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Physical distancing and mental health during the COVID-19 pandemic: Factors associated with psychological symptoms and adherence to pandemic mitigation strategies

Title of preprint: *The mental health impact of non-pharmacological interventions aimed at impeding viral transmission during the COVID-19 pandemic in a general adult population and the factors associated with adherence to these mitigation strategies*

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Abstract

This epidemiological investigation assesses the prevalence of depression and anxiety symptoms during the COVID-19 pandemic. A total of 10,061 adults participated in the study. Symptoms of depression and anxiety were two to three times higher compared to pre-pandemic samples. Those who predominantly socially distanced themselves revealed substantially higher symptoms than their counterparts. Females, ethnic and sexual orientation minorities, younger adults, unemployed individuals, and those with a psychiatric diagnosis reported higher prevalence of psychological symptoms. Worry about prolonged duration of physical distancing protocols and frustration of autonomy was associated with elevation in symptoms of depression and anxiety. Increased competence to deal with the crisis was associated with fewer adverse symptoms. Physical exercise, experiencing nature, and distraction with activities were associated with reduced depressive symptoms, but not anxiety. The extent of information access about the pandemic was associated with reduced anxiety symptoms. Furthermore, adherence to mitigation protocols was investigated. Younger adults and males reported lowest adherence. Altruistic attitudes, in addition to mandatory as opposed to voluntary adherence was associated with higher adherence rates. Worrying about significant others' health was associated with higher, while worry about duration of pandemic protocols was associated with lower adherence rates.

Key words: COVID-19; Mental Health; Depression and Anxiety; Adherence; Social Distancing

Introduction

The spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), known as the coronavirus disease (COVID-19), has accumulated into an ongoing pandemic with profound impacts on global public health. On the 30th of January 2020, the outbreak was declared an international public health emergency by the World Health Organization (WHO). As of October 1, 2020, 34 million confirmed cases have been reported, accompanied by more than 1 million corona-related deaths (WHO, 2020). While awaiting the implementation of an efficacious vaccine into routine healthcare, countries across the globe have employed disease containment strategies aimed at impeding viral transmission chains. These strategies are collectively referred to as non-pharmacological interventions (NPIs; Ferguson et al., 2020). NPIs are mitigation strategies designed to decrease physical contact among individuals within a community with the goal of reducing the reproduction number R_0 , the average number of secondary cases generated by each positive case (Ferguson et al., 2020). The term NPI is commonly used interchangeably with physical distancing or social distancing protocols. Importantly, a variety of NPIs are contemporaneously in practice worldwide, with many countries implementing strategies including lockdowns (e.g., physical closure of schools and universities), social distancing from peers and public activity, quarantine, and isolation. Consequently, accompanied by the realization that the end of the crisis is not yet in sight, a different dimension of public health which requires urgent attention has emerged. This concerns the associations between mental health symptoms and the NPIs implemented during the COVID-19 pandemic (e.g., Holmes et al., 2020; Nature Medicine, 2020). As many of these NPIs are concurrently in operation globally, their potentially detrimental associations with the health status of the general public has now become a prime concern of clinicians, scientists, and health policy makers. This matter is further reflected by numerous calls for papers urging that mental health be taken into consideration (e.g., Brooks et al., 2020; Galea,

Merchant, & Lurie, 2020; Holmes et al., 2020; Nature Human Behaviour, 2020; Nature Medicine, 2020; Pfefferbaum & North, 2020; Venkatesh & Edirappuli, 2020; Yao, Chen, & Xu, 2020).

Among the psychological symptoms highlighted for investigation in the general population, depression and anxiety are critical (Brooks et al., 2020; Galea et al., 2020; Nature Medicine, 2020; Yao et al., 2020; Venkatesh & Edirappuli, 2020). Depression and anxiety are two prevalent domains of mental health symptoms of which the former primarily encompasses of persistent feeling of sadness and loss of interest, while the latter mainly comprises of extensive and persistent apprehensive expectation about a number of events and activities (American Psychiatric Association, 2013). Notably, previous findings have discovered that acute life events, bereavement, and financial crises often precede the onset and maintenance of depression (Herman et al., 2019; Lund et al., 2018; Paykel, 2003). Similarly, anxiety disorders are revealed to be aggravated by stressful events (Tyrer & Baldwin, 2006). An increase in depression and anxiety is concerning, given the disorders' tendencies to persist following termination of the eliciting situation, their relapse rates, economic and societal costs, quality of life impairments, as well as their associated mortality rates (Herman et al., 2019; Lund et al., 2018; Patel et al., 2016; Tyrer & Baldwin, 2006). As such, large-scale screenings of these mental health symptoms using specific validated instruments including the Patient Health Questionnaire (PHQ-9) and the Generalized Anxiety Disorder scale (GAD-7) have been urgently called for, providing an overview of the current prevalence estimates of mental health symptoms during the pandemic (e.g., Nature Medicine, 2020). Additionally, large-scale assessments are imperative for identifying groups of individuals vulnerable to unfavorable mental health outcomes. Insight into specific symptom level increases and the factors associated with such changes provides a foundation for knowledge concerning the treatment needs of the population, in addition to providing ground

upon which the development of context-specific preventive and interventive measures are to be based (e.g., Brooks et al., 2020; Galea et al., 2020; Nature Medicine, 2020; Yao et al., 2020; Venkatesh & Edirappuli, 2020). Such an investigation further provides an initial evaluation of the mental health symptomology associated with the globally omnipresent NPIs. Moreover, the issue of adherence to NPIs is noteworthy, as lockdown and social distancing strategies are ineffective if individuals do not adhere to them (e.g., Brooks et al., 2020). This accentuates the importance of investigating factors associated with adherence to NPIs, which is deemed vital in the current time-sensitive battle against the pandemic.

In recent calls for papers (e.g., Brooks et al., 2020; Galea et al., 2020; Holmes et al., 2020; Nature Human Behaviour, 2020; Nature Medicine, 2020; Pfefferbaum & North, 2020; Venkatesh & Edirappuli, 2020; Yao et al., 2020), numerous factors have been suggested to be associated with the potential increases in mental health problems, and other variables are hypothesized to be related to adherence difficulties. In non-pandemic settings, factors associated with increases in depressive and anxiety symptoms include female gender (Nolen-Hoeksema, 2001; McLean, Asnaani, Litz, & Hofmann, 2011), younger age (Molarius et al., 2009), being single (Scott et al., 2010), lower education (Bjelland et al., 2008), and involuntary job loss (Linn, Sandifer, & Stein, 1985). Furthermore, several other factors have been deemed important to investigate regarding depressive and anxiety symptoms in pandemic settings. These include frustration of autonomy, commonly observed due to imposed behavioral restrictions during pandemics, as well as perceived lack of competence, which is of increased relevance in novel uncertain situation and has been previously associated with detrimental psychopathological symptoms (e.g., Tindall & Curtis, 2019). Additionally, calls have been made (e.g., Brooks et al., 2020) for investigations into the relationship between these symptoms with the extent of information access and worry about the duration of implemented pandemic protocols, as these cognitive variables are

hypothesized to be associated with detrimental mental health symptoms. Furthermore, it remains unclear whether protective behaviors such as physical activity and distraction with other positive activities (a common emotion-regulation technique) are beneficial for mental health during pandemics, and whether such factors may alleviate the symptoms of depression or anxiety alone, or benefit both symptomologies.

Similarly, a great deal remains unknown concerning which factors are associated with adherence to NPIs. Considering the mixed evidence concerning demographic characteristics associated with adherence in previous pandemics (Webster et al., 2020), the role of gender, age, and educational level remain unclear. Access to information and altruistic attitude have been theorized to increase adherence (e.g., Brooks et al., 2020; Webster et al., 2020).

Similarly, worry about the duration of pandemic protocols (e.g., Brooks et al., 2020; Webster et al., 2020), the role of fear for one's own and significant others' health, and the relationship between psychopathology and adherence remains uninvestigated. As individuals with considerable depressive and anxiety symptoms reveal higher risk aversion (e.g., Maner et al., 2007), both these symptomologies could be associated with increased adherence to pandemic protocols. However, considerable depressive symptoms have previously been linked with lower adherence in other settings (e.g., DiMatteo, Lepper, & Croghan, 2000), indicating that such problems could also likely be associated with reduced adherence to pandemic protocols, thus requiring empirical investigation. Furthermore, situational variables such as one's employment status and the ability to work from home, which is highly relevant for maintaining quarantine orders, in addition to suspicions of having contracted the virus, are potentially relevant factors that may influence adherence-behavior. These aforementioned factors not only require empirical examination in the context of the COVID-19 pandemic, but, more importantly, are of increased utility when examined with a multifactorial approach

which takes into account the relative strength of each variable while controlling for other relevant variables.

The present research thus aims to empirically clarify the relationship between these theorized and called for variables in terms of 1) central psychological symptoms (i.e., depression and anxiety) and 2) adherence. The presented findings are of utility toward identification of important factors which may aid in reducing the mental health burden of pandemics, while increasing adherence to NPIs.

Methods

The present cross-sectional study is part of the Norwegian COVID-19, Mental Health and Adherence Project, and is conducted in accordance with the guidelines of the Strengthening the Reporting of Observational Studies in Epidemiology statement (STROBE; Von Elm et al, 2007). Health estimates were reported in accordance with the GATHER statement (Stevens et al., 2016). The study was registered on Clinicaltrials.gov prior to any examination or analysis of the data, after the data collection period. Its protocol can be found at Clinicaltrials.gov (Identifier: NCT04356365). All elements of the submitted study adhere to its protocol.

