Investigating predictors contributing to the expression of schizotypy during the COVID-19 pandemic

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ABSTRACT

The coronavirus (COVID-19) pandemic has caused major disruptions to social and other forms of functioning, which may influence schizotypy expression. The current study aimed to explore possible distal and proximal predictors contributing to schizotypy in a sample of the Australian general population during the COVID-19 pandemic. The COvid-19 and you: mentaL heaLth in AusTralia now survEy (COLLATE) project is an online mental health study aimed at tracking key mental health indicators over the progression of the pandemic. Adults residing in Australia were invited to take part using non-discriminative snowball sampling. Demographic-clinical information was collected for 850 participants in either October 2020 or January 2021. To assess schizotypy facets, the Launay-Slade Hallucinations Scale-Extended (LSHS-E) and Peters Delusions Inventory (PDI-21) were used to measure hallucination and delusion proneness respectively. Generalised linear models (with gamma and negative binomial distributions) were employed. Age, negative emotions and loneliness significantly contributed to both hallucination and delusion proneness; gender, education and religiosity also significantly contributed to delusion proneness, in the final regression models. Our study corroborated the specific contribution of loneliness, amongst other factors, in the prediction of schizotypy facets. Tackling loneliness represents a public health challenge that needs to be urgently addressed, especially in the face of the ongoing COVID-19 pandemic.

1. Introduction

Schizotypy is a group of personality traits that manifest as experiences resembling the signs and symptoms of schizophrenia, only these experiences tend to be less severe and have less impact upon emotional, social and occupational functioning (Baumeister et al., 2017; de Leede-Smith and Barkus, 2013; van Os et al., 2009). Nevertheless, schizotypal experiences are often found to coalesce within multiple dimensions that also resemble the syndromes of schizophrenia (van Os et al., 2009), such as a positive dimension encompassing hallucination- and delusion-like experiences, a negative dimension encompassing anhedonia and social withdrawal, and a disorganised dimension encompassing odd speech and eccentric behaviour (Vollema and van den Bosch, 1995).

According to dimensional models of psychopathology, individuals who express high levels of schizotypy are more prone to developing schizophrenia and share many of the same risk factors for the disorder (Meehl, 1962; van Os et al., 2009). For example, they are more likely to have a first-degree relative with schizophrenia, be exposed to the same environmental risk factors (e.g. urban upbringing, traumatic childhood, etc.), and demonstrate cognitive impairments that are analogous, but milder, to those seen in schizophrenia (Barrantes-Vidal et al., 2015; Binbay et al., 2012; Morton et al., 2017; van Os et al., 2009). In addition, like schizophrenia, high schizotypy is associated with mood dysregulation, cannabis abuse, being single or divorced, and being in a lower socioeconomic bracket (Binbay et al., 2012).

Although biological and environmental risk factors are often emphasised, some researchers have stressed the added importance of

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social functioning in the development and maintenance of schizophrenia. For instance, links between the schizotypy-schizophrenia continuum and social isolation have been reported (Gayer-Anderson and Morgan, 2013; Le et al., 2019; Michalska da Rocha et al., 2018; Narita et al., 2020), and these associations encompass elevated loneliness (i.e. the subjective experience of being disconnected from others; Michalska da Rocha et al., 2018), as well as smaller, more distant social networks and less frequent social contact (i.e. objective social isolation; Gayer-Anderson and Morgan, 2013). Social contact may provide opportunities for normalizing explanations of anomalous experiences, and so social isolation has been hypothesised to facilitate and maintain the presence of positive symptoms, particularly delusions (Garety et al., 2001). Loneliness is also thought to encourage the perception of threat and the development of negative affect (Eglit et al., 2018). Indeed, several studies have reported specific relationships between delusions or delusion-like experiences of suspiciousness, and both social isolation (Myin-Germeys et al., 2001; Sorenson et al., 2021) and loneliness (Jaya et al., 2016; Narita et al., 2020; Sorenson et al., 2021; Sundermann et al., 2014). Moreover, the associations with loneliness appear to be mediated by levels of negative affect (Jaya et al., 2016; Sundermann et al., 2014). Given the influences of various environmental risk factors and social functioning upon the expression of schizotypy, the occurrence of major societal crises might be expected to coincide with widespread increases in schizotypal experiences. One such crisis, the coronavirus (COVID-19) pandemic, has caused major life disruptions, either directly as a result of the disease itself or indirectly via societal restrictions imposed by governments to contain its spread. In Australia, these restrictions have included strict lockdown measures and curfews, social distancing and the implementation of density limits, quarantining, transitioning education to remote learning, and working from home (Department of Health, 2020; see also: O'Sullivan et al., 2020). In turn, there have been numerous detrimental secondary effects, such as job losses, financial instability, relationship conflicts, domestic violence and xenophobia, all of which have potentially contributed to an increase in loneliness and social isolation (Boxall et al., 2020; Furlong and Finnie, 2020; O'Sullivan et al., 2020; Smith and Lim, 2020; Usher et al., 2020).

