Who thrives in a public health crisis?☆

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ABSTRACT

Public health emergencies such as the COVID-19 pandemic pose daunting challenges to both policymakers and citizens. Social distancing measures have been found to adversely impact mental health. In this study, we sought to identify those who thrived throughout the worst wave of the COVID-19 pandemic in Hong Kong. We used a 30-day diary dataset that captured the daily hopefulness ratings of 611 participants (15,575 observations) together with their Big Five personality scores. Hopefulness scores remained stable throughout the enforcement and lifting of social distancing. Individuals who were emotionally stable, extraverted, open to experience, and conscientious felt hopeful overall. In contrast, agreeable individuals, who tend to hold a positive view of human nature, did not feel hopeful during the 30-day period. Our findings suggest that people with agreeable and positive traits do not retain their hopefulness during an actual health crisis and might be at risk of poor mental health, suggesting the need for intervention.

1. Introduction

As the most severe worldwide public health emergency in the last 100 years (Gates, 2020), the COVID-19 pandemic ("the pandemic") has extensive implications for both individuals and societies worldwide (Asmundson & Taylor, 2020). The pandemic not only posed significant challenges to physical health but has also had far-reaching psychological and emotional repercussions (Torales et al., 2020). As the world progresses beyond the pandemic, it is crucial to identify the key variables that enable people to thrive during such a crisis. Feeling hopeful—the ability to find meaning in life and to maintain emotional resilience during adversity—is a critical measure of an individual's capacity to cope effectively (Folkman, 2011). Finding purpose amidst uncertainty reflects people's daily lives during the pandemic around the globe. In the present study, we assessed individuals' levels of hopefulness during the worst wave of the pandemic in Hong Kong and sought to map the personality characteristics of those who thrived through the 30-day study period.

The social distancing measures implemented during the pandemic have been reported as being toxic to people's mental health around the globe (Reitsema et al., 2023), including in Hong Kong (Hou et al., 2021; Wong et al., 2023; cf. Yik & Siu, 2024). Interestingly, a sentiment analysis of Hong Kong residents' Twitter posts revealed a decline in pleasure scores during the early months of the pandemic in 2020, although the scores recovered in subsequent months (Chen, 2022). Chen and Yik (2022) obtained comparable results in their analysis of Weibo posts during the Wuhan lockdown in China (see Gutierrez-Cobo et al., 2021; Su et al., 2021).

Although the pandemic appeared to affect people's well-being, the research findings are far from conclusive. The impacts of the pandemic, which have been loosely defined in past research, may be attributable to numerous factors, including mandatory testing, working/studying from home, and enforced social distancing measures. Studies on mental health factors during the pandemic provide only a static snapshot of

individuals' mental health at a particular point during the pandemic because they exclusively used cross-sectional designs (e.g., Franke & Elliott, 2021). The trajectories of mental health indicators during a health crisis remain to be explored (Myin-Germeys et al., 2018). In the present study, we tested the daily impact of social distancing on Hong Kong residents' hopefulness while the city was transitioning out of the strictest pandemic restrictions. Our study represents a natural experiment assessing the effects of social distancing measures on daily hopefulness levels (Leatherdale, 2019).[1]

Hopefulness has a profound impact on physical and psychological health (Laranjeira & Querido, 2022; Milona, 2020). Individuals who exhibit hopefulness are characterized by emotional resilience and the ability to find meaning in their experiences even when facing challenging situations. They tend to report low levels of distress in everyday life and to approach stressful situations with a proactive and problem-solving mindset, viewing setbacks as temporary and manageable (Alarcon et al., 2013). This collection of resilient attributes enables individuals to navigate difficulties effectively, maintain a high level of mental wellness, and foster positive social relationships (Non et al., 2020; Oshio et al., 2018). In the present study, we used hopefulness to define individuals' daily mental health and examined its variations throughout the study period.

We defined the personality characteristics of those who were feeling hopeful according to the Big Five model of personality (McCrae & John, 1992), which consists of five factors: neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. Neuroticism reflects an individual's emotional instability and tendency to experience negative emotions; extraversion indicates an individual's level of sociability and preference for social interactions; openness to experience denotes an individual's curiosity about their inner and outer worlds and willingness to embrace new ideas; agreeableness measures compassion and interpersonal tendencies; and conscientiousness describes a person's determination to achieve, dependability, and discipline (McCrae & Costa, 2008; Soto & John, 2017).

These Big Five factors have been extensively studied in relation to mental wellness during the pandemic, including psychological resilience and well-being (Heidemeier & Göritz, 2016; Kocjan et al., 2021; Steel et al., 2008). Yik and Siu (2024) found that both extraversion and agreeableness were positively correlated with happiness. Pauly et al. (2021) found that higher levels of agreeableness and conscientiousness were associated with better mental health, while neuroticism was correlated with higher levels of depression, anxiety, stress, and loneliness. These relationships were significantly moderated by resilience. For instance, higher resilience was associated with lower stress, depression, and anxiety among neurotic individuals, whereas higher resilience was associated with increased stress levels among conscientious individuals.

