalence in Ireland, where COVID-19-related PTSD rate is 17.7% (Karatzias et al., 2020). Despite the background of existing war-related trauma, mental health risk in the Croatian population during the pandemic appears to be broadly similar to that of other countries. However, it is possible that within the Croatian population, shared pain or adversity affected by war promotes solidarity, resulting in social cohesion (see Bastian et al., 2014). Upon large scale disasters such as a massive earthquake or a terrorist attack, people who work together to survive and help each other emotionally are more socially resilient and have better mental health outcomes (see Garcia and Rime, 2019). Thus, it may be that individual differences in vulnerability to psychological disorders might be uniquely affected by trauma and social disconnection.

The present study investigated the role of psychosocial predictors of both physical and mental health (and, in particular, of loneliness) among the Croatian population during COVID-19, with specific focus on psychosis risk, depression, anxiety and stress. We hypothesized that loneliness would have a negative impact on mental health overall and will act as significant risk factor in predicting psychotic symptoms. Further, we expect that individuals with a history of trauma will be more vulnerable to the effects of the current pandemic, loneliness, and psychosis risk. Because of Croatia's recent history of transgenerational war trauma and the relative lack of prodromal data, this study presented a unique opportunity to examine the impact of loneliness and other psychosocial factors on psychosis-proneness.

## 2. Methods

### 2.1. Participants and procedure

The sample consisted of 404 adults (aged 18 and above) residing in

Croatia. The participants completed an online, anonymous survey in Croatia, created via SurveyMonkey. The survey link was distributed via online channels and platforms including university emailing lists, social media platforms, and in person. Before starting the survey, participants acknowledged their participation was voluntary, and consented to participate and have their anonymous data used for analysis. The survey was open to everyone and described by introducing type of questions that will be asked, including the possibility to stop at any time. The average time of survey completion was about 24 min. Data collection occurred between July and September 2020, during the first peak wave of COVID-19 pandemic. This study received exempt status from the Vanderbilt University Institutional Review Board (Vanderbilt IRB exempt #200,337).

### 2.2. Measures

The survey consisted of 183 questions that asked about participant demographics, questions regarding COVID-19 concern, past trauma exposure, and general and mental health, including validated measures to assess loneliness (the UCLA (University of California, Los Angeles) Loneliness Scale; Russell, 1996); depression, anxiety, and stress (Depression, Anxiety and Stress Scale (DASS-21); Lovibond and Lovibond, 1995) and psychosis risk (Prodromal Questionnaire-16 (PQ-16); Ising et al., 2012). Also, questions about social network were asked (Social Network Index (SNI); Cohen et al., 1997).

To assess the effects of the COVID-19 pandemic on individuals' daily lives, we asked participants to self-report changes in their financial situation, current/past quarantine periods, number of days spent at home, and level of concern about the pandemic. Likert scale ratings were given with appropriate responses to each item (i.e., for level of COVID concern, options ranged from *not at all concerned* to *extremely concerned*). To assess past and cumulative trauma, participants were asked to report experiences of traumatic events from an established list (e.g., natural disasters, war, sudden loss of family, abuse, and neglect, forced displacement etc.) with the option to write-in events that were not

**Table 4**  
Psychosocial predictors of general and mental health status.

	Model statistics				Variable statistics		
	df	$\Delta R^2$	$\Delta F$	p	$\beta$	T	p
<b>General health</b>							
Step 1	5	0.124	7.873	<0.001			
Step 2	3	0.030	3.232	0.023			
Age					-0.132	2.219	0.027*
Gender					-0.001	0.015	0.988
Domestic abuse/ violence					-0.192	3.376	0.001*
COVID-19 concern					-0.117	2.034	0.043*
Traumatic experience					-0.089	1.510	0.132
SNI Social Network					-0.071	0.932	0.352
SNI Embedded Network					0.026	0.361	0.718
Loneliness					-0.179	3.047	0.003*
<b>Days physical health not good</b>							
Step 1	5	0.076	4.591	<0.001			
Step 2	3	0.074	8.039	<0.001			
Age					-0.094	1.579	0.116
Gender					0.045	0.795	0.427
Domestic abuse/ violence					0.080	1.398	0.163
COVID-19 concern					0.108	1.885	0.061
Traumatic experience					0.107	1.805	0.072
SNI Social Network					0.162	2.134	0.034*
SNI Embedded Network					-0.109	1.495	0.136
Loneliness					0.266	4.521	<0.001*
<b>Days mental health not good</b>							
Step 1	5	0.148	9.659	<0.001			
Step 2	3	0.129	16.352	<0.001			
Age					-0.100	1.815	0.071
Gender					0.042	0.800	0.424
Domestic abuse/ violence					0.116	2.201	0.029*
COVID-19 concern					0.137	2.590	0.010*
Traumatic experience					0.166	3.038	0.003*
SNI Social Network					-0.035	0.501	0.617
SNI Embedded Network					-0.115	1.707	0.089
Loneliness					0.318	5.846	<0.001*
<b>Days usual activities affected by health</b>							
Step 1	5	0.077	4.623	<0.001			
Step 2	3	0.062	6.675	<0.001			
Age					-0.112	1.875	0.062
Gender					0.048	0.830	0.407
Domestic abuse/ violence					0.168	2.919	0.004*
COVID-19 concern					0.136	2.357	0.019*
Traumatic experience					-0.045	0.757	0.450
SNI Social Network					0.021	0.275	0.783
SNI Embedded Network					0.028	0.377	0.706
Loneliness					0.265	4.467	<0.001
<b>Days usual activities affected by pain</b>							
Step 1	5	0.058	3.453	0.005			
Step 2	3	0.029	2.94	0.034			
Age					-0.139	2.248	0.025*
Gender					0.052	0.880	0.380
Domestic abuse/ violence					0.064	1.090	0.277
COVID-19 concern					0.129	2.162	0.031*
Traumatic experience					0.070	1.150	0.251
SNI Social Network					0.053	0.674	0.501
SNI Embedded Network					0.037	0.488	0.626
Loneliness					0.176	2.879	0.004*
<b>Days feeling worried, anxious or tense</b>							
Step 1	5	0.137	8.892	<0.001			
Step 2	3	0.095	11.364	<0.001			
Age					-0.195	3.445	0.001*
Gender					0.044	0.820	0.413
Domestic abuse/ violence					0.087	1.603	0.110
COVID-19 concern					0.153	2.796	0.006*
Traumatic experience					0.132	2.348	0.020*
SNI Social Network					0.028	0.393	0.695
SNI Embedded Network					-0.074	1.073	0.284
Loneliness					0.306	5.457	<0.001*