Study design and participants

In this cross-sectional and epidemiological study, we investigated the mental health status of the general adult population and adherence to NPIs aimed at impeding viral transmission chains, across all regions in Norway during the ongoing COVID-19 pandemic. These regions serve a geographically defined area of approximately 5.3 million individuals, the population of Norway, all serving under identical nationally initiated NPIs. The study design involved the inclusion of a proportionate number of participants from each region of Norway compared to the population of the region. Eligible participants were all adults of 18 years and above currently living in Norway and thus experiencing identical NPIs, who

provided informed consent to participate in the study. The period of data collection lasted seven days, between March 31, 2020 and April 7, 2020. This encompasses a timeframe where all NPIs were in place and held constant during the two weeks prior to data collection, as well as during the data collection week. Furthermore, no new information was provided by the government during this period concerning changes of NPIs, keeping expectation effects constant.

The stopping rule for data collection was designed to ensure that the NPIs were held constant across all counties for two weeks prior to and during the week of the data collection period, as well as controlling for expectation effects by stopping data collection instantly once information concerning modification of NPIs were provided.

Ethical approval of the study was granted by the Regional Committee for Medical and Health Research Ethics and the Norwegian Centre for Research Data (reference numbers: 125510 and 802810, respectively), who approved the study protocol and analysis plan prior to data collection.

Procedure

The dissemination of the online survey was systematically conducted through six platforms to obtain a probability sample. Due to infection guidelines concerning viral transmission and the time-sensitive nature of the study with the aim of measuring mental health during a period with identical NPIs, we could not disseminate the survey through conventional methods such as access to registry data. Consequently, the survey was disseminated online through various national, regional, and local platforms. The target population (i.e., Norwegian adults) consists of approximately 4.2 million individuals. To give the adult population an equal opportunity to participate in the study, the survey was disseminated in the following six ways. 1) The majority of the sample (i.e., 70%) were obtained randomly using a Facebook Business algorithm, with imputed parameters reaching a

population of 3.6 million adults, proportionately targeting each region compared to their relative size. The final number of individuals reached through this method encompassed a random selection of 174,885 of these 3.6 million individuals. As Facebook includes 85% of the Norwegian adult population (i.e., 3.6 of 4.2 million), five other methods were used to maximize the probability of reaching the residual 15% of the adult population (i.e., 600,000 individuals); 2) through broadcasting on the national news channel of Norway, with approximately 1.1 million viewers at the time of broadcast, through 3) national radio stations, 4) regional and local radio stations across the country, 5) national newspapers, and 6) regional and local newspapers across the country, as well as additional local and regional media and social media sources. These national, regional, and local (i.e., 2–6) advertisements contained brief messages informing about the possibility to partake in a study at the University of Oslo about mental health in the adult population. Consequently, among the 10061 participants in this study, close to 70% were obtained randomly among the pool of Norwegian adults on Facebook (3.6 million; 85% of the adult population), while 30% were obtained through platform 2 to 6 to reach the residual 15% of Norwegian adults. The sampling procedure and the population distribution used for the calculation of the post-stratification weights (elaborated under Statistical analyses section) are portrayed in the online Supplemental Material, Figure S1.

Measurement

The survey consisted of a list of items elaborated below, administered in a random order. The demographic variables included sex, self-reported identification with sex, age, education, ethnicity, marital status, and employment status.

In terms of psychological symptoms, validated screening measures routinely used in practice to assess symptom levels suggestive of psychological diagnosis were utilized. The PHQ-9 and GAD-7 were specifically chosen due to the limited overlap between the items of

each respective measures with regards to symptoms of depression and anxiety, allowing the examination of unique risk factors associated with each symptom group as called for in the literature (e.g., Nature Medicine, 2020), and how such variables may be divergently related to them. The Patient Health Questionnaire (PHQ-9; Kroenke, Spitzer, & Williams, 2001) consists of nine items scored on a four-point Likert-scale (0–3), with scores ranging from 0 to 27. Higher scores on the PHQ-9 indicate greater depression severity and scores above and including 10 are considered indicative of a depressive diagnosis, with a sensitivity and specificity of 88% (Kroenke et al., 2001). The internal consistency of this scale was good in this sample, with a Cronbach's α of .88. The Generalized Anxiety Disorder 7 (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006) consists of seven items measuring anxiety on a four-point Likert scale (0–3), with scores ranging from 0 to 21. For GAD-7, internal consistency was good, with a Cronbach's α of .88. Higher scores indicate greater anxiety severity. A commonly used cut-off for GAD-7 scores includes 8 or above, which has been further validated as the cut-off for determining the presence of an anxiety disorder in Norwegian samples (Johnson, Ulvenes, Øktedalen, & Hoffart, 2019). Another commonly used cut-off for GAD-7 includes 10 and above (Spitzer et al., 2006). Consequently, we report the results for both these cut-offs, presenting the one appropriate for Norwegian samples in the results section, and the results for the cut-off value of 10 in Table S1, found in the online Supplemental Material. Symptoms of health anxiety was measured with two items from the validated Health Anxiety Inventory (HAI; Salkovskis, Rimes, Warwick, & Clark, 2002), one item measuring specific fear of being infected by coronavirus ("I fear being infected by the coronavirus"), and an item measuring fear of dying due to the coronavirus ("I fear dying through contracting the coronavirus") on a four-point Likert scale (0–3). Internal consistency was good for health anxiety, with a Cronbach's α of .79.

Adherence to NPIs was measured by asking the participants how well they managed to follow each of the specific NPIs employed by the Norwegian government. A full list of the NPIs in place during the measurement period is provided in Table S2 and the full list of the items measuring adherence in Table S3, both found in the online Supplemental Material. Internal consistency was acceptable for this scale, with a Cronbach's α of .66. Scores range from 0 to 32, measuring the degree of adherence on a five-point Likert scale (0: No days at all; 1: Some days; 2: Half of the days; 3: Almost every day; 4: Every day), operationalized with regard to the approximate number of days during which participants managed to follow each NPI during the last 14 days.

Situational variables included two dichotomous variables, involuntary job loss related to the COVID-19 pandemic and voluntary versus mandatory adherence to social distancing measures. Other situational variables included extent of access to information related to the coronavirus and NPIs; frustration of autonomy; perceived competence to deal with the pandemic ("I feel confident in my abilities to deal with the challenges related to the pandemic crisis"); and difficulty to work from home, all measured on a four-point Likert Scale (0-3). Finally, participants were asked the number of days out of the last 14 days which they had socially distancing themselves from peers and public activity. Those who reported to have socially distanced themselves for at least 10 of the last 14 days were coded as having predominantly followed distancing protocols.

Cognitions, fears, and worries related to the pandemic were measured, including worry about significant others being infected by the virus ("I worry about those close to me contracting the coronavirus), worry about transmitting others with the coronavirus ("I worry about transmitting others with the coronavirus"), and worry about prolonged duration of the implemented NPIs ("I worry that the implemented pandemic protocols may be extended further in duration"), all measured on four-point Likert scales (0-3). Suspicious of being

infected by the coronavirus was measured dichotomously (i.e., on a Yes or No scale) with a single item (“Have you suspected having contracted the coronavirus during the past two weeks?”). Altruism was measured with the single item “It is important for me to follow the pandemic mitigation protocols (i.e., NPIs) to help my fellow human beings and society”, measured on a four-point Likert scale (0-3). Three protective variables were assessed: a) experiencing nature; b) distraction with positive activities one would otherwise not have the time for during non-pandemic everyday life, measured on a four-point Likert scale (0-3); and c) physical activity defined as lasting at least 30 minutes and leading to at least light sweat or increased pulse, measured in accordance to its frequency during the past two weeks. Finally, the presence of a pre-existing psychological diagnoses was queried, asking the participants to report whether they currently have a formal psychiatric diagnosis given by a health care professional.

Statistical analyses

All statistical analyses were performed using R (version 4.0.2). Descriptive analyses were reported using means and standard deviations, and difference tests between subgroups were conducted using chi-squared tests. In calculating the percentage meeting the cut-offs for PHQ-9 and GAD-7, 10,000 bootstrap simulations were conducted to generate 95% confidence intervals. Three multiple linear regression analyses were conducted, with one for each dependent variable, namely 1) depressive symptoms, 2) anxiety symptoms, and 3) adherence to NPIs. The inference criteria (i.e., $p < .001$) for all analyses was pre-defined taking into consideration the large sample size and the number of investigated relationships to account for multiple testing and further minimize the risk of type I errors. In total, 45 relationships were investigated (i.e., three regressions including 15 predictors each), thus yielding a Bonferroni corrected alpha level of $.05/45 = .001$. Adjusted R^2 was used instead of R^2 , as the adjusted R^2 accounts for the numbers of predictors in the model, only increasing explained variance if the

added variables improve the model than what is expected by chance. To investigate the relative importance and strength of the different factors compared to one other, effect sizes were calculated using part (semi-partial) correlations. Part correlations provide easily interpretable effect estimates and represent the least biased estimates of the strength of a predictive relationship (Dudgeon, 2016). They reveal the correlation between the dependent variable and the aspects of the predictor variable that are unique when accounting for all other predictors. As correlation estimates, they are evaluated in accordance with the standards provided by Cohen (1988), with small effects $\geq .10$; medium effects $\geq .30$; and large effect sizes $\geq .50$. The assumptions of multiple regression were checked, and multicollinearity diagnostics were conducted in accordance with common guidelines ($VIF < 3$ and Tolerance $> .20$; Hocking, 2013). Each model assesses the joint and unique contribution of the included predictors and accounts for possible correlations between them. Outliers were examined using Cook's distance statistics, which allows for the detection of data points that can bias the results.