Referred to as the "Cinderella" trait of the Big Five, agreeableness has been shown to be positively related to mental health and social relations (Furnham, 2017). Agreeable people are empathetic and eager to help others, and they expect others to be equally helpful in return (McCrae & Costa, 2010). Research has indicated that higher levels of agreeableness are associated with lower levels of deterioration in mental health, particularly during stressful periods like the COVID-19 pandemic (Proto & Zhang, 2021). Agreeable individuals tend to experience better social support and relationship management (Tobin & Gadke, 2015), which may provide a buffer against mental health challenges. Overall, agreeable people tend to have a positive outlook on human nature, which contributes to their psychological well-being. We were interested in testing whether the positive outlook of agreeable individuals influenced

their ability to thrive during the pandemic.

The present study examined whether levels of hopefulness were affected by the enforcement and lifting of social distancing measures during the worst wave of the pandemic in Hong Kong. Given that our study period covered Hong Kong's transitioning out of the strictest social distancing measures, we hypothesized that levels of hopefulness would fluctuate between the enforcement and lifting of the pandemic measures (cf. Yik & Siu, 2024). Next, we sought to map the personality characteristics of those who thrived through the pandemic. Echoing past findings on mental health indicators and personality, we hypothesized that hopefulness would be related to all five personality factors except openness to experience (Kocjan et al., 2021; Pauly et al., 2021). We also tested the effect of the interaction between agreeableness and social distancing measures on hopefulness. We anticipated that agreeable individuals would display higher levels of hopefulness when social distancing measures were enforced (see Proto & Zhang, 2021; Yik & Siu, 2024).

2. Method

2.1. Data collection and participants

Recently, we published a paper investigating the relationship between personality and 30 days of happiness scores (Yik & Siu, 2024). The participants in that study also completed a measure of hopefulness, which is the focus of the current study. We recruited 764 participants from a university in Hong Kong through mass invitation emails, of whom 611 (54% female) were included in the final dataset. All of the participants resided in Hong Kong at the time of recruitment and completed the questionnaires in both the pre-diary and post-diary phases and at least one day of the diary phase. The retention rate of 86% was consistent with that of similar diary studies (Vachon et al., 2019). The average number of days completed was 25.5 (range = 5 to 30 days), demonstrating a high level of compliance, similar to that in other diary studies (Wilt & Revelle, 2019).

2.2. Procedure

Data were collected through surveys posted on surveyYIK, an app developed by the first author for use on Android and iOS devices. The study consisted of three phases. In the pre-diary phase, the participants were required to provide informed consent before responding to several questionnaires, including Diener et al.'s (1985) Satisfaction with Life Scale, and demographic questions within a week. On the day after they completed the pre-diary survey, the participants began a 30-day diary phase during which they received a daily pop-up notification on their smartphones at 8:00 pm that reminded them to answer the question "Compared with an average Hong Kong University of Science and Technology (HKUST) student, how hopeful were you today?" using a 5-point rating scale ranging from 1 (*very unhopeful*) to 5 (*very hopeful*). In the third (post-diary) phase, which began after the completion of the diary phase, the participants were asked to complete several questionnaires, including the NEO Five-Factor Inventory 3 (FFI-3; McCrae & Costa, 2010; Yik et al., 2023), within one week. The study protocol was approved by the Human and Artefacts Research Ethics Committee of the HKUST.

2.3. Measures

2.3.1. Social distancing

The severity of societal restrictions was measured using the stringency index (SI) of the Oxford Government Response Tracker (Hale et al., 2021), an assessment tool that aggregates the degree of strictness of global policies that restrict behaviors under social distancing or lockdown protocols. The SI ranges from 0 (*no restrictions*) to 100 (*complete lockdown*).

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[1] The study period, from 29 March to 4 May 2022, provided an ideal context in which to test the effects of enforced social distancing on hopefulness given that Hong Kong experienced the strictest enforcement from 29 March to 20 April 2022 and a subsequent easing of social distancing from 21 April to 4 May 2022.

2.3.2. NEO Five-Factor Inventory 3 (FFI-3)

We used 60 items from the self-report measure (Form S) of the FFI-3 to measure neuroticism (N), extraversion (E), openness to experience (O), agreeableness (A), and conscientiousness (C). The participants reported how much they agreed with each item on a 5-point rating scale that ranged from 0 (*strongly disagree*) to 4 (*strongly agree*). The Cronbach's alpha values were 0.79 (neuroticism), 0.74 (extraversion), 0.69 (openness to experience), 0.68 (agreeableness), and 0.81 (conscientiousness).