DASS stress

(continued on next page)

Table 4 (continued)

	Model statistics				Variable statistics		
	df	$\Delta R^2$	$\Delta F$	p	$\beta$	T	p
<b>Step 1</b>	5	0.152	9.824	<0.001			
<b>Step 2</b>	3	0.179	24.203	<0.001			
	Age				-0.165	3.102	0.002*
	Gender				0.032	0.621	0.535
	Domestic abuse/ violence				0.046	0.912	0.363
	COVID-19 concern				0.032	0.623	0.534
	Traumatic experience				0.229	4.335	<0.001*
	SNI Social Network				0.052	0.767	0.444
	SNI Embedded Network				0.004	0.062	0.951
	Loneliness				0.448	8.457	<0.001*
<b>DASS anxiety</b>							
<b>Step 1</b>	5	0.129	8.133	<0.001			
<b>Step 2</b>	3	0.127	15.491	<0.001			
	Age				-0.216	3.851	<0.001*
	Gender				-0.016	0.297	0.767
	Domestic abuse/ violence				0.096	1.791	0.074
	COVID-19 concern				0.049	0.897	0.371
	Traumatic experience				0.158	2.835	0.005*
	SNI Social Network				-0.023	0.324	0.747
	SNI Embedded Network				0.084	1.231	0.219
	Loneliness				0.375	6.719	<0.001*
<b>DASS depression</b>							
<b>Step 1</b>	5	0.158	10.342	<0.001			
<b>Step 2</b>	3	0.219	31.834	<0.001			
	Age				-0.171	3.328	0.001*
	Gender				0.044	0.899	0.370
	Domestic abuse/ violence				0.121	2.451	0.015*
	COVID-19 concern				0.050	1.018	0.309
	Traumatic experience				0.161	3.157	0.002*
	SNI Social Network				-0.014	0.211	0.833
	SNI Embedded Network				-0.023	0.372	0.711
	Loneliness				0.477	9.341	<0.001
<b>PQ total</b>							
<b>Step 1</b>	5	0.135	8.371	<0.001			
<b>Step 2</b>	3	0.168	21.264	<0.001			
	Age				-0.219	3.980	<0.001*
	Gender				-0.202	3.833	<0.001*
	Domestic abuse/ violence				0.094	1.779	0.076
	COVID-19 concern				0.074	1.395	0.164
	Traumatic experience				0.002	0.042	0.966
	SNI Social Network				-0.068	0.974	0.331
	SNI Embedded Network				0.050	0.736	0.462
	Loneliness				0.418	7.647	<0.001*
<b>PQ distress</b>							
<b>Step 1</b>	5	0.155	9.809	<0.001			
<b>Step 2</b>	3	0.173	22.671	<0.001			
	Age				-0.217	4.017	<0.001*
	Gender				-0.118	2.279	0.023*
	Domestic abuse/ violence				0.208	4.009	<0.001
	COVID-19 concern				0.059	1.140	0.255
	Traumatic experience				0.033	0.611	0.542
	SNI Social Network				-0.035	0.511	0.610
	SNI Embedded Network				0.073	1.096	0.274
	Loneliness				0.434	8.091	<0.001

Note1. Predictive variables kept in the second step: age, gender, domestic abuse/violence, level of concern about COVID-19, and traumatic experience.

Note2. DASS=Depression, Anxiety and Stress; PQ= prodromal questionnaire. SNI=Social Network Index; Loneliness= the UCLA Loneliness scale.

included in the list. Also, questions about instances of domestic violence/abuse in the past month were asked.