The survey involved voluntary participation, thus being susceptible to oversampling and undersampling of certain subgroups. To deal with this problem and take the most conservative and accurate approach concerning inference to the adult population, all overrepresented and underrepresented subgroups were assigned appropriate weights proportionate to the exact distribution of each subgroup in the Norwegian population. More weight was assigned to underrepresented units and less weight to overrepresented units. Specifically, age, sex, education, geographic region, ethnic distribution proportionate to each ethnic group, and the percentage of healthcare and social workers were all weighted to represent their exact distributions and frequencies in the population. The precise distributions used for the calculation of these post-stratification weights are portrayed in the online Supplemental Material, Figure S1. Post-stratification weights were assigned using the R-

package “survey”. To avoid that the matching of the distribution of one factor unmatches the distribution of other factors, an iterative algorithm (i.e., raking ratio estimation) was used. This iterative algorithm post-stratifies factors by turn, leading to a converging set of weights for each factor that matches the population distribution. All three regression models involved the use of this weighted and adjusted sample. This weighted sample was additionally used in descriptive estimations to assess the replicability of the results revealed by the main unadjusted sample.

Sensitivity analyses involving only the randomly obtained participants

Approximately 70% of the participants in the present study were randomly obtained, leaving 30% of the participants in the main analysis non-randomly reached. Consequently, we selected a random and post-stratified proportion (i.e., subsample) of only those participants who were obtained by the random selection technique through the Facebook Business algorithm. This was used in sensitivity analyses to further assess the robustness and the replicability of the main results stemming from the original sample. These sensitivity analyses were additionally conducted following matching of demographic variables proportionate to the adult population of Norway. In sum, the robustness of the original results was assessed twice, with sensitivity analyses consisting of solely randomly obtained individuals, as well as with a weighted and adjusted sample involving post-stratification weights proportionate to the population distribution.

Comparison of concurrent symptom levels with pre-pandemic samples

Although we did not employ a prospective design and could not directly assess changes in the same subjects, we were able to investigate differences in symptom levels by acquiring data from the same population as the population of the present study (i.e., Norwegian adults) from 2015. This pre-pandemic sample consists of 1944 representative and randomly sampled Norwegian adults who had responded to the PHQ-9 before the COVID-19

pandemic (i.e., 2015), including 1051 females and 893 males (Krogstad et al., 2020).

Additionally, the prevalence rates of depression and anxiety in the current pandemic sample were compared to representative pre-pandemic samples from similar populations as well as more distinct cultures encompassing similar population characteristics, using the same instruments and cut-off values.

Results

Sample description

National NPIs aimed at reducing viral transmission were employed in Norway on March 12, 2020. The data collection of this study was conducted between March 31, 2020 and April 7, 2020. Consequently, at the time of measurement, the duration of NPIs experienced by respondents ranged from 19 to 26 days. Overall, a total of 10,061 adults participated in the study. All 10,061 participants (100% of the sample) were included in all descriptive reports and prevalence estimates. A total of 10,035 participants (99.75% of the sample) were included in the regression analyses, as two levels of the sex variable (i.e., intersex and transgender) included too few participants to be included as separate categories in the regression analyses (4 and 22 participants, respectively). The age of participants ranged from 18 to 86, with a mean age of 36 years ($SD = 13.46$). The proportion of pre-existing mental health conditions in this sample was 17.11%, which reflects the lower end of the known rate of psychological disorders in the adult population of Norway, which is between 16.66% to 25.00% (Norwegian Institute of Public Health, 2016). Participants' demographic information can be found in Table 1. The sample was also geographically representative of Norway, with the ratio of individuals from each region being proportionate to the population parameter. Specifically, 63.02% of the sample (as compared to 58.32% in the population) were from Eastern Norway, 24.87% of the sample (versus 20.28% in the population) were from Western Norway, 10.50%

of the sample (compared to 15.95% in the population) were from Mid-Norway, and 3.60% of the sample (versus 5.45% in the population) were from Northern Norway.

Out of the 10,061 participants, a total of 3,583 (35.61%) reported suspicions of having been infected by COVID-19 during a two-week period. Of these individuals, 1,090 respondents (30.42%) reported visiting the healthcare system for this problem specifically. Furthermore, a total of 4,846 (48.17%) of all respondents reported difficulties working from home for more than half of the days during which they experienced NPIs, while 4,963 (49.33%) of all participants reported that the NPIs affected their productivity related to their job or schoolwork. More than 59% of the 10,061 participants reported financial concerns. The Norwegian government held press conferences on national television, providing clear and transparent information updates concerning the pandemic situation. These press conferences were well-received by the adult population, with only 4.97% of the 10,061 participants reporting being negatively affected by them.

Prevalence of psychological symptoms in the general population

Descriptive statistics of depressive and anxiety symptoms across different subgroups in the present pandemic sample are provided in Table 2, along with the proportion of participants meeting the validated cut-off points on PHQ-9 (≥ 10) and GAD-7 (≥ 8) for clinically significant depressive and anxiety symptoms. The level of depressive and anxiety symptoms is much higher in the present sample of participants experiencing the NPIs aimed at mitigating viral transmission during the COVID-19 pandemic, as compared to obtained data from the same population before the pandemic in 2015, in addition to similar samples from other countries during non-pandemic periods. These results are presented in Table 3. Specifically, the prevalence of depression estimated by PHQ-9 (cut-off ≥ 10) in the present pandemic sample is 30.78% (95% CI 29.88% – 31.70%). In the obtained data from the same population in 2015 estimated by PHQ-9 (cut-off ≥ 10), the prevalence of depression was

10.24%. Consequently, the prevalence of depression in the present pandemic sample is three times higher than estimations from the obtained data of the same population (i.e., Norwegian adults) before the pandemic (30.78% versus 10.24%), as well as approximately three times higher than similar representative samples from other countries in non-pandemic periods (8.20–14.70%), all using the same instrument and cut-off value (Johansson, Carlbring, Heedman, Paxling, & Anderson, 2013; Kauffman et al., 2020; Krogstad et al., 2020; Maske et al., 2006). Additionally, there was a significant difference ($p < .001$) in depressive symptoms between those who predominantly socially distanced themselves and those who did not. 32.81% of adults who predominantly socially distanced themselves met the cut-off for clinically significant depression (PHQ-9 ≥ 10), in contrast with 23.14% among those who did not predominantly socially distance.

The prevalence of clinically significant anxiety estimated with GAD-7 (cut-off ≥ 8) is 27.57% (95% CI 26.70% – 28.43%), between two to three times higher than estimations using the same instrument and cut-off from similar samples in non-pandemic periods (Hinz et al., 2017; Johansson et al., 2013; Maideen, Sidik, Rampal, & Mukthar, 2015). In all mentioned non-pandemic samples, a larger proportion of women met the cut-off criteria of both GAD-7 and PHQ-9, revealing more severe symptoms of depression and anxiety. Of note, there was a significant difference ($p < .001$) in anxiety symptoms between those who predominantly socially distanced themselves and those who did not. 29.00% of those who predominantly socially distanced themselves protocols met the cut-off for clinically significant anxiety (GAD-7 ≥ 8), in contrast with 22.24% among those who did not predominantly follow these protocols.

In the current pandemic sample, single or divorced individuals, those not identifying with their biological sex, non-natives, and unemployed individuals, represented other

vulnerable demographic groups, yielding higher levels of depressive and anxiety symptoms, as reflected by Table 2.

To further control for the robustness of these results, the same analyses were repeated using the weighted and adjusted sample. This representative sample replicated the original findings, revealing an overall prevalence of 29.56% (as compared to 30.78%) for depression and a prevalence of 26.26% (as compared to 27.57%) for anxiety. Additionally, sensitivity analyses were conducted based on a random subsample of the randomly obtained portion of participants, further matched in accordance with population parameters. These sensitivity analyses involved a random subsample including 3,098 of the participants. Once again, the results showed identical prevalence estimates for depression (30.89%) and anxiety (26.66%) as compared to the original sample (30.78% and 27.57%, respectively), replicating the original findings for the second time and providing further support for the robustness of the presented results.

Factors associated with depressive symptoms

The multiple regression examining the variables associated with depressive symptoms is presented in Table 4. Overall, the regression model accounted for 52% of the variance in depressive symptoms. Female gender associated with more depressive symptoms than male. Increased age was associated with less depression. Those who were single or divorced, as well as those with lower education, were associated with more depressive symptoms. Regarding situational variables, being employed was associated with less depression, whereas job loss related to the pandemic was unrelated to depressive symptoms. Frustration of autonomy was associated with greater depression severity. Mandatory social distancing ($p = .009$) and extent of access to information ($p = .011$) were unrelated to depressive symptoms at the pre-specified $p < .001$ level, while perceived competence to deal with the crisis was associated with less depression. Worry about prolonged duration of the implemented NPIs

predicted more depressive symptoms. Physical activity, distraction with positive activities not performed otherwise during non-pandemic everyday life, and experiencing nature were protective factors against depression, with more involvement in these activities being associated with fewer depressive symptoms. Having a pre-existing mental health condition was controlled for in the multiple regression model, and unsurprisingly this variable was associated with greater depression severity.