Accordingly, emerging research from other countries is beginning to indicate that the pandemic may be contributing to increased schizotypy expression (Alle and Berntsen, 2021; Bortolon et al., 2021; Fekih-Romdhane et al., 2021; Knolle et al., 2021; Strauss et al., 2022). For instance, Knolle et al. (2021) surveyed the mental health impact of the COVID-19 pandemic during May 2020, recruiting samples of the general population from the UK and Germany when the two countries were still within their initial lockdown periods. Using the Schizotypal Personality Questionnaire (SPQ; Raine, 1991), they found that schizotypy scores were increased in people who were concerned about life stability, who had a greater financial burden, who had poorer pre-existing physical and mental health, and those who had not transitioned to working from home. A second survey conducted by the same research group in October 2020, when most restrictions had eased, revealed that schizotypy levels were again elevated in people with poorer physical health, as well as in people with increased financial burden and loneliness (Daimer et al., 2021). Other surveys conducted during the initial lockdowns in France (Bortolon et al., 2021) and the USA (Alle and Berntsen, 2021), as well as at the end of lockdown restrictions in Tunisia (Fekih-Romdhane et al., 2021), all showed somewhat similar findings, suggesting that negative affect (Bortolon et al., 2021; Fekih-Romdhane et al., 2021), maladaptive coping (Bortolon et al., 2021; Fekih-Romdhane et al., 2021), loneliness (Bortolon et al., 2021) and social isolation (Alle and Berntsen, 2021; Fekih-Romdhane et al., 2021) significantly predicted schizotypal experiences during the COVID-19 pandemic.

Although the aforementioned findings are consistent with a COVID-19-related exacerbation of schizotypy, the replicability of these findings and their generalisability to Australia is not yet clear. Australia has been relatively successful in containing the spread of COVID-19, and mitigated the number of infections and deaths, but its population has had to endure some of the strictest social isolation measures in the world (described earlier). As such, it provides an excellent context for investigating associations between loneliness and social isolation, and schizotypy. Furthermore, there is currently very little information regarding whether some pandemic-related disruptions are associated with particular schizotypy dimensions, or whether they implicate schizotypy globally. Only Knolle et al. (2021) and Bortolon et al. (2021) have investigated individual schizotypy dimensions separately, and they reported evidence of dimension-specific relationships. For instance, Bortolon et al. (2021) found that the frequency of experiencing paranoia during lockdown was predicted by a different set of variables to those that predicted the frequency of experiencing hallucinations. This difference included loneliness, which predicted paranoia but not hallucinations.

Therefore, the aim of the current study was to investigate whether self-reported life disruptions during COVID-19 were associated with hallucination- and delusion-like experiences in an Australian general population sample. Our research question focused on exploring whether proximal changes in employment, financial status, work location, negative emotions, social contact and loneliness are significantly associated with hallucination- and delusion-like experiences, while controlling for existing distal factors (i.e. age, gender, education, religiosity, living situation, and pre-existing physical and mental health) that are known to influence the expression of these schizotypy facets. Based on previous findings, we expected to find that more self-reported financial and employment disruptions (including not being able to work from home), social isolation and loneliness, and negative emotions would all be significantly associated with more experiences of schizotypal hallucinations and delusions during the COVID-19 pandemic, after accounting for the effects of the aforementioned distal influences.