DASS-21 yielded three subscale scores quantifying depression, stress, and anxiety, which were then stratified into 5 severity levels ranging from *none* to *extremely severe*. The PQ-16 assessed the number of psychotic-like experiences endorsed by each participant (i.e., their *total score*) and accompanying distress (i.e., their *distress score*). A *total score* of 6 or more qualifies high risk status for psychosis (Ising et al., 2012).

Subjective feelings of loneliness and social isolation were assessed with the UCLA Loneliness Scale. Quality, size, and diversity of social networks (e.g., number of social roles, embedded social networks, and regular contacts) were assessed with SNI.

### 2.3. Statistical analysis

Descriptive statistics were performed to measure demographic

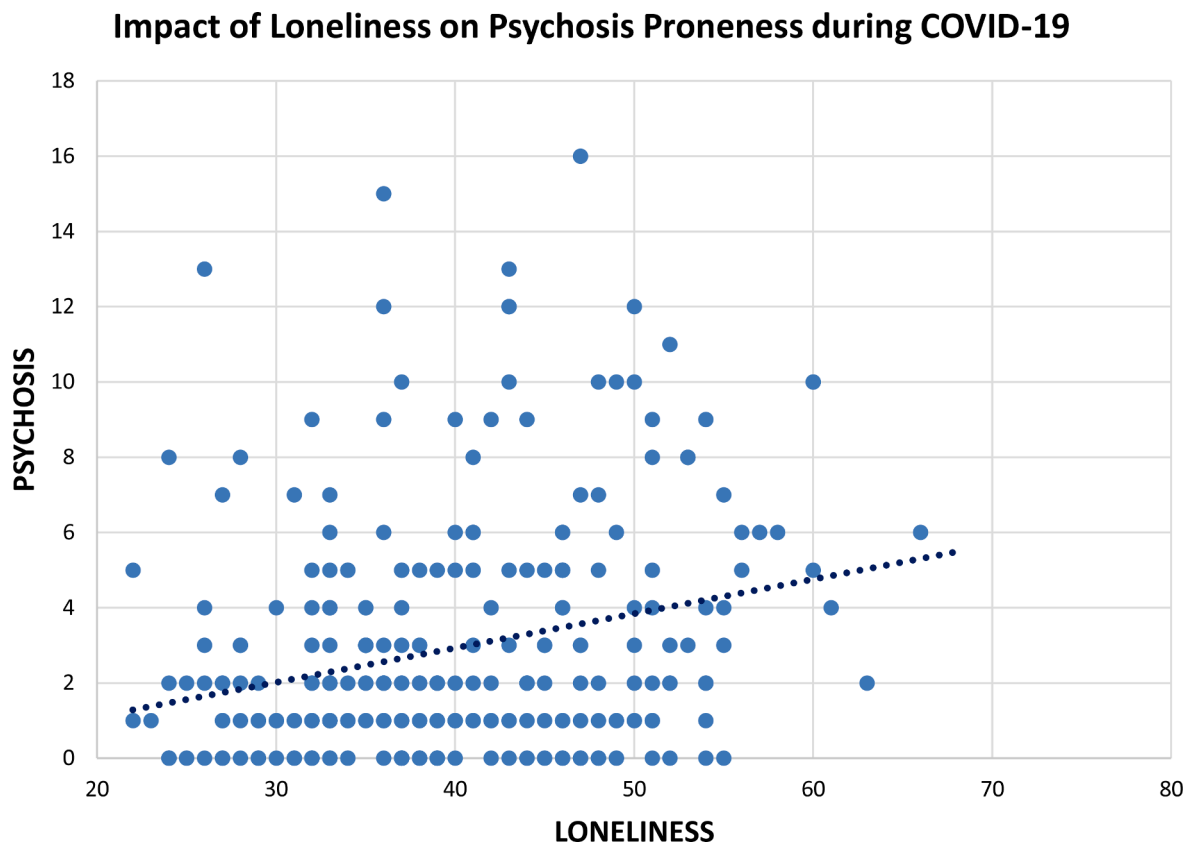


Fig. 2. Impact of loneliness on prodromal (PQ-16) scores during COVID-19.

information, general and mental health statuses, COVID-19 concern, and incidence of trauma and domestic violence. *T*-tests were conducted to assess general health between age groups, genders, trauma groups, and concern levels regarding COVID-19. Hierarchical linear regressions were also performed to assess the roles of psychosocial predictors, loneliness, and social network size in determining physical and mental health variables. In the first step, independent variables for age, gender, domestic violence, trauma experience, and concern for COVID-19 were used to form the basic model. In the second step, loneliness, social network diversity, and social network size were included in the full model. For each dependent variable (e.g., self-reported health, days physically ill, days when physical and mental health limited engagement in usual activities, days when pain limited functioning, days mentally ill, days feeling anxious, DASS, and PQ-scores), change in  $R^2$  between the basic model and full model was used to examine whether the addition of loneliness and/or the social network variables explained more of the variance in these variables, after controlling for age, gender, domestic violence, trauma, and COVID concern. Bonferroni correction of  $p < 0.0045$  was applied to minimize Type I Errors.

### 3. Results

The total of 404 (78.5% females) participants participated in the study. See Table 1 for the detailed descriptive data of the demographic information. From those, 85.4% completed the general health items (Table 2) of which 71–73% went on to complete the mental health item. DASS was completed by 81% of participants (Table 3, Fig. 1), PQ was completed by 71% of which 17% were a high risk for psychosis (Table 3), SNI was completed by 76% and 73.5% completed UCLA Loneliness (Table 3).