Among these associations, part correlations revealed the factors most strongly associated with depressive symptoms while accounting for all other variables. The strongest factors associated with depressive symptoms included worry about prolonged duration of the implemented physical distancing protocols (part correlation = .21), frustration of autonomy (part correlation = .24), pre-existing mental health conditions (part correlation = .29), age of the participants (part correlation = -.18), sex (part correlation = .10), being employed (part correlation = -.11), distraction with positive activities not done otherwise (part correlation = -.11), and perceived competence to deal with the crisis (part correlation = -.15), all revealing small to medium effects, as described in Table 4.

Factors associated with anxiety symptoms

The multiple regression model examining the factors associated with anxiety symptoms can be found in Table 4, explaining 49% of the variance in anxiety symptoms. Females were associated with more severe anxiety. Higher age was associated with fewer anxiety symptoms. Employment was associated with lower anxiety severity. Extent of information access was borderline significant ($p = .001$) and served as a protective factor associated with less anxiety symptoms. Perceived competence to deal with the crisis was another protective factor associated with less anxiety symptoms. Worry about prolonged duration of the implemented NPIs was associated with more anxiety symptoms. History of

mental disorder was controlled for in this model, and unsurprisingly those with mental disorders reported more anxiety symptoms.

Among these associations, part correlations revealed the factors most strongly associated with anxiety symptoms while accounting for all other variables. These included perceived competence to deal with the pandemic (part correlation = $-.23$), worry about prolonged duration of implemented physical distancing protocols (part correlation = $.25$), age of the participant (part correlation = $-.12$), sex (part correlation = $-.10$), pre-existing mental health conditions (part correlation = $.25$), and frustration of autonomy (part correlation = $.22$), all revealing small to medium effects, presented in Table 4.

Factors associated with adherence to mitigation strategies

Additionally, we fitted a multiple regression model to investigate the factors associated with adherence to the NPIs employed aimed at impeding viral transmission chains. The model explained 19% of the variance, presented in Table 4. Females revealed higher rates of adherence than males. There was a significant association between increased age and higher adherence rates, whereas education was unrelated to adherence. Increased altruistic attitude was associated with higher adherence, whereas being employed was associated with lower adherence. Voluntary social distancing was associated with less adherence as compared to mandatory social distancing. Extent of information access was unrelated to adherence to NPIs. Difficulty to work from home was associated with lower adherence. Worry about transmitting the virus to others was associated with lower adherence, whereas worry about significant others being infected by the virus was associated with higher adherence to NPIs. Worry about prolonged duration of the implemented NPIs was associated with lower adherence rates.

Among these significant associations, part correlations revealed the factors most strongly associated with levels of adherence while accounting for all other variables.

Adherence was most strongly associated with altruistic attitude (part correlation = .32) and the age of the participants (part correlation = .10), with the former yielding a medium effect size and the latter a small effect.

Discussion

Prevalence of psychological symptoms

Level of current psychopathology was markedly (i.e., three times) larger during the period with implemented NPIs as compared to an obtained pre-pandemic sample from the same population in 2015, and similar representative samples in Sweden (Johansson et al., 2013), Germany (Maske et al., 2006), and the United States (Kauffman et al., 2020) during non-pandemic periods. Overall, nearly one-third of the present sample met the cut-off for clinically significant depressive symptoms. These findings correspond to a previous study examining levels of depression during an NPI-active period during the SARS pandemic in Canada (Hawryluck et al., 2004), and a recent meta-analysis by Salari et al. (2020), revealing a prevalence of 33.70% for depression during the present pandemic across 14 studies ($N = 44,531$). Additionally, a recent prospective study by Ettman et al. (2020) following participants from before to after the pandemic, revealing threefold increases in depressive symptoms. Consequently, the findings reflect the consistent associations between exposure to stressful life events and greater severity of depressive symptoms in the literature (e.g., Hammen, Davila, Brown, Ellicott, & Gitlin, 1992; Kendler, Karkowski, & Prescott, 1999; McGonagle & Kessler, 1990; Tennant, 2002), revealing the heavy psychological burden that accompanies pandemics. Of note, in the present sample, there was a substantial (i.e., 10%) difference in the prevalence of clinically significant depressive symptoms among those who predominantly socially distanced themselves versus those who did not (33% versus 23%, respectively). Social distancing protocols were thus associated with higher depressive symptomology. Such differences have been found for anxiety symptoms during the present

pandemic, where it has been discovered that quarantine individuals reported significantly higher symptoms of anxiety than non-quarantined participants (Zhao et al., 2020). The present results extend to the literature by revealing these associations with regards to depressive symptoms.

For anxiety symptoms, comparisons to similar representative samples from Sweden (Johansson et al., 2013), Germany (Hinz et al., 2017), and Malaysia (Maideen et al., 2015) during non-pandemic periods reveal that the prevalence of anxiety symptoms is between two to three times higher during an NPI-active period in the current pandemic. These results are comparable to a study which found that more than one-third of participants experienced high levels of psychological distress during a period of Equine influenza outbreak in Australia (Taylor, Agho, Stevens, & Raphael, 2008) and coincide with a recently published meta-analysis by Salari et al. (2020), revealing a prevalence rate of 31.90% for anxiety during the present pandemic across 17 studies ($N = 63,439$). Moreover, in the present sample, there was a substantial (i.e., 7%) difference in the prevalence of clinically significant anxiety symptoms among those who predominantly socially distanced themselves versus those who did not (29% versus 22%, respectively). Social distancing protocols were thus associated with higher anxiety symptoms, consistent with a recent study revealing that quarantine individuals reported significantly higher symptoms of anxiety than non-quarantined participants (Zhao et al., 2020).

In sum, prevalence of clinically significant depression and anxiety symptoms measured during the NPI-active period was between two to three times larger than estimates of these symptoms in a) the same population from 2015 and b) other comparable populations during non-pandemic periods without NPIs. These symptom increases were further comparable to prevalence estimates from c) previous pandemics and d) a meta-analysis assessing the same symptoms during the present pandemic. Moreover, in the present sample,

e) social distancing protocols were associated with significantly higher proportions of depressive and anxiety symptoms. Our results suggest that female respondents, individuals belonging to sexual orientation minorities, non-natives, single individuals, those with pre-existing mental health conditions, and unemployed individuals are associated with higher risk of meeting the cut-off for clinically significant depression and anxiety symptoms, suggesting that these groups may be more susceptible to requiring interventive measures in the present pandemic, as well as preventative measures in forthcoming pandemics employing similar NPIs. Taken together, the presented suggest that the present pandemic and its implemented mitigation protocols are associated with detrimental mental health symptomology. Although the strict NPIs employed in Norway successfully managed to reduce R_0 from 2.4 to 0.7 during the survey period, these findings suggest that such intensive lockdown strategies and social distancing interventions, which are presently ubiquitous across all continents, are likely to include detrimental psychological costs. Although some respondents will experience immediate relief of symptoms once NPIs are lifted, others may continue to experience these symptoms for long durations even after NPIs are discontinued. Indeed, several studies from previous pandemics have suggested long-term effects of NPIs on mental health and behavior (Brooks et al., 2020). Consequently, the markedly larger prevalence rates of clinically significant depressive and anxiety symptoms may have adverse implications for respondents' future mental health states, a cause for concern which will be crucial to monitor over the forthcoming period.

Factors associated with depression and anxiety

Several factors associated with depression were also associated with anxiety, which is not surprising given their correlation in this sample ($r = .76, p < .001$). However, important differences emerged amongst both risk factors and predictors of depression and anxiety, requiring attention from clinicians and health policy makers. Females, younger adults, and

individuals with a pre-existing psychiatric disorder had greater symptom severity for both depression and anxiety. In terms of relationship status, being married or in a civil union was a significant protective factor of depressive symptoms, but not anxiety. Furthermore, lower education levels were associated with more depressive symptoms, but unrelated to anxiety. Job loss related specifically to the COVID pandemic was unrelated to depression and anxiety severity, although being employed (versus unemployed) in general served as a protective factor against these symptoms. This finding is consistent with the economic stress hypothesis, where unemployment has been related to increased symptoms of psychological disorders (Catalano & Dooley, 1983). Furthermore, as employment has been robustly associated with reduced symptoms of depression and anxiety (Lund et al., 2018), this finding encourages government officials to find solutions that make use of individuals' skills to keep them employed. These findings further particularly highlight the vulnerability of single individuals with regards to depressive symptomology during pandemic periods, with twice as many (in contrast with those in relationships) and nearly 40% of single individuals experiencing clinically significant depressive symptoms. This seemingly reflects the importance of social contact, which has been reduced to a greater extent for single individuals by the strictly employed social distancing protocols. Appropriate action to incorporate mitigation strategies that may alleviate these symptoms while simultaneously maintaining viral transmission control is warranted. A utile intervention toward both these causes may include the use of social support bubbles, allowing single individuals to have a few contact points during strict lockdown and curfew periods. Additionally, other important differences between depression and anxiety included that higher engagement in coping behaviors such as physical activity, distraction with positive activities not done otherwise, and experiencing nature were protective factors associated with reduced burden of depression, but not anxiety. To further advance the literature on coping strategies effective during pandemic periods, forthcoming

studies should investigate other coping behaviors with the potential of reducing the burden of anxiety.