2. Methods

2.1. Participants and procedures

The COvid-19 and you: mentaL heaLth in AusTralia now survEy (COLLATE) project was launched on 1 April 2020, as a nationwide study aimed at tracking the mental health of Australians amidst the COVID-19 pandemic. This project has been described elsewhere (Rossell et al., 2021; Tan et al., 2020) but in brief, comprises 13 online surveys, activated for 72 h at the start of each month, followed by a series of follow-up surveys over the next four years. Members of the general public residing in Australia, aged 18 years or older, were invited to complete the survey via social media advertising and other online networks, participant registries held by Swinburne University of Technology as well as non-discriminative snowball sampling stemming from these initial recruitment methods. Past respondents were encouraged to participate in each new round of surveys, but new respondents who had not previously taken part were also accepted. This serial cross-sectional design permitted timely snapshots across multiple points to gain a broad understanding of population mental health as the COVID-19 situation evolved.

The current study utilised data collected in October 2020 and January 2021, as questions about hallucination- and delusion-like experiences, and loneliness were asked in these two months. This was based on a pre-determined survey design, which involved a brief core battery of key survey questions, alongside a secondary list of questionnaires that were inserted/removed in line with a regular rotation schedule. All January 2021 participants as well as unique October 2020 participants (who did not respond to January survey) were retained. This was done because the January response rate was lower, and we wanted to match sample sizes for the two time points as much as possible, whilst ensuring each participant was included only once. To provide additional context around these time points, Victoria was coming towards the end of a strict ~16-week lockdown in October 2020 (~18,000 cases were recorded during this second wave of infections),

with the rest of Australia generally free from COVID-19; most of Australia was in a similar state of stability, with negligible COVID-19 cases in January 2021, except for a small pocket of New South Wales which was experiencing a minor outbreak of infections (<150 cases). The study received ethics approval from the Swinburne University Human Research Ethics Committee (#20202917-4107), and complied with the Declaration of Helsinki. Respondents provided online informed consent, and collected responses were anonymous.

2.2. Measures

Two broad areas were examined: i) sociodemographic information, and ii) mental health status. Basic sociodemographic information was collected, including: age, gender, education, religiosity, employment status (whether adversely impacted by COVID-19) and work location (whether working from home), living situation (whether residing alone or with others), household income in the past fortnight, reduction in social contact owing to COVID-19 (in terms of number of hours), as well as whether respondents had a pre-existing physical/medical condition (*yes/no*), and/or were a person with lived experience of a mental illness (*yes/no*). The response categories for each of these sociodemographic variables are presented in Table A (supplementary section).

Mental health status was assessed further using several measures. Negative emotions were evaluated using the Depression Anxiety Stress Scales (DASS-21), a 21-item self-report measure, rated on four-point Likert scales (0–3), comprising three subscales: depression, anxiety, stress (Lovibond and Lovibond, 1995). Loneliness was gauged by the abbreviated University of California, Los Angeles Loneliness Scale (UCLA-LS), comprising two positively worded and two negatively worded items, rated on four-point Likert scales (1–4; Russell et al., 1980). Hallucination and delusion proneness were assessed using the Launay-Slade Hallucinations Scale-Extended (LSHS-E) and Peters Delusions Inventory (PDI-21) respectively. The LSHS-E is a 16-item measure, rated on five-point Likert scales (0–4), assessing multisensory hallucinatory experiences in the general population, with higher summed scores indicating increased hallucination proneness (Vellante et al., 2012). The PDI is a 21-item multidimensional measure of the propensity for delusional thinking based on atypical beliefs or vivid mental experiences, tapping into themes involving reference, persecution, grandiosity, religion-supernatural, mind-reading, control, jealousy, sin-guilt, somatic, thought alienation and nihilism (Peters et al., 2004). Questions describe unusual thinking styles or mental events, and require a *yes/no* answer (dimensional *distress*, *preoccupation* and *conviction* ratings were not collected in the current study). Each *yes* answer is allocated a score of 1, with higher summed scores indicating increased delusion proneness.