Participants indicated an overall good physical and mental health over the past 30 days (Table 2).

In the first step, the analysis of psychosocial measures of general and

mental health showed a significant negative association of age on general health, DASS subscales, and both PQ total and distress scores (Table 4). Domestic abuse/violence was negatively associated to general health in which there was an increase of days when mental health was poor and when activities were affected by poor health as well as increased DASS depression. COVID-19 concern led to a decrease in general health items; to an increase in the number of days when mental health was poor, when usual activities were affected by health and by pain, and to an increased feelings of worry, anxiety, or tension. Past incidence of traumatic experience increased the number of days mental health was poor, the days spent worried, anxious, or tense as well as stress, anxiety, and depression. In the second step, there was a significant negative association between loneliness and indices of general health in this sample. The increased loneliness was positively associated with the number of days physical health and mental health was poor; days when usual activities were affected by health and by pain, and days when the participant felt worried, anxious, or tense. Also, increased loneliness was associated with greater stress, anxiety, and depression. Lastly, participants reported the number of days in the past month when they experienced poor physical health. These “sick days” were negatively associated with the SNI (social network index) such that those with diminished social network were more likely to report increased number of sick days.

The analysis of PQ items indicated that 16.7% participants met the criteria as high-risk for psychosis. Loneliness was positively associated to prodromal total and distress scores (Fig. 2). Gender influenced both PQ total and distress scores in which women endorsed fewer items and reported less distress compared to men. However, there were no significant sex differences in experience of loneliness. Domestic abuse/violence was positively associated only to PQ distress as well as was the concern with COVID. Furthermore, exposure to trauma was positively associated to loneliness, but not to prodromal symptoms of psychosis. Importantly, both PQ total and distress scores were associated with

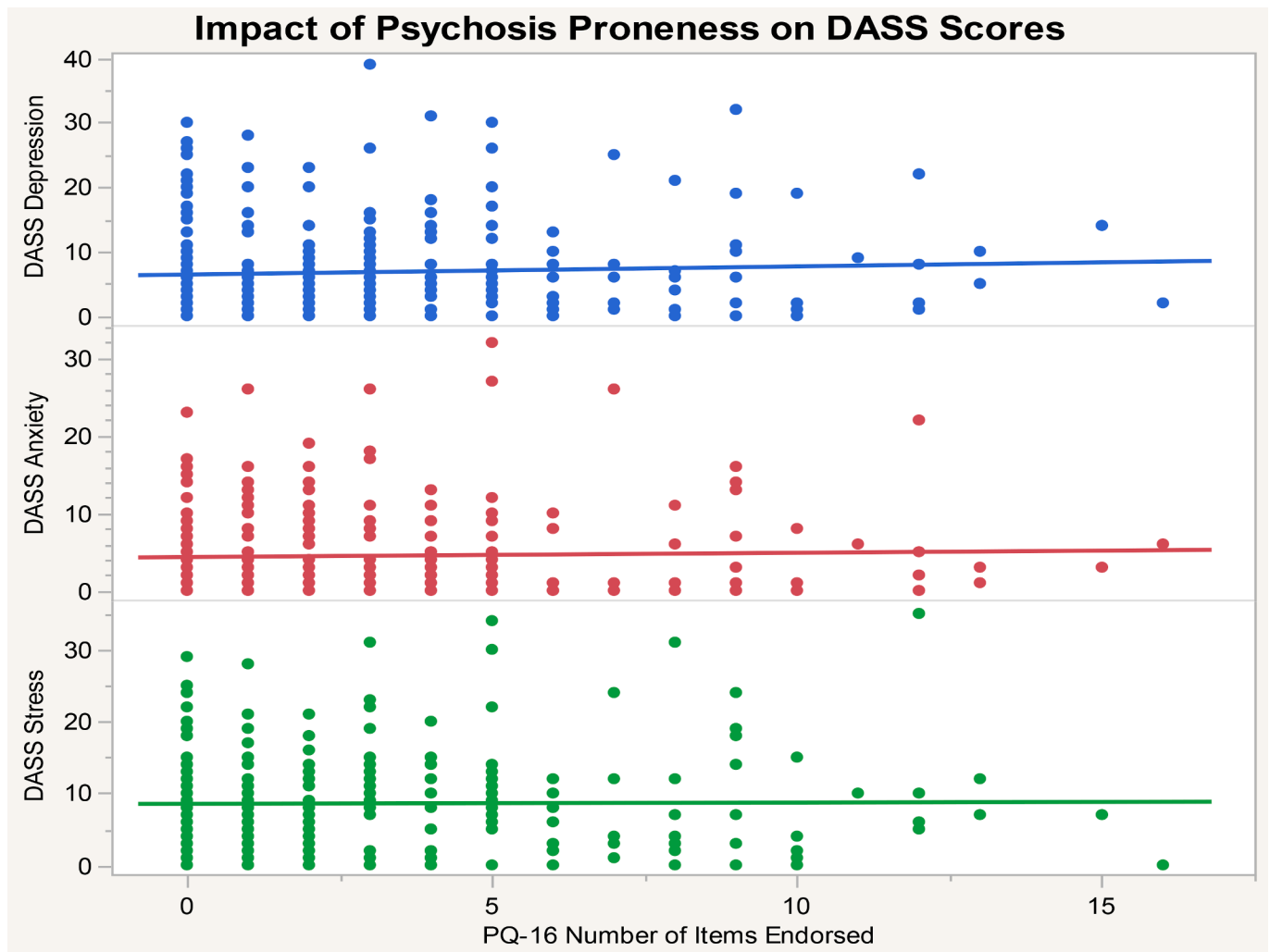


Fig. 3. Impact of prodromal symptoms on depression, anxiety, and stress during COVID-19.