2.3.3. Satisfaction with Life Scale (SWLS)

The study participants indicated the extent of their agreement with each of the five statements (e.g., "In most ways, my life is close to my ideal") in the SWLS (Diener et al., 1985) on a 7-point scale that ranged from 1 (*strongly disagree*) to 7 (*strongly agree*). The five ratings were then averaged, with high values indicating high satisfaction with life. The Cronbach's alpha for the scale was 0.84.

2.3.4. Covariates

Age, sex, and SWLS scores were included in the analyses because of their documented associations with the study variables (Chen & Yik, 2022; Weber et al., 2015; Yik & Siu, 2024). Weekends and public holidays were also included as covariates.

2.4. Analytic strategy

Given the hierarchical structure of the dataset, in which repeated measures of hopefulness were nested within each participant, multilevel modeling was deemed suitable for the statistical analysis (Lafit et al., 2021). We grand-mean centered the personality factors for within- and between-person analyses. Social distancing, sex, public holidays, and weekends were dummy coded. A code of 0 was used for the period during which social distancing was lifted and 1 for the period during which social distancing was enforced. Social distancing measures were eased in Hong Kong on 22 April 2022; on that date, the SI of the Oxford Government Response Tracker decreased from 71 to 60. Men and women were coded as 0 and 1, respectively. Non-statutory holidays were coded as 0 and public holidays as 1 (Tomb Sweeping Day on 5 April 2022; Easter holidays from 15 to 18 April 2022), and weekdays and weekends were coded as 0 and 1, respectively. The Appendix includes the model specifications.

3. Results

Fig. 1 shows the daily mean scores for hopefulness and the number of new COVID-19 cases during the periods of enforcement and lifting of social distancing measures over the study period. Levels of hopefulness (all above 2.79 out of 5) remained stable across the 37 days and the two social distancing periods. Levels of hopefulness did not rise as the number of new cases declined and did not fluctuate between the two periods.

Table 1 shows the univariate and bivariate statistics for the study variables and covariates. The results revealed significant correlations between the mean hopefulness scores and the Big Five factors. The SWLS scores were significantly correlated with hopefulness and all five personality factors.

To assess the proportion of variance in the hopefulness ratings attributable to between-person and within-person levels, an empty multilevel model with a random intercept was applied to the dataset following the approach outlined by Snijders and Bosker (2011). The analysis revealed significant between-person variance (F [26, 769] = 20.9, $p < .001$), indicating meaningful variability in hopefulness ratings across individuals. The computed intraclass correlation coefficient was 0.39, with a 95% confidence interval of [0.28, 0.56]. This suggests that 39% of the total variance in hopefulness was attributable to between-person differences. These findings provided a solid basis for

conducting multilevel analysis at both Level 1 (within-person) and Level 2 (between-person), validating the necessity of accounting for the nested structure of the data. We fitted the main effects model to the data using the daily hopefulness scores as the dependent variable and the personality factors as the independent variables. The results are summarized in Table 2. Although social distancing did not have a significant effect on hopefulness ($b = 0.083$, $p = .098$), the significant random effect for days ($\chi^2(1) = 137.5$, $p < .001$) indicated that hopefulness levels varied across the 30 days. All of the personality factors except agreeableness were associated with hopefulness. The participants with high scores for extraversion, openness to experience, and conscientiousness reported higher levels of hopefulness over time, whereas those with high scores for neuroticism reported lower levels of hopefulness over time.

Next, we tested the interaction effects between social distancing and personality traits on hopefulness, and the results are shown in the last column of Table 2. Contrary to our hypothesis, the interaction between agreeableness and social distancing was not significant. Indeed, none of the five interaction terms were statistically significant. The main effects of the personality factors remained consistent with those of the previous model, as all of the factors except agreeableness were associated with hopefulness.[2]

4. Discussion

Hong Kong recorded its first case of COVID-19 on 22 January 2020, after which the city faced several waves of widespread infection. Hong Kong entered the fifth wave of the pandemic in late December 2021, when the city implemented the strictest social distancing measures (Li et al., 2023). Using a dataset that included 15,575 observations ($N = 611$) from a 30-day period during the fifth wave, we found that social distancing did not have a statistically significant effect on the participants' hopefulness scores.

In contrast to previous studies that have reported the adverse consequences of social distancing measures on mental health (Cerbara et al., 2020; Ford, 2021; Moeck et al., 2023), our findings revealed that hopefulness levels remained stable throughout the study period regardless of the enforcement or lifting of social distancing measures (see also Yik & Siu, 2024). While these results might appear to be counterintuitive, it is important to note that hopefulness is a complex psychological construct that can be influenced by interpersonal factors such as social distancing as much as by intrapersonal factors such as resilience, coping strategies, and individual differences (Berry et al., 2021; Corn et al., 2020; Greenaway et al., 2016).