2.3. Data analysis

Statistical analyses were conducted using IBM SPSS Statistics, version 27. To contextualise our results, we first reported pertinent demographic and clinical information relevant to our sample, and compared our mean hallucination and delusion proneness scores with those of the respective original validation studies (Peters et al., 2004; Vellante et al., 2012). To examine the influence of distal and proximal factors, two sets of generalised linear models were employed to identify predictive factors contributing to hallucination and delusion proneness. A gamma distribution for LSHS-E and a negative binomial distribution for PDI-21 were assumed to account for the high degree of skewness in these distributions. Analyses were performed across the entire sample collapsed across the two time points (with duplicate respondents removed) to gain a continuum understanding of these experiences and beliefs during the COVID-19 outbreak. Variables of interest were assigned as distal (i.e. pre-existing factors typically associated with sociodemographics) or proximal (i.e. relatively state-based and assessed over a recent period of time) to COVID-19, prior to being entered into

the model. Distal predictors (age, gender, education, religiosity, living situation, and pre-existing physical and mental health conditions) were entered in Block 1; and proximal predictors (finances and employment status, work location, reduced social contact, negative emotions and loneliness) were entered in Block 2; with hallucination- and delusion-like experiences designated as the dependent variables. The overall number of predictors was within recommended guidelines for minimum sample size requirements (Tabachnick and Fidell, 2007).

3. Results

Survey responses from 1078 participants were recorded in October 2020 and January 2021. Seventy-five participants were removed from the October 2020 dataset because they had also completed the January 2021 survey. There was no evidence of change in LSHS-E, PDI-21, UCLA-LS or DASS-21 scores between these two time points within this sub-sample (see Table B, supplementary section). An additional 228 observations were removed due to missing data, resulting in 850 observations for the generalised linear model of LSHS-E scores and 805 observations for the generalised linear model of PDI-21 scores.

Participants had a mean age of 35.9 years, with a standard deviation of 13.0 years (range 18–84 years; see Table A in supplementary materials for detailed descriptive statistics and coding of variables for the regression analyses). Of these, 43.5% were male, and 67.6% had received a tertiary education. Most (70.7%) rated religion as not important in their lives, and a minority (16.1%) resided alone. The majority had their employment somewhat affected by the COVID-19 outbreak, with almost half (45.6%) working from home. Most reported a fortnightly household income of less than $7,000K (93.4%). A minority had pre-existing physical health conditions (30.2%) and/or lived experience of a mental illness (22.2%).

Scores from all three DASS subscales were highly inter-correlated in the current dataset ($0.65 \leq r_s \leq 0.72$, all $p < .001$). Thus, only total DASS scores were entered into subsequent analyses. Mean LSHS-E was slightly higher in our sample ($M = 11.3$, $SD = 11.4$) than the mean of 10.7 obtained in the original validation study (Peters et al., 2004; Vellante et al., 2012). Conversely, mean PDI-21 was somewhat lower in our sample ($M = 3.4$, $SD = 3.5$) than the mean of 6.7 obtained in the original validation study (Peters et al., 2004; Vellante et al., 2012). Notably, these schizotypy dimensions declined with age and higher education level, and increased with physical and mental illness, loneliness and negative emotions. PDI-21 was also significantly higher for females than males, and for those who endorsed greater religiosity, lower income and not working from home (see Table C in the supplementary section for the relevant correlation matrix).

Table 1 shows the results of the two generalised linear models elucidating which predictive factors significantly contributed to hallucination- and delusion-like experiences. For LSHS-E, age, education, religiosity, living situation, physical health and mental illness were significant distal predictors in Block 1. Gender did not significantly predict LSHS-E scores. Of the significant predictors form Block 1, only age remained significant in Block 2, with negative emotions and loneliness being significant proximal predictors. The final model was significant ($\chi^2[14] = 264.1$, $p < .001$). For PDI-21, age, gender, education, religiosity, physical health and mental illness were significant distal predictors in Block 1. Living situation did not significantly predict PDI-21 scores. Age, gender, education and religiosity remained significant in Block 2, alongside negative emotions and loneliness, which were significant proximal predictors. The final model was also significant ($\chi^2[14] = 194.8$, $p < .001$).