DASS subscales in which higher PQ led to higher experience of stress, anxiety, and depression (Fig. 3).

#### 4. Discussion

The preliminary findings highlight the important role of psychosocial factors, specifically loneliness, in determining mental wellbeing in Croatia during the COVID-19 pandemic. Although most participants indicated overall good general health, our findings show that a substantial number of psychosocial predictors including high levels of COVID concern led to a decrease in both general health and wellbeing. There was an overall increase in the number of days when mental health was not good, when usual activities were affected by poor health or pain, and when participants felt worried, anxious, or tense. Our findings are in line with overall research on the impact of COVID-19 pandemic on mental health, suggesting that social isolation and distancing might increase signs of anxiety, depression, stress, and loneliness (Carvalho et al., 2020).

In our study, loneliness was found to be a considerable problem in the general population during the pandemic. It was associated with poor general health as well as poor mental health, feelings of worry, anxiety, or tension. Loneliness had a statistically significant impact on psychosis-proneness; with psychosis-proneness being strongly associated with depression, anxiety, and stress. This finding is in line with growing evidence for loneliness as a transdiagnostic risk factor across many different mental disorders, but especially as a major risk factor for

psychosis (da Rocha et al., 2018). The COVID-19 pandemic has disrupted social connectedness and networking, which can provide protection against the distress, but also against the feelings of loneliness. Given the relationship between loneliness and psychosis (Badcock et al., 2020) it is not surprising that psychosis-risk and loneliness are highly interrelated during the pandemic.

With respect to trauma, domestic abuse/violence was also associated with elevated risk for psychosis. The impact of previous trauma strongly affected the mental health and increased stress, anxiety, depression, and the number of days feeling worried, anxious, and tense during the pandemic. Surprisingly, previous exposure to trauma was relatively weakly associated with psychosis-risk, despite the history of wars and recent natural disasters in Croatia. One of the potential reasons for the weak association could be the lower prevalence of psychosis in the general population compared with the much greater rates of depression, anxiety, and stress. This is supported by the previous research findings showing that within Croatian population, prevalence of depression, anxiety and stress is very high (Loncar et al., 2006; Mollica et al., 2001). Furthermore, one must consider the population-wide adaptation to increasing levels of adversity over time across multiple generations in Croatia, which has survived one-hundred years of war trauma resulting from the World War I, World War II, Independence War between 1991 and 1995 (Lampe et al., 2022). Thus, COVID-19 pandemic situation, even though dire, maybe not have been experienced as stressful or traumatic as previous nation-wide catastrophes. Another possible explanation could be ascribed to mirroring behaviors (Dilthey and



Rickman, 1976), which suggests that individuals tend to feel and behave similarly to the overall crowd; strengthening the notion that all are bound together in this pandemic situation, resulting in resilience and protection from adverse effects (Vukojevic et al., 2020; Bastian et al., 2014; Gracia et al., 2019). Lastly, post-trauma recovery treatments are commonly available in Croatia; for example, past war victims and survivors have undergone excessive PTSD treatments and/or are still under medical supervision and therapy. Therefore, this existing mental health infrastructure might have provided much needed additional support. Perhaps this is an important lesson to prepare for future pandemics.

There are several caveats. First, although the sample size was relatively good, many participants did not complete the questionnaire resulting in the overall smaller sample size for some of the measures (e. g., PQ-16). Second, the sample consisted of predominantly females, thus limiting its generalizability. Likewise, high educational level of the participants (master's degree), may be another factor limiting the generalizability of the study. However, we note that despite the potential protection associated with higher education, we still observed mental health challenges during COVID. Thirdly, the cross-sectional nature of the study lacks the longitudinal data to track changes in mental health over time. Regardless, the study allowed for a robust investigation of multiple psychosocial predictors of psychosis-risk, providing preliminary evidence for an adverse effect of COVID-19 pandemic on loneliness and prodromal symptoms of psychosis that are a major gap in the literature within the Croatian population.