Frustration of autonomy and worry about prolonged duration of the implemented social distancing measures (i.e., NPIs) was associated with greater severity, while perceived competence to deal with the pandemic crisis was an associated protective factor for both anxiety and depressive symptoms. Worry about prolonged duration of implemented NPIs had an equally large effect on anxiety symptoms as a pre-existing psychiatric disorder, suggesting the strength and importance of this variable in its association with anxiety symptoms. The extent of access to information was unrelated depression, but significantly associated with anxiety symptoms. It would thus seem that for depression, it is more the content of information rather than its frequency that is associated with symptomology. Thus, competence enhancing public health messages combined with provision of predictable estimates concerning the duration of implemented pandemic measures may be a utile strategy with regards to combating depressive symptoms, a strategy of possible utility to health policy makers. For anxiety, both worry about prolonged duration of implemented NPIs, as well as extent of access to information are of importance. This finding is meaningful in light of empirical findings revealing that anxiety is mainly driven by worry and an intolerance of uncertainty (e.g., Grupe & Nitschke, 2013; Rosser et al., 2019), both of which seem to be alleviated through availability of information and predictable information concerning the lengths of NPIs. Although the causal directions of this relationship is not certain, there is a possibility that providing credible and accurate information concerning the pandemic situation may be beneficial in reducing symptoms of anxiety, a finding which should be investigated in forthcoming studies. This is in line with the uncertainty and anticipation model of anxiety (Grupe & Nitschke, 2013), describing how uncertainty of possible future events may result in anxiety. Consequently, preparing the population for plausible upcoming scenarios in an open

and transparent manner may have the potential to reduce such uncertainty and in turn protect against detrimental mental health outcomes.

Moreover, diverting efforts toward supporting individual autonomy and perceived competence may be beneficial, as it is associated with reduced symptoms of both depression and anxiety, which could possibly be achieved by providing individuals with information fostering a sense of self-efficacy in their own ability to cope with the present crisis. It may be possible that the shock accompanied by the early pandemic phase resulted in a state of perceived helplessness, which has been previously associated with depressive symptoms arising from environmental factors (e.g., Miller, Rosellini, & Seligman, 1977). The initial shock arising from the pandemic may also have led to increased worry about the future, which has previously been associated with increased anxiety symptoms (e.g., Wells, 2009). Investigations of such potential underlying mechanisms of increases in depressive and anxiety symptoms should be a priority for forthcoming studies, as they can provide important insights concerning treatment targets.

Factors associated with adherence to mitigation strategies

Adherence levels were generally high in Norway, with most individuals reporting to have followed the NPIs for more than half of the days to nearly every day. These findings are consistent with Google Mobility reports during the measurement period, attached in Supplemental Material A1, which can be found online. The Google Mobility report portrays a sharp decrease in social and physical activities, with large decreases in overall national mobility in Norway, further reflecting that individuals adhered to the NPIs requiring physical and social distancing. Female gender and older aged individuals were associated with higher adherence. This finding suggests that males and younger individuals may take pandemic risks less seriously, revealing that alternative strategies are necessary to increase the adherence of these subgroups of individuals. Indeed, previous studies have indicated that older adults tend

to see more risk in matters of health compared to younger adults (i.e., Bonem, Ellsworth, & Gonzalez, 2015). One possible utile strategy to increase adherence in these groups may include the adaptation of risk perception in public health messaging, with previous findings (e.g., Brewer et al., 2004) on Lyme disease finding that individuals more aware of its associated risks were more likely to engage in adaptive adherence behavior.

Current employment was associated with lower adherence levels, which could be explained by the fact that many of the NPIs concern socially distancing oneself and staying at home, guidelines which certain groups of employed individuals may have to violate for work-related purposes. Those instructed to socially distance themselves (i.e., mandatory or rule-enforced social distancing) had higher adherence levels compared to those who voluntarily socially distanced themselves. This finding may be explained by the fact that those who were instructed to engage in mandatory social distancing were either carriers of the infection (being instructed to isolate) or had been in contact with infected others (being instructed to enter quarantine). Consequently, it may seem that these individuals were more likely to adhere to NPIs involving social distancing as they were either infected and/or had increased risk of infecting others, possibly taking the NPIs more seriously. Extent of access to information was unrelated to adherence, suggesting that it is the content rather than the frequency of information that is relevant with regards to adherence. Given the current overload of available information about the pandemic (i.e., an overload termed as an ‘infodemic’ by the WHO), these findings have important implications suggesting that public health officials may more reliably focus on the clarity and content of messaging rather than increasing its frequency when informing the public about pandemic mitigation protocols.

Worry about significant others being infected by the coronavirus was associated with higher adherence to NPIs. However, it was found that worry of transmitting the virus to others was associated with lower adherence to NPIs. As the presented data is correlational, it may

seem more plausible to consider the other direction in interpreting the latter association, where it may be that individuals who at first did not adhere to NPIs subsequently experienced worry about transmitting the virus to others rather than the other way around. Finally, worry about prolonged duration of implemented NPIs was associated with lower adherence. Taken together with the other findings of this study, the latter association seems to reflect an emotional burden of adhering to NPIs, as is evident from the severely high prevalence rates of depression and anxiety in this sample. However, the direction of this association is uncertain, as it may be that individuals first worry about extended duration of NPIs after having violated them, instead of this worry itself being primary and subsequently leading to lower adherence. Such directional associations are important to investigate in forthcoming studies involving multiple time-points, which have the potential of moving closer to causal understandings given temporal precedence in data structures. In any case, it appears that strategies aiming to reduce worry about prolonged durations of implemented mitigation strategies, such as the provision of information concerning how long they will be implemented, is associated with decreases in anxiety and depressive symptoms and increases in adherence to NPIs.

Importantly, increased altruistic attitude was a potent factor associated with higher adherence, revealing a medium to large effect size. This finding adds to the literature by providing support for a previously uninvestigated hypothesis by Brooks and colleagues (2020), suggesting that appealing to altruism during pandemic periods may foster favorable effects. Previous studies (e.g., Tajfel & Turner, 1979) highlight possible ways through which altruism may effectively be increased, including the formation of a collective identity via establishing shared interests which may further be enhanced through public health-messaging campaigns involving framing such as ‘our united battle against the virus’. Additionally, studies (e.g., Bendapudi, Singth, & Bendapudi, 1996; Gouldner, 1960) have found that presenting helping behaviors as norms may enhance altruistic attitude. This is revealed to

happen through the mechanism of reinforcement, with peers in society reinforcing newly established norms, in addition to through the presentation of cues for how to behave in novel situations (e.g., Bendapudi et al., 1996; Gouldner, 1960). Consequently, public health officials may find it useful to provide clear guidelines on specific behavioral etiquettes and norms in pandemic situations, provide suggestions on how to best conduct these behaviors, stress the importance of helping behavior, in addition to providing a collective cause and establishing common interests to motivate individuals to adhere to mitigation protocols.

Magnitude of investigated associations

Importantly, we point to the magnitude of the associations between the examined predictors (i.e., Table 4) and depression, anxiety, and adherence. As these regression analyses involve high-dimensional and multifactorial models (i.e., involving numerous and diverse sets of variables) with all variables controlling for the influence of one another, the relative effect size per predictor is naturally lower in contrast to unidimensional models examining few predictors. Thus, models including more relevant variables naturally reveal smaller effect sizes for each included variable, as each added relevant factor competes for the same pool of variance. Consequently, in interpreting the effect sizes, we point the reader to the unstandardized regression coefficients and the relative part correlations between variables, which provide more accurate representations of the magnitude of associations. For instance, the association between worry about prolonged duration of NPIs (part correlation .25) is equal in size to that of having a psychiatric diagnosis (part correlation = .25). Such comparisons are also available for depression (i.e., frustration of autonomy, worry about prolonged duration of NPIs), revealing the substantial associations between these factors and the criterion variables, as shown in Table 4.

Strengths and limitations

A major strength of the present study is the obtainment of pre-pandemic data within the same population in comparison with the large pandemic sample. Another substantial strength of this study involves the multifactorial investigations of factors related to depression, anxiety, and adherence. Moreover, the main results were replicated across the main sample and two cross-validations, including an adjusted and representative weighted sample, and the entirely randomly selected and adjusted subsample of participants in the sensitivity analyses, attesting to the robustness of the findings. Further, this study has momentarily captured the effects of NPIs as they happen, and while they are identical and held constant across the measurement period. It involves an investigation of commonly utilized NPIs, providing the grounds for the evaluation and modification of these such strategies when similar approaches are taken in the present and forthcoming pandemics. Self-selection bias was further accounted for in multiple ways, including through a subsample sensitivity analyses involving the randomly selected participants with matched characteristics to the population parameter, in addition to following assignment of post-stratification weights on the entire sample that matched the demographic groups to the exact distributions known in the population. Both of these analyses further replicated the original findings of the present study.

A limitation of the present study includes its cross-sectional design, which impairs the ability to draw conclusions concerning directional and causal effects. This highlights the importance of future research to investigate such directional effects in studies involving multiple time-points. Clever experimental designs which may imply causal effects are warranted. Another limitation concerns the self-reporting of symptoms and the presence of a psychiatric diagnosis rather than the use of diagnostic interviews. Moreover, one of the predictors in the regression concerning anxiety (i.e., ‘worry about prolonged duration of NPIs’) slightly overlaps with the process of worry and its uncontrollability in this measure.