4. Discussion

The current study aimed to investigate how the expression of schizotypy facets, specifically hallucination- and delusion-like experiences, were associated with factors that were distal and proximal to the

Table 1
Generalised linear models elucidating significant predictors contributing to hallucination- and delusion-like experiences (N = 805–850).

	Hallucination-like experiences (LSHS-E)					Delusion-like experiences (PDI-21)				
	B	Wald	p	Exp(B)	95% CI	B	Wald	p	Exp(B)	95% CI
Block 1 (distal only)										
Age	-.015	38.3	<.001	0.985	0.981–0.990	-.016	25.4	<.001	0.984	0.979–0.990
Gender	.019	0.1	.751	1.019	0.908–1.143	.223	8.3	.004	1.250	1.073–1.455
Education	.132	4.8	.028	1.142	1.014–1.285	.412	26.9	<.001	1.510	1.293–1.765
Religiosity	-.163	4.7	.030	0.850	0.733–0.984	-.539	29.9	<.001	0.583	0.481–0.707
Living situation	.196	6.2	.013	1.217	1.042–1.420	.026	0.1	.809	1.026	0.831–1.267
Physical health	-.257	14.0	<.001	0.773	0.676–0.885	-.239	7.1	.008	0.787	0.660–0.939
Mental illness	-.468	41.2	<.001	0.626	0.542–0.723	-.354	13.8	<.001	0.702	0.583–0.846
Block 2 (distal and proximal)										
Age	-.008	11.8	.001	0.992	0.987–0.996	-.010	7.3	.007	0.990	0.983–0.997
Gender	-.034	0.3	.571	0.967	0.861–1.086	.205	5.6	.018	1.228	1.036–1.454
Education	.049	0.6	.432	1.050	0.929–1.187	.260	8.4	.004	1.298	1.087–1.548
Religiosity	-.125	2.7	.102	0.883	0.760–1.025	-.583	28.7	<.001	0.558	0.451–0.691
Living situation	.141	3.2	.075	1.151	0.986–1.344	-.029	0.1	.805	0.971	0.769–1.226
Physical illness	-.096	1.8	.184	0.909	0.789–1.046	-.085	0.7	.405	0.919	0.752–1.122
Mental illness	-.153	3.6	.057	0.859	0.734–1.004	-.105	0.9	.344	0.901	0.725–1.119
Household income	.066	0.3	.570	1.068	0.851–1.342	.293	2.7	.099	1.340	0.947–1.897
Employment	-.151	1.7	.192	0.860	0.685–1.079	.091	0.3	.605	1.095	0.777–1.543
Working from home	.015	0.1	.797	1.015	0.905–1.139	.149	2.9	.087	1.161	0.978–1.378
Reduced social contact	.002	<.01	.943	1.002	0.954–1.052	.014	0.1	.703	1.014	0.945–1.088
Negative emotions (DASS-21)	.014	76.8	<.001	1.014	1.011–1.017	.011	26.0	<.001	1.011	1.007–1.015
Loneliness (UCLA-LS)	.056	20.3	<.001	1.058	1.032–1.084	.078	18.9	<.001	1.081	1.044–1.119

Note. DASS-21 = Depression Anxiety Stress Scales; UCLA-LS = University of California, Los Angeles Loneliness Scale; LSHS-E = Launay-Slade Hallucinations Scale-Extended; PDI-21 = Peters Delusions Inventory. See Table A for coding of categorical variables.

COVID-19 pandemic. Our hypothesis that financial and employment disruptions, loneliness and reduced social contact, and negative emotions would be associated with more hallucination- and delusion-like experiences was only partly supported. Loneliness and negative emotions predicted both facets of schizotypy independently of sociodemographic factors distal to the pandemic. However, whilst household income and the ability to work from home were both associated with more delusion-like experiences (but not hallucination-like experiences), these associations were weak and were not independent of the distal sociodemographic factors.