## 5. Conclusions

We investigated the mental health consequences of COVID-19 pandemic in the general Croatian population to identify factors that may increase the risk for psychosis. We found that loneliness is a significant factor that can exacerbate mental health problems especially psychosis-risk. Loneliness has already been identified as a highly salient issue for individuals with psychosis and underscores the importance of assessing and targeting loneliness within a multi-faceted psychosocial intervention for those at risk for psychosis (Badcock et al., 2020). Our findings are consistent with previous studies that suggest loneliness is a reliable risk factor for an onset of psychosis (da Rocha et al., 2018; Mäki et al., 2014). Therefore, to mitigate the potential epidemic of mental illness in the near future that may result from COVID-19, there is an urgent need to prepare clinicians, caregivers, and stakeholders to focus on the impact of loneliness on mental health (Badcock et al., 2020). Lastly, the results reported in the present study could help inform future public health strategies during global catastrophes similar to the current pandemic (Valiente et al., 2021)

## Funding sources

Gertrude Conaway Vanderbilt Endowment fund partly supported this project.

## CRedit authorship contribution statement

**Alena Gizdic:** Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization. **Tatiana Baxter:** Methodology, Software, Writing – review & editing, Visualization. **Neus Barrantes-Vidal:** Supervision, Writing – review & editing. **Sohee Park:** Conceptualization, Methodology, Software, Resources, Writing – review & editing, Supervision, Project administration, Funding acquisition.

## Declaration of Competing Interest

None

## Acknowledgments

We would like to thank Igna Brajevic-Gizdic, MD, PhD, psychiatrist from Public Health Institute of Split and Dalmatia County, Mental Health Service Department for outpatient treatment of Addiction in Split, Croatia for help with data collection.

## References

- Ajduković, D., Rezo Bagarić, I., Bakić, H., Stevanović, A., Frančisković, T., Ajduković, M., 2020. Mental health status and risk factors during Covid-19 pandemic in the Croatia's adult population. *EJPT* 12, 1984050. <https://doi.org/10.1080/20008198.2021.1984050>.
- Babić-Banaszak, A., Kovacic, L., Kovacevic, L., Vuletić, G., Mujkić, A., Ebling, Z., 2002. Impact of war on health-related quality of life in Croatia: population study. *Croat. Med. J.* 43, 396–402. PubMed PMID: 12187516.
- Badcock, J., Adery, L.H., Park, S., 2020. Loneliness in psychosis: a practical review and critique for clinicians. *Clin. Psychol.* 27 <https://doi.org/10.1111/cpsp.12345>.
- Bastian, B., Jetten, J., Ferris, L.J., 2014. Pain as social glue: shared pain increases cooperation. *Psychol. Sci.* 25, 2079–2085. <https://doi.org/10.1177/0956797614545886>.
- Butler, J., Djatche, L.M., Sawhney, B., Chakladar, S., Yang, L., Brady, J.E., Yang, M., 2020. Clinical and economic burden of chronic heart failure and reduced ejection fraction following a worsening heart failure event. *Adv. Ther.* 37, 4015–4032. <https://doi.org/10.1007/s12325-020-01456-1>.
- Cacioppo, S., Grippo, A.J., London, S., Goossens, L., Cacioppo, J.T., 2015. Loneliness: clinical import and interventions. *Perspect. Psychol. Sci.* 10, 238–249. <https://doi.org/10.1177/1745691615570616>.
- Carvalho, P.M.M., Moreira, M.M., de Oliveira, M.N.A., Landim, J.M.M., Neto, M.L.R., 2020. The psychiatric impact of the novel coronavirus outbreak. *Psychiatry Res.* 286, 112902 <https://doi.org/10.1016/j.psychres.2020.112902>.