Although the predictor represents a pandemic-specific worry and is distinct from this general process of worrying and its uncontrollability, this minor overlap should be noted as a limitation. As with traditional sampling techniques involving access to registry data and any other techniques involving voluntary participation, potential self-selection of participants may be present. However, analyses were conducted to reduce the influence of such effects, replicating the main findings and thus suggesting lowered likelihood of such effects.

Future directions

Research on the mental health impacts of the current global crisis is in its infancy, and there is an urgent need for more studies on the topic. Among other areas, future studies should investigate the general mental health and post-traumatic symptoms of vulnerable groups, such as healthcare workers, individuals in critical positions susceptible to burnout (e.g., politicians and teachers), parents, children in vulnerable homes, those with special needs, public service providers at increased risk of contracting the virus, individuals with pre-existing mental and physical health conditions, and minority subgroups. Investigating adherence as well as mental health symptoms in immigrants may also be of importance, as language barriers have the potential effect of causing anxiety symptoms in addition to problems with adherence. Examining the impact of information sources on adherence and psychiatric symptoms would further greatly benefit the literature. An investigation of post-traumatic symptoms, parental stress, and other mental health symptoms in both parents and children in unfavorable home situations is warranted, which may be amplified by closure of schools and quarantine measures. Investigations of other symptoms of psychopathology are warranted, including insomnia and disturbances to circadian rhythms which have been amplified due to the large changes in daily routines globally. Studies involving complex systems approaches such as network methodology are warranted, with the potential of revealing specific symptom relations during pandemic periods as well as investigating the mechanisms underlying

emergent detrimental mental health states. It would be of great utility to the pandemic research literature if there were studies comparing the network structure of psychopathological symptoms in pre-pandemic sample versus pandemic samples, which may reveal structural differences and mechanisms especially relevant during pandemic periods. Finally, studies investigating time-trends and psychological symptoms across multiple time-points during different phases of the pandemic will be imperative, allowing for the monitoring of subgroups requiring interventive measures, revealing more resilient groups requiring less attention, and further assessing the possible long-term effects of pandemic protocols.

Concluding remarks

The present study reveals a two to threefold increase in depressive and anxiety symptoms in the adult population as compared to pre-pandemic samples. Although these symptoms increased for all individuals, there was a large difference between those who were predominantly exposed to pandemic mitigation protocols and those who were not, suggesting unfavorable associations between these strict physical distancing measures and mental health symptoms. Several risk factors, pandemic-specific situational factors, and psychological factors associated with mental health symptoms were investigated, in addition to factors associated with adherence to pandemic protocols. Cumulatively, the presented results have implications for approaches that may be favorable in the efforts of increasing adherence to pandemic mitigation protocols, while simultaneously protecting the population from the detrimental mental health correlates of these implemented strategies. Appropriate action must be taken by government officials, researchers, and clinicians to minimize mental health risks accompanying pandemics and its burdensome mitigation protocols, and to monitor the development of these symptoms during the course of the pandemic and following its termination.

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Conflict of interest

All authors are employed by the University of Oslo and Modum Bad Psychiatric Hospital. The funder of the project had no role in any part of the study. The authors declare no conflicts of interest with respect to the authorship or the publication of this article.

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Table 1. Demographic information of the participants in the present sample, $N = 10061$.

Subgroups	N (%)
Age group, years	
18-30	4706 (46.77%)
31-44	2849 (28.32%)
45-64	2142 (21.29%)
65+	364 (3.62%)
Sex	
Female	7851 (78.03%)
Male	2184 (21.71%)
Intersex	4 (0.04%)
Transgender	22 (0.22%)
Self-identifies with biological sex	
Yes	10010 (99.49%)
No	51 (0.51%)
Civil Status	
Single or divorced	5310 (52.78%)
Married or in a civil union	4751 (47.22%)
Education Level	
Did not complete Junior High School	11 (0.11%)
Completed Junior High School	511 (5.08%)
Completed High School	1784 (17.73%)
Currently studying	2111 (20.98%)
Completed University Degree	5644 (56.10%)
Currently Employed	
Employed	8140 (80.91%)
Unemployed	1921 (19.09%)

Table 2. Levels of psychiatric symptoms in a general adult population ($N = 10061$) following two weeks of non-pharmacological interventions (NPIs) aimed at impeding viral transmission chains during the COVID-19 pandemic. Percentage meeting cut-offs for clinically significant depression and anxiety are revealed. Differences between subgroups are reported using chi-squared tests χ^2 .

	<i>N</i>	Mean (SD), Range	Percentage of subgroups meeting diagnostic cut- off (%)	Chi-squared test, χ^2
Symptoms of depression (PHQ-9)				
All participants	10061	7.61 (5.69), 0–27	30.78% of full sample	
Sex				$\chi^2 (3, N = 10061) = 165.61, p < .001$
Female	7851	8.08 (5.70), 0-27	33.63%	
Male	2184	5.91 (5.34), 0-27	20.10%	
Intersex	4	8.75 (8.46), 0-16	50.00%	
Transgender	22	12.50 (5.70), 2-23	72.73%	
Identification with Sex				$\chi^2 (1, N = 10061) = 24.58, p < .001$
Self-identifies with biological sex	10010	7.59 (5.68), 0-27	30.62%	
Does not self- identify with biological sex	51	11.67 (6.82), 0-24	62.75%	
Civil status				$\chi^2 (1, N = 10061) = 312.29, p < .001$
Single or divorced	5310	8.73 (5.86), 0-27	38.48%	
Married or in a civil union	4751	6.37 (5.23), 0-27	22.19%	
Ethnicity				$\chi^2 (1, N = 10061) = 9.05, p = .003$
Native	9487	7.58 (5.70), 0-25	30.44%	
Non-native	574	8.22 (5.57), 0-27	36.41%	
Employment status				$\chi^2 (1, N = 10061) = 125.27, p < .001$
Currently employed	8140	7.25 (5.34), 0-27	28.28%	

Currently unemployed	1921	9.16 (6.77), 0-27	41.39%	
Predominantly socially distanced^a				$\chi^2 (1, N = 10061) = 73.16, p < .001$
Yes	7952	7.92 (5.76), 0-27	32.81%	
No	2109	6.48 (5.30), 0-27	23.14%	
Symptoms of anxiety (GAD-7)				
All participants	10061	5.73 (4.62), 0-21	27.57% of full sample	
Sex				$\chi^2 (3, N = 10061) = 161.57, p < .001$
Female	7851	6.13 (4.64), 0-21	30.39 %	
Male	2184	4.26 (4.26), 0-21	17.13%	
Intersex	4	5.50 (5.80), 1-14	25.00%	
Transgender	22	8.82 (4.13), 2-17	59.09%	
Identification with gender				$\chi^2 (1, N = 10061) = 11.81, p < .001$
Self-identifies with biological sex	10010	5.72 (4.62), 0-21	27.46%	
Does not self-identify with biological sex	51	8.19 (4.88), 0-18	49.02%	
Civil status				$\chi^2 (1, N = 10061) = 93.98, p < .001$
Single or divorced	5310	6.22 (4.75), 0-21	31.66%	
Married or in a civil union	4751	5.19 (4.42), 0-21	23.01%	
Ethnicity				$\chi^2 (1, N = 10061) = 16.12, p < .001$
Native	9487	5.69 (4.61), 0-21	27.13%	
Non-native	574	6.48 (4.81), 0-21	34.84%	
Employment status				$\chi^2 (1, N = 10061) = 96.82, p < .001$
Currently employed	8140	5.47 (4.38), 0-21	25.44%	
Currently unemployed	1921	6.83 (5.39), 0-21	36.59%	

**Predominantly
socially distanced^a**

$\chi^2 (1, N = 10061) =$
38.01, $p < .001$

Yes	7952	5.94 (4.68), 0-21	29.00%
No	2109	4.96 (4.33), 0-21	22.24%

^a Predominantly (i.e., at least 10 out of 14 days) followed distancing protocol by socially distancing from peers and public activity.

Table 3. Percentage meeting validated cut-off of depression and anxiety in the current pandemic sample, the same population before the pandemic (i.e., obtained data from 2015), and similar representative populations of adults in Germany, Sweden, Malaysia, and the United States before the pandemic, all using the same instrument and cut-offs, PHQ-9 (≥ 10) and GAD-7 (cut-off ≥ 8).

	Present study, pandemic sample ($N = 10061$)	Non-pandemic sample from the same population (Norwegian adults, $N = 1944$)	Non-pandemic Swedish sample ($N = 3001$; Johansson et al., 2013)	Non-pandemic German sample ($N = 7987$; Maske et al., 2006)	Non-pandemic US sample ($N = 5134$; Kauffman et al., 2020)		Present study, pandemic sample ($N = 10061$)	Non-pandemic Swedish sample ($N = 3001$; Johansson et al., 2013)	Non-pandemic German sample ($N = 9721$; Hinz et al., 2017)	Non-pandemic Malaysian sample ($N = 1556$; Maideen et al., 2015)
Symptoms of depression (PHQ-9; cut-off ≥ 10)						Symptoms of generalized anxiety (GAD-7; cut-off ≥ 8)				
Overall	30.78%	10.24%	10.80%	6.10%	8.10%	Overall	27.57%	14.70%	11.00%	8.20%
Female	33.63%	12.46%	12.90%	10.20%	9.60%	Female	30.39 %	17.90%	14.10%	8.40%
Male	20.10%	7.61%	8.30%	6.10%	6.50%	Male	17.13%	10.70%	7.70%	7.70%

Table 4. Three multiple regression models ($N = 10035$) presenting the predictors of depressive symptoms, symptoms of anxiety, and degree of adherence to non-pharmacological interventions employed against COVID-19 in their respective columns.