Younger age was a significant distal predictor of hallucination- and delusion-like experiences in the final regression models, while female gender, higher education levels and reduced religiosity were also associated with delusion-like experiences. These findings are broadly consistent with previous literature. For instance, younger age and lower education are often associated with increased schizotypy (Binbay et al., 2012; van Os et al., 2009), including hallucination- and delusion-like experiences specifically (Knolle et al., 2021), and these relationships continue to be found during the pandemic (Knolle et al., 2021). Moreover, whilst schizotypal experiences tend to be slightly more common in males than females (Binbay et al., 2012; van Os et al., 2009), Knolle et al. (2021) reported more anomalous experiences and beliefs in females than males during the pandemic when modelled with other demographic predictors. The fact that pre-existing physical and mental health predictors (significant in the first step of both regressions) were no longer significant in the final models signifies possible mediation effects of proximal predictors entered in the second step, as supported by preliminary studies (Daimer et al., 2021; Knolle et al., 2021). It is noted that slightly different factors were involved in predicting hallucination-like experiences versus delusion-like experiences. In particular, certain sociodemographic factors (gender, religiosity, household income and working from home) seemingly influenced the development of delusion, but not hallucination, proneness. This underscores the importance of examining schizotypy on a dimensional or facet level, rather than as a single overarching construct.

Of the significant predictors identified in the final models, proximal factors associated with negative emotions, reduced social contact and loneliness were of special interest, as these represent possible psychological outcomes stemming from the pandemic. Preliminary research

supports the notion that negative affect (Daalman and Diederen, 2013; Laroi et al., 2012) and loneliness (Le et al., 2019; Michalska da Rocha et al., 2018; Narita et al., 2020) may increase the likelihood of transition to psychotic illness in the face of heightened schizotypy. Although loneliness and social isolation are often conflated or used interchangeably, it is of note that these constructs are distinct; being socially isolated does not necessarily equate to feeling lonely and vice versa. This is exemplified in our analysis, where loneliness, but not reduced social contact, significantly contributed to our two schizotypy dimensions. Indeed, the correlation between loneliness and reduced social isolation did not survive correction for multiple comparisons (Table B, supplementary section), though we do note that our measure of reduced social contact since the onset of the pandemic (relative to pre-pandemic levels) does not necessarily equate to social isolation per se. Regardless, there are steps people can still take to tackle loneliness, including regularly engaging with loved ones virtually or through other means. In light of this, raising public awareness about the importance of managing negative emotions and feelings of loneliness during these challenging times might be of benefit.

Relative to figures reported in the respective original validation research (Peters et al., 2004; Vellante et al., 2012), our mean scores for LSHS-E were similar, but our mean scores for PDI-21 were somewhat lower. This could be attributed to demographic differences of samples involved across these studies (e.g. Australia versus Italy and the UK, general population versus student cohorts, cohort effects over time, etc.). By contrast, the DASS scores currently sampled were similar to those reported in a previous study earlier in the pandemic, and these levels of negative emotions were substantially high compared to pre-pandemic normative data from Australia (Rossell et al., 2021). Psychological research in previous pandemics has suggested that some adverse impacts to mental health may only emerge after a prolonged time lag, and could persist for significant periods thereafter (Ayers and Yellowlees, 2008). Given the expected delays from pandemic onset to full manifestation of mental health repercussions, as well as the fact that the COVID-19 pandemic is continuing in Australia (and globally), the full extent of its impact on schizotypy expression will likely depend on a myriad of factors moving forward, such as personal, social or economic losses and other unfavourable events, such as further lockdowns. Moreover, the impact of the COVID pandemic on people's mental health

may be exacerbated in those experiencing socioeconomic disadvantage (O'Sullivan et al., 2020). Further research is thus required to elucidate these complex interrelationships.