- Cohen, S., Doyle, W.J., Skoner, D.P., Rabin, B.S., Gwaltney, J.M., 1997. Social ties and susceptibility to the common cold. *JAMA* 277, 1940–1944. <https://doi.org/10.1001/jama.1997.03540480040036>.
- Dean, D.J., Tso, I.F., Giersch, A., Lee, H.S., Baxter, T., Griffith, T., Song, L., Park, S., 2021. Cross-cultural comparisons of psychosocial distress in the USA, South Korea, France, and Hong Kong during the initial phase of COVID-19. *Psychiatry Res.* 295, 113593. <https://doi.org/10.1016/j.psychres.2020.113593>.
- Degnan, A., Berry, K., Sweet, D., Abel, K., Crossley, N., Edge, D., 2018. Social networks and symptomatic and functional outcomes in schizophrenia: a systematic review and meta-analysis. *Soc. Psychiatry. Psychiatr. Epidemiol.* 53, 873–888. <https://doi.org/10.1007/s00127-018-1552-8>.
- Dilthey, W., Rickman, H.P., 1976. *W. Dilthey, Selected Writings*. Cambridge University Press, Cambridge. ISBN: 9780521295888.
- Ehsan, A., Klaas, H.S., Bastianen, A., Spini, D., 2019. Social capital and health: a systematic review of systematic reviews. *SSM-population health* 8, 100425. <https://doi.org/10.1016/j.ssmph.2019.100425>.
- Elovainio, M., Hakulinen, C., Pulkki-Råback, L., Virtanen, M., Josefsson, K., Jokela, M., Vahtera, J., Kivimäki, M., 2017. Contribution of risk factors to excess mortality in isolated and lonely individuals: an analysis of data from the UK Biobank cohort study. *Lancet. Public health.* 2, 260–266. [https://doi.org/10.1016/S2468-2667\(17\)30075-0](https://doi.org/10.1016/S2468-2667(17)30075-0).
- García, D., Rimé, B., 2019. Collective emotions and social resilience in the digital traces after a terrorist attack. *Psychol. Sci.* 30, 617–628. <https://doi.org/10.1177/0956797619831964>.
- Holmes, E.A., O'Connor, R.C., Perry, V.H., Tracey, I., Wessely, S., Arseneault, L., Ballard, C., Christensen, H., Cohen Silver, R., Everall, I., Ford, T., John, A., Kabir, T., King, K., Madan, I., Michie, S., Przybylski, A.K., Shafran, R., Sweeney, A., Worthman, C.M., Yardley, L., Cowan, K., Cope, C., Hotopf, M., Bullmore, E., 2020. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. *Lancet. Psychiatry.* 7, 547–560. [https://doi.org/10.1016/S2215-0366\(20\)30168-1](https://doi.org/10.1016/S2215-0366(20)30168-1).
- Holt-Lunstad, J., 2018. Why social relationships are important for physical health: a systems approach to understanding and modifying risk and protection. *Annu. Rev. Psychol.* 69, 437–458. <https://doi.org/10.1146/annurev-psych-122216-011902>.
- Howell, K.H., Kaplow, J.B., Layne, C.M., Benson, M.A., Compas, B.E., Katalinski, R., Pasalic, H., Bosankic, N., Pynoos, R., 2015. Predicting adolescent posttraumatic stress in the aftermath of war: differential effects of coping strategies across trauma reminder, loss reminder, and family conflict domains. *Anxiety, Stress Coping.* 28, 88–104. <https://doi.org/10.1080/10615806.2014.910596>.
- Ising, H.K., Veling, W., Loewy, R.L., Rietveld, M.W., Rietdijk, J., Dragt, S., Klaassen, R. M., Nieman, D.H., Wunderink, L., Linszen, D.H., van der Gaag, M., 2012. The validity of the 16-item version of the Prodromal Questionnaire (PQ-16) to screen for ultra-high risk of developing psychosis in the general help-seeking population. *Schizophr. Bull.* 38, 1288–1296. <https://doi.org/10.1093/schbul/sbs068>.
- Javed, S., Shad, M.U., 2021. COVID-related psychosis in adolescents: a case-based review. *Prim. Care Companion CNS Disord.* 23 <https://doi.org/10.4088/PCC.21nr03107>.
- Jeftić, A., Ikizer, G., Tuominen, J., Chrona, S., Kumaga, R., 2021. Connection between the COVID-19 pandemic, war trauma reminders, perceived stress, loneliness, and PTSD in Bosnia and Herzegovina. *Curr. Psycho.* 22, 1–13. <https://doi.org/10.1007/s12144-021-02407-x>.