	<i>B</i>	<i>SE (B)</i>	<i>p</i>	Part correlati -on, <i>r</i>		<i>B</i>	<i>SE (B)</i>	<i>p</i>	Part correlati -on, <i>r</i>		<i>B</i>	<i>SE (B)</i>	<i>p</i>	Part correlati -on, <i>r</i>
Predictors of depressive symptoms (PHQ-9). $N = 10035$, Adjusted $R^2 = .52$					Predictors of anxiety symptoms (GAD-7). $N = 10035$, Adjusted $R^2 = .49$					Predictors of adherence to NPIs employed against COVID-19. $N = 10035$, Adjusted $R^2 = .19$				
Intercept	14.585	.442	< .001		Intercept	9.638	.353	< .001		Intercept	22.542	.649	< .001	
Sex^a	-.948	.121	< .001	-.099	Sex^a	-.756	.099	< .001	-.095	Sex^a	-.589	.091	< .001	-.082
Age	-.072	.004	< .001	-.175	Age	-.039	.003	< .001	-.118	Age	.029	.004	< .001	.096
Married or in a civil union^b	-.884	.114	< .001	-.094	Married or in a civil union^b	-.042	.091	.648	-.005	Education	.055	.043	.196	.018
Education	-.257	.055	< .001	-.058	Education	-.118	.046	.010	-.032	Altruism	2.103	.195	< .001	.316
Employed^c	-1.444	.150	< .001	-.114	Employed^c	-.766	.120	< .001	-.074	Voluntary social distancing^f	-.531	.094	< .001	-.075

Lost job due to COVID-19 crisis^d	.274	.162	.093	.021	Lost job due to COVID-19 crisis^d	.192	.136	.157	.018	Employed^c	-.507	.112	< .001	-.055
Frustration of autonomy	1.323	.072	< .001	.244	Frustration of autonomy	.976	.058	< .001	.219	Extent of information access	.100	.057	.075	.026
Perceived competence to deal with the pandemic crisis	-1.080	.095	< .001	-.148	Perceived competence to deal with the pandemic crisis	-1.410	.081	< .001	-.228	Worry about prolonged duration of implemented NPIs	-.291	.052	< .001	-.071
Extent of information access	-.199	.079	.011	-.034	Extent of information access	-.203	.064	.001	-.042	Difficult to work from home	-.130	.034	< .001	-.047
Worry about prolonged duration of implemented NPIs	1.164	.066	< .001	.212	Worry about the prolonged duration of implemented NPIs	1.131	.055	< .001	.247	Worry about transmitting the virus to others	-.161	.046	< .001	-.037
Pre-existing mental health condition^e	3.868	.176	< .001	.288	Pre-existing mental health condition^e	2.792	.142	< .001	.254	Worry about significant other being infected by the virus	.227	.045	< .001	.055
Physical	-.201	.050	< .001	-.046	Physical activity	-0.032	.039	.415	-.009	Health anxiety	.038	.024	.109	.017

activity					symptoms									
Experience nature	-.346	.067	< .001	-.057	Experience nature	-0.124	.055	.024	-.025	Depressive symptoms	.008	.013	.521	.006
Distraction with positive activities not done otherwise	-.583	.062	< .001	-.113	Distraction with positive activities not done otherwise	-.066	.052	.198	-.016	GAD symptoms	.016	.017	.358	.007
Voluntary social distancing^f	-.294	.113	.009	-.031	Voluntary social distancing^f	-.038	.097	.691	-.005	Suspecting COVID infection^g	-.186	.096	.052	-.024

^a Male (1), Female (0); ^{b, c, d, e, g} Yes (1), No (0); ^f Voluntarily socially distanced (1), mandatory socially distanced (0); *B*: Unstandardized regression coefficient; Part-correlation: semi-partial correlations.

Supplementary Materials: Figure S1

Figure S1. Sampling and post-stratification weighting of participants. The majority (i.e., approximately 70%) of the participants were randomly obtained using Facebook Business Algorithm with imputed instructions to have an equal probability to reach any adult registered on Facebook in the Norwegian population (i.e., 85% of all Norwegian adults). The residual 15% of Norwegian adults not registered on Facebook were targeted systematically through national, regional, and local television, radio channels, and newspapers. The survey involved voluntary participation, thus being susceptible to over and undersampling of certain subgroups. All over and undersampled subgroups were consequently assigned appropriate post-stratification weights proportionate to the exact distribution of each subgroup in the Norwegian population, as portrayed in this figure.

Supplementary Table S1. Levels of GAD (cut-off ≥ 10) in a general population following two weeks of non-pharmacological interventions (NPIs) related to the COVID-19 pandemic.

	<i>N</i>	Mean (SD), Range	Percentage of subgroups meeting the cut-off for GAD-7 (≥ 10) (%)
Symptoms of generalized anxiety (GAD-7)			
All participants	10061	5.73 (4.62), 0-21	18.63% of full sample
Female	7851	6.13 (4.64), 0-21	20.66%
Male	2184	4.26 (4.26), 0-21	11.08%
Intersex	4	5.50 (5.80), 1-14	25.00%
Transgender	22	8.82 (4.13), 2-17	40.90%
Self-identifies with biological sex	10010	5.72 (4.62), 0-21	18.53%
Does not self-identify with biological sex	51	8.19 (4.88), 0-18	37.26%
Single	4006	6.19 (4.77), 0-21	22.09%
Married or in a civil union	4751	5.19 (4.42), 0-21	14.86%
In a relationship (Other)	1304	6.31 (4.66), 0-21	21.70%
Native	9487	5.69 (4.61), 0-21	18.25%
Non-native	574	6.48 (4.81), 0-21	24.91%
Currently employed	8140	5.47 (4.38), 0-21	27.90%
Currently unemployed	1921	6.83 (5.39), 0-21	16.43%
Predominantly socially distanced	7952	5.94 (4.68), 0-21	19.82%
Did not predominantly socially distance	2109	4.96 (4.33), 0-21	14.13%

^a Predominantly (i.e., at least 10 out of 14 days) followed distancing protocol by socially distancing from peers and public activity.

Supplementary Table S2. All nationally initiated non-pharmacological interventions during the COVID-19 pandemic in Norway actively in place during the first wave of data collection. NPIs were identical across all regions and throughout the measurement period. No new information was given about modifications of NPIs during the measurement period, controlling for expectation effects.

Non-pharmacological intervention	Duration of NPI	Modification or novel information about modification of NPI provided during the measurement period
1. Individuals who have been in contact with anyone who has been infected by the disease are quarantined for 14 days following initial contact with the infected person.	Two weeks prior to and during the measurement period.	No
2. Anyone suspecting symptoms of the coronavirus or is confirmed to have the virus must be in isolation.	Two weeks prior to and during the measurement period.	No
3. Social and physical distancing: individuals are disallowed from being in groups with more than five people and must maintain at least two meters distance from others.	Two weeks prior to and during the measurement period.	No
4. Closing schools, kindergartens, and universities.	Two weeks prior to and during the measurement period.	No
5. Close of all businesses in the catering, food, and beverage industry. The exception of the rule involves eateries that may facilitate visitors to have at least a one-meter distance from each other.	Two weeks prior to and during the measurement period.	No
6. Closure of all additional businesses with increased risk of infectious spread. This includes any business involving human contact, with the exception of grocery stores.	Two weeks prior to and during the measurement period.	No
7. Individuals returning to Norway receive an automatic quarantine duration of 14 days.	Two weeks prior to and during the measurement period.	No
8. Cancellation of cultural events (e.g., concerts), closing of gyms and physical work-out centers.	Two weeks prior to and during the measurement period.	No
9. Health personnel disallowed from leaving the country.	Two weeks prior to and during the measurement period.	No
10. All hospitals and health institutions must introduce access control and stop regular visitation routines.	Two weeks prior to and during the measurement period.	No
11. Ban on traveling to and staying overnight at one's leisure property outside the individuals residing municipality.	Two weeks prior to and during the measurement period.	No
12. Border control: The borders are closed with regards to visitors from other countries.	Two weeks prior to and during the measurement period.	No

Supplementary Table S3. Questions measuring degree of adherence by the asking participants how well they managed to follow each of the following guidelines employed by the Norwegian government.

Item number	Question
1	I have managed to adhere to the guidelines of not leaving my home unless necessary with regards to medical visits and purchase of essential supplies.
2	I have managed to adhere to the guidelines of not traveling within the country or outside the country.
3	I have avoided social gatherings involving more than five peers.
4	I have managed to adhere to the guidelines of washing my hands regularly.
5	I have managed to adhere to the guidelines of maintaining a two-meter distance from others when I am outside my home.
6	I have managed to adhere to the guidelines of avoiding groups larger than five even when meeting peers outdoors or outside of my home/peers' home.
7	I have managed to adhere to the guidelines of keeping a two-meter distance from any peers who visit my home, with the exception of those in my household.
8	I have managed to adhere to the guidelines of avoiding all cultural gatherings and organized sports activities arranged indoors or outdoors.