The current study had several limitations. First, we did not measure schizotypy scores before the onset of the COVID-19 pandemic in the current sample. Moreover, although we categorised loneliness and negative affect as being proximal to the pandemic, the grouping of these variables encompasses their potential for change (relative to the distal factors) based on the timeframe used for their assessment (i.e. self-reporting the occurrence of experiences within the past week or the past four weeks). In the absence of pre-pandemic data, we cannot determine with certainty whether the reported levels of schizotypy, loneliness and negative affect represent changes that have occurred since the onset of the pandemic (i.e. COVID-related), or whether they have remained stable despite the pandemic (i.e. intransient despite COVID). Indeed, even comparisons with pre-pandemic normative data is limited for the reasons mentioned above. Second, the fluctuating time course and severity of differing pockets of COVID-19 outbreaks across the various Australian states meant that we were unable to accurately account for state-wise variations, even though it was apparent that Victoria (where the majority of our respondents resided) had borne the brunt of COVID-infected numbers, related fatalities and lockdowns. As an added point of consideration, our combined data across two time points may help to balance out some of the differences owing to disparities in location/timing of COVID impacts in Australia, although loneliness, negative affect and schizotypal experiences appeared relatively stable amongst people who completed the survey at both time points. Third, our variable involving reduced social contact attributed to COVID restrictions was employed as a proxy for social isolation, but the validity of this assumption may be questioned, depending on how social isolation has been defined within the context under investigation. Finally, we did not rate dimensional distress, preoccupation and conviction for the PDI-21 in the current study, owing to constraints around study design and administration time. Having this information would have been beneficial in facilitating a more nuanced understanding of delusion-like schizotypy experiences amidst the COVID-19 pandemic.

The current study design permitted a series of cross-sectional indicators of population mental health over the course of the COVID-19 outbreak, but was not longitudinal in nature. Future research would benefit from focusing on further longitudinal studies aimed at fully elucidating the complex interplay amongst schizotypy expression, negative affect and loneliness. Despite the devastation wreaked by the pandemic, ensuing lockdowns and other social restrictions enacted do offer an unfortunate, but unique, opportunity to study resultant effects on constructs such as schizotypy expression, impacted by these events. This is especially so in countries like Australia, where medical aspects of COVID-19 have been relatively well-managed. In fact, this begets the question of whether nations facing less severe COVID-19 outbreaks may observe smaller changes in population schizotypy levels, with continued longitudinal research imperative in capturing these longer-term effects. Related to this, future studies may also examine other predictors not assessed in the current study, for instance involving the consumption of alcohol, tobacco or other illicit substances and social media use, where preliminary results suggesting significant influences exist (e.g. Knolle et al., 2021). Constructive findings from this avenue of research may be applied to mitigate the potentially adverse impact of negative psychological and social variables spurring the transition of typical schizotypy expression to serious psychotic illness.

In summary, negative emotions and loneliness were associated with the expression of hallucination- and delusional-like experiences during the COVID-19 pandemic. Given the adverse influences on our general health, as well as specific impact in relation to increased schizotypy, public health campaigns to tackle these negative psychological outcomes, with dedicated interventions targeting loneliness, might be warranted moving forward.

Author contributions

Wei Lin Toh: Data curation, Investigation, Methodology, Writing - original draft, Writing - review & editing; **Philip Sumner:** Data curation, Investigation, Methodology, Software, Writing - original draft, Writing - review & editing; **Denny Meyer:** Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing - review & editing; **Erica Neil:** Data curation, Investigation, Methodology, Writing - review & editing; **Andrea Phillipou:** Data curation, Investigation, Methodology, Writing - review & editing; **Eric Tan:** Data curation, Investigation, Methodology, Writing - review & editing; **Tamsyn Van Rheenen:** Data curation, Investigation, Methodology, Writing - review & editing; **Susan Rossell:** Conceptualization, Data curation, Investigation, Methodology, Project administration, Resources, Supervision, Writing - review & editing.

Data sharing

The dataset is available on request by qualified researchers-scientists. Requests require a concept proposal describing the purpose of data access, appropriate ethical approval, and provision for data security. All data analysis scripts and results files are available for review.

Declaration of competing interest

The authors have no conflicts of interest to declare.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychires.2022.03.060.

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