- Jokić-Begić, N., Hromatko, I., Jurin, T., Kamenov, Ž., Keresteš, K., Kuterovac, Jagodić, K., Sangster Jokić, C., 2020. How are we? Life in Croatia in time of corona. In: Bogdan, Andreja (Ed.), *Koronavirus i Mentalno zdravlje: Psihološki aspekti, Savjeti i Preporuke*. Hrvatska psihološka komora, pp. 415–460. URN: NBN. <https://urn.nsk.hr/urn:nbn:hr:131:293364>. ISBN: 978-953-49226-0-6.
- Karatzias, T., Shevlin, M., Murphy, J., McBride, O., Ben-Ezra, M., Bentall, R.P., Hyland, P., 2020. Post-traumatic stress symptoms and associated comorbidity during the COVID-19 pandemic in Ireland: a population-based study. *J. Trauma. Stress.* 33, 365–370. <https://doi.org/10.1002/jts.22565>.
- Kozato, N., Mishra, M., Firdosi, M., 2021. New-onset psychosis due to COVID-19. *BMJ Case Rep* 14. <https://doi.org/10.1136/bcr-2021-242538>.
- Lampe, J.R., Pleština, Dijana, Bracewell, C.W., David-Barrett, Liz., 2022. Croatia. *Encyclopedia Britannica*. <https://www.britannica.com/place/Croatia>.
- Lee, H.S., Dean, D.J., Baxter, T., Griffith, T., Park, S., 2021. Deterioration of mental health despite successful control of the COVID-19 pandemic in South Korea. *Psychiatry Res* 295, 113570. <https://doi.org/10.1016/j.psychres.2020.113570>.
- Loncar, M., Medved, V., Jovanovic, N., Hotujac, L., 2006. Psychological consequences of rape on women in 1991-1995 war in Croatia and Bosnia and Herzegovina. *Croat. Med. J.* 47, 67–75. PMID: 16489699; PMCID: PMC2080379.
- Lovibond, P.F., Lovibond, S.H., 1995. The structure of negative emotional states: comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behav. Res. Ther.* 33, 335–343. [https://doi.org/10.1016/0005-7967\(94\)00075-u](https://doi.org/10.1016/0005-7967(94)00075-u).
- Mäki, P., Koskela, S., Murray, G., Nordström, T., Miettunen, J., Jääskeläinen, E., Veijola, J., 2014. Difficulty in making contact with others and social withdrawal as early signs of psychosis in adolescents – the Northern Finland Birth Cohort 1986. *Eur. Psychiatry.* 29, 345–351. <https://doi.org/10.1016/j.eurpsy.2013.11.003>.
- Michalska da Rocha, B., Rhodes, S., Vasilopoulou, E., Hutton, P., 2018. Loneliness in psychosis: a meta-analytical review. *Schizophr. Bull.* 44, 114–125. <https://doi.org/10.1093/schbul/sbx036>.
- Mollica, R.F., Sarajlic, N., Chernoff, M., Lavelle, J., Vukovic, I.S., Massagli, M.P., 2001. Longitudinal study of psychiatric symptoms, disability, mortality, and emigration among Bosnian refugees. *JAMA* 286, 546–554. <https://doi.org/10.1001/jama.286.5.546>.
- Newby, J.M., O'Moore, K., Tang, S., Christensen, H., Faasse, K., 2020. Acute mental health responses during the COVID-19 pandemic in Australia. *PLoS ONE* 15, 0236562. <https://doi.org/10.1371/journal.pone.0236562>.
- Nitschke, J.P., Forbes, P.A., Ali, N., Cutler, J., Apps, M.A., Lockwood, P.L., Lamm, C., 2021. Resilience during uncertainty? Greater social connectedness during COVID-19 lockdown is associated with reduced distress and fatigue. *Br. J. Health Psychol.* 26, 553–569. <https://doi.org/10.1111/bjhp.12485>.
- Nowland, R., Robinson, S.J., Bradley, B.F., Summers, V., Qualter, P., 2018. Loneliness, HPA stress reactivity and social threat sensitivity: analyzing naturalistic social challenges. *Scand. J. Psychol.* 59, 540–546. <https://doi.org/10.1111/sjop.12461>.
- O'Sullivan, K., Clark, S., McGrane, A., Rock, N., Burke, L., Boyle, N., Joksimovic, N., Marshall, K., 2021. A qualitative study of child and adolescent mental health during the COVID-19 pandemic in Ireland. *Int. J. Environ. Res. Public Health.* 18, 1062. <https://doi.org/10.3390/ijerph18031062>.
- Park, S.Y., Kim, Y.M., Yi, S., Lee, S., Na, B.J., Kim, C.B., Kim, J.I., Kim, H.S., Kim, Y.B., Park, Y., Huh, I.S., Kim, H.K., Yoon, H.J., Jang, H., Kim, K., Chang, Y., Kim, I., Lee, H., Gwack, J., Kim, S.S., Jeong, E.K., 2020. Coronavirus disease outbreak in call center. *South Korea. Emerg. Infect. Dis.* 26, 1666–1670. <https://doi.org/10.3201/eid2608.201274>.
- Peplau, L.A., Perlman, D., 1982. Perspectives on loneliness. In: Peplau, L.A., Perlman, D. (Eds.), *Loneliness: A sourcebook of Current theory, research, and Therapy*. Wiley, New York, pp. 1–8. <https://doi.org/10.12691/ajap-2-4-3>.
- Rossi, R., Succi, V., Talevi, D., Mensi, S., Niolu, C., Pacitti, F., Di Marco, A., Rossi, A., Siracusano, A., Di Lorenzo, G., 2020. COVID-19 pandemic and lockdown measures impact on mental health among the general population in Italy. *Front. Psychiatry.* 11, 790. <https://doi.org/10.3389/fpsy.2020.00790>.
- Russell, D., 1996. UCLA Loneliness Scale (Version 3): reliability, validity, and factor structure. *J. Pers. Assess.* 66, 20–40. <https://doi.org/10.1207/s15327752jpa6601>.
- Solomon, Z., Bensimon, M., Greene, T., Horesh, D., Ein-Dor, T., 2015. Loneliness trajectories: the role of posttraumatic symptoms and social support. *J. Loss. Trauma.* 20, 1–21. <https://doi.org/10.1080/15325024.2013.815055>.
- Taquet, M., Holmes, E.A., Harrison, P.J., 2021. Depression and anxiety disorders during the COVID-19 pandemic: knowns and unknowns. *Lancet* 398, 1665–1666. [https://doi.org/10.1016/S0140-6736\(21\)02221-2](https://doi.org/10.1016/S0140-6736(21)02221-2).
- Tso, I.F., Park, S., 2020. Alarming levels of psychiatric symptoms and the role of loneliness during the COVID-19 epidemic: a case study of Hong Kong. *Psychiatry Res* 293, 113423. PMC 7443338.
- Tsur, N., Defrin, R., Lahav, Y., Solomon, Z., 2018. The traumatized body: long-term PTSD and its implications for the orientation towards bodily signals. *Psychiatry Res* 261, 281–289. <https://doi.org/10.1016/j.psychres.2017.12.083>.
- Van Winkel, R., Stefanis, N.C., Myin-Germeys, I., 2008. Psychosocial stress and psychosis. A review of the neurobiological mechanisms and the evidence for gene-stress interaction. *Schizophr. Bull.* 34, 1095–1105. <https://doi.org/10.1093/schbul/sbn101>.
- Vukojević, J., Sušac, J., Brečić, P., 2020. Psychosis and pandemics: is there a secret protector? *Psychiatry Res* 291, 113199. <https://doi.org/10.1016/j.psychres.2020.113199>.