Supplementary Material A1 – Google Mobility Report

COVID-19 Community Mobility Report

Norway March 29, 2020

Mobility changes

Google prepared this report to help you and public health officials understand responses to social distancing guidance related to COVID-19. This report shouldn't be used for medical diagnostic, prognostic, or treatment purposes. It also isn't intended to be used for guidance on personal travel plans.

Location accuracy and the understanding of categorized places varies from region to region, so we don't recommend using this data to compare changes between countries, or between regions with different characteristics (e.g. rural versus urban areas).

We'll leave a region out of the report if we don't have statistically significant levels of data. To learn how we calculate these trends and preserve privacy, read [About this data](#).

Retail & recreation

-65%

compared to baseline

Mobility trends for places like restaurants, cafes, shopping centers, theme parks, museums, libraries, and movie theaters.

Grocery & pharmacy

-32%

compared to baseline

Mobility trends for places like grocery markets, food warehouses, farmers markets, specialty food shops, drug stores, and pharmacies.

Parks

-5%

compared to baseline

Mobility trends for places like national parks, public beaches, marinas, dog parks, plazas, and public gardens.

Transit stations

-57%

compared to baseline

Mobility trends for places like public transport hubs such as subway, bus, and train stations.

Workplaces

-34%

compared to baseline

Mobility trends for places of work.

Residential

+11%

compared to baseline

Mobility trends for places of residence.

Additional Supplemental Material – Brief systematic review

Given the gravity of the current situation, although a recent and thorough systematic review has published on in February by Brooks et al. (2020), we conducted our own brief systematic review to help the scientific community with up to date knowledge concerning the effects of social distancing on mental health for the interested reader. As these results are not related to the empirical investigation and research questions of the present paper, we present the findings of this up to date and brief systematic review in Supplementary Material A, with its results identifying several novel studies adding to the last systematic review (Brooks et al., 2020).

We conducted systematic searches without time restrictions in MEDLINE (PubMed) and PsycINFO, with the final update on May 1, 2020. We conducted searches with high specificity using terms related to (a) mental health and psychiatric disorders; (b) pandemics or health disasters; and (c) non-pharmacological interventions (NPIs) or disease containment strategies such as social distancing, quarantine and isolation. The search string is specific terms are presented in the table below:

Search terms and databases used for the brief systematic review

MEDLINE (Ovid) and PsycINFO (OvidSP)

1 ("psychopathology" or "mental health" or "psychiatric symptoms" or "psychiatric" or "psychological symptoms" or "psychological" or "psychology" or "psychological disorder*" or "psychiatric disorder*" or "psychopathology symptoms" or "depression" or "anxi*" or "depres*" or "depressive disorder*" or "major depressive disorder" or "major depression" or "major depressive" or "depression" or "depression disorder*" or "depressive symptoms" or "depression symptoms" or "major depress* episode*" or "depress* episode*" or "symptoms of depression" or "symptoms of major depression" or "symptoms of major depressive disorder" or "anxiety disorder*" or "symptom* of anxiety*" or "anxi* disorder*" or "anxi* symptom*" or "generalized anxi* disorder*" or "generalised anxi* disorder*" or "loneliness" or "PTSD" or "post-traumatic stress" or "acute stress symptoms" or "acute stress disorder" or "post traumatic stress" or "PTSS" or "traumatic stress").mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]

2 ("COVID-19" or "corona" or "covid" or "coronavirus" or "SARS-CoV-2" or "severe acute respiratory syndrome coronavirus 2" or "SARS" or "Severe Acute Respiratory Syndrome" or "SARS-CoV" or "MERS" or "Middle East Respiratory Syndrome" or "MERS-COV" or "pandemic" or "health disaster" or "health-related disaster" or "health related disaster").mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]

3 ("quarantine" or "isolation" or "social distanc*" or "physical distanc*" or "non-pharmacological intervention" or "behavi* intervention" or "disease containment measure*" or "disease-containment measur*" or "disease-containment intervention" or "disease containment intervention" or "disease containment strateg*" or "disease-containment strateg*" or "infectious disease containment").mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]

4 (1 AND 2 AND 3)

Studies from any language was included in the search, and no eligible study in a language incomprehensible to the authors was encountered. Eligible studies were screened with inclusion criteria involving (a) any peer-reviewed study concerning (b) pandemics or health-related disasters; (c) measuring the association of NPIs with (d) mental health symptoms or psychiatric disorders; in (e) an adult population. The reference lists of eligible studies were investigated. Furthermore, we examined published reviews on the topic and hand-searched their reference lists, including a recent review by Brooks and colleagues on the associations of quarantine with mental health.

Of the 256 studies identified, 14 studies involving either quantitative or qualitative design met the inclusion criteria. These 14 studies are very briefly summarized in the table (Table A) below in narrative format:

Table A. Brief narrative summary of identified studies

Authors (year)	Design	Brief narrative summary of findings
Blendon et al. (2004)	Synthesized data from 13 public surveys in North America.	Describes the importance of communication as a means of avoiding community-wide problems reported during the SARS pandemic. Provides a description of concern for contracting SARS as related to variables such as washing hands, avoiding large gatherings and avoidance of public transportation. Describes the negative economic impact of SARS.
Cava et al. (2005)	Qualitative interviews of 21 individuals experiencing quarantine during the SARS pandemic in Toronto.	Participants verbally reported themes such as uncertainty, fear and lack of information surrounding the illness (SARS). Additionally, those experiencing isolation reported feeling stigmatized. Participants also reported inadequate coping strategies to deal with the crisis.
Cowling et al. (2010)	Quantitative investigation of 12965 individuals in Hong Kong during the HK 2009 Influenza A (H1N1)	The authors reported high levels of risk perception, anxiety symptoms, and further reported that knowledge about infectious transmission did not improve through the measurement period.
DiGiovanni et al. (2004)	Mixed methods design involving 1509 participants.	Qualitative findings revealed that individual's willingness to comply were increased when the source of information was perceived to be legitimate and

		<p>the criteria for quarantine was clear. Participants also reported that concerns about wages and income, as well as logistical problems concerning ways of buying groceries and other services necessary for daily living inhibited compliance. The study reports that boredom was a disincentive toward compliance. Participants reported emotional reactions such as loneliness, fear, anxiety and boredom.</p>
Gong et al. (2020)	<p>Data from 4913 online consultations in China related to the COVID-19 pandemic.</p> <p>Analysis of content of consultations identification of common problems yielding suggestions of roles for online internet hospitals.</p>	<p>The study describes the role of internet hospitals, internet doctors and staff in reducing social panic, promoting social distancing, and correcting improper medical seeking behavior related to the current COVID-19 pandemic.</p>
Jeong et al. (2016)	<p>A quantitative retrospective study investigating the mental health status of individuals isolated during the MERS pandemic 4-6 months post-isolation.</p>	<p>Retrospective investigation asking participants in presence how they felt 4-6 months before the time of query, when isolated, revealing that participants reported increased anxiety symptoms. Reports of the participants current (i.e., during the time of measurement; 4-6 months post-isolation) anxiety and anger symptoms were lower, indicating that anxiety and anger symptoms decreased with time.</p>
Kim et al. (2018)	<p>Retrospective quantitative study of 40 patients who were isolated in hospitals due to being infected by MERS</p>	<p>The authors report that the participants there was an association between participants having MERS with depressive and PTSD symptoms. The authors request that forthcoming studies identify vulnerable subgroups prone to depression during pandemic periods.</p>
Kwok et al. (2020)	<p>Quantitative study involving 1715 participants during the</p>	<p>Using HADS-A, the authors found elevated anxiety levels in participants as well as high</p>

	COVID-19 pandemic in Hong Kong.	levels of perceived risk.
Maunder et al. (2003)	Qualitative interviews of 19 health-care staff during the first 4 weeks of SARS.	Participants reported increased boredom, fear, loneliness, anger, worry about the effects of quarantine on their mental health, anxiety and insomnia. Medical staff reported fear of being infected and fear of infecting their own family.
Mihashi et al. (2009)	Retrospective quantitative study of 300 printing company works, conducted 7-months post-pandemic (SARS).	26.2% of factory workers in China met the criteria for a psychiatric diagnosis following a 7 to 8-month mass isolation period related to the SARS pandemic. Length of isolation was unclear.
Reynolds et al. (2008)	Quantitative study of 1912 quarantined individuals during the SARS pandemic in Canada.	Authors reported increased levels of PTSD symptoms among health-care workers. The importance of providing a rationale for quarantine was elaborated, revealing that compliance was higher when rationale for quarantine was understood. They further found that longer quarantine periods were associated with increased PTSD symptoms.
Roy et al. (2020)	Quantitative study of 662 adults in India during the COVID-19 pandemic.	The study reported amount of knowledge in the population about COVID-19 and knowledge about preventive aspects in terms of infectious spread. The authors further identified high levels of anxiety in the sample, although without the use of any validated measure of anxiety. The study included a snowballing sample. Participants further reported sleep difficulties, paranoia acquiring COVID-19, and distress related to social media. The authors report that the perceived mental health-care need was more than existent for more than 80% of the participants.

Sprang & Silman (2013)	Retrospective quantitative study of 398 parents and youth in quarantine.	Around one-third of the children and one-fourth of the parents in quarantine or isolation met the criteria for PTSD. Length of quarantine or isolation was unclear.
Yoon et al. (2016)	Quantitative study of 6231 individuals under quarantine in South Korea during the MERS pandemic	The authors report that 19.3% of the participants reported depressive symptoms, although without the use of validated measures. Length of quarantine was unclear.

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