In our multi-level models, we observed that individuals characterized by low N, high E, high O, and high C exhibited notably higher levels of hopefulness during the worst wave of the pandemic in Hong Kong. Individuals with low N demonstrate greater emotional stability, leading to fewer negative emotions and stressors and thereby fostering hopefulness in challenging situations (cf. Proto & Zhang, 2021). High E is associated with sociability, positive emotions, and reward-seeking, allowing extraverts to engage actively with their environment (Smillie et al., 2019). Such propensity provides these individuals with support and encouragement, enhancing their sense of hope (Tan et al., 2018). High O reflects a tendency to explore new ideas and experiences. This

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[2] We created a hopefulness score for each participant by taking an average of their hopefulness scores during the study period. We tested a stepwise regression model in which the average hopefulness scores were regressed on the Big Five factors. First, the same covariates as listed in Table 2 were entered into block 1 using a forced entry procedure. Second, the Big Five factors were entered using a stepwise procedure. Agreeableness was not significantly correlated with the hopefulness scores. Next, we repeated the preceding regression analysis using only the first hopefulness score for each participant as the dependent variable, and again, agreeableness and hopefulness were not significantly correlated.
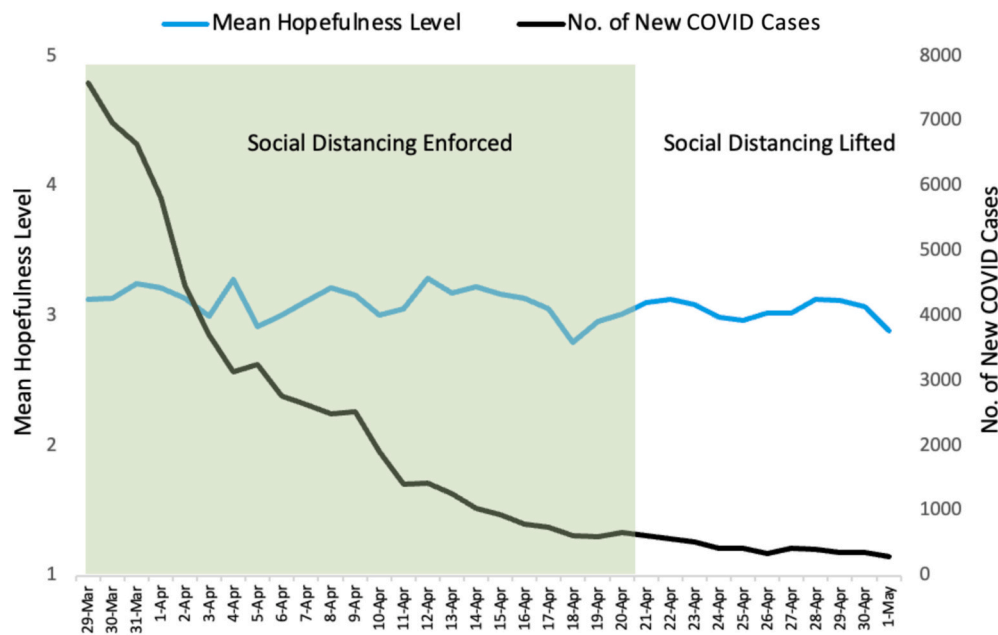
Fig. 1. Daily hopefulness levels during the COVID-19 pandemic (29 March – 4 May 2022; *N* = 611).
Note: Possible mean hopefulness scores ranged from 1 to 5; actual scores ranged from 2.80 to 3.29. The graph displays the mean hopefulness scores for a given date when at least 10 data points were available.

Table 1
Descriptive statistics of the study variables and covariates (N = 611).

Correlations									
Variable	*M*	*SD*	1	2	3	4	5	6	7	8
1. Hopefulness	3.09	0.53								
2. N	28.65	6.51	−0.203							
3. E	24.63	5.81	0.277	−0.232						
4. O	28.32	5.55	0.264	0.029	0.173					
5. A	28.19	5.51	0.108	0.022	0.065	0.284				
6. C	27.19	6.25	0.247	−0.300	0.312	0.101	0.146			
7. Age	20.31	1.80	0.094	−0.082	0.042	0.042	0.004	0.110		
8. Sex	–	–	0.081	0.057	0.038	0.101	0.111	0.109	−0.047	
9. SWLS	3.88	1.17	0.367	−0.356	0.259	0.127	0.112	0.288	−0.047	0.042

Note: Hopefulness = mean hopefulness score; N = neuroticism; E = extraversion; O = openness to experience; A = agreeableness; C = conscientiousness; SWLS = satisfaction with life scale. Possible score ranges were 1 to 5 for hopefulness, 0 to 48 for N, E, O, A, and C, and 1 to 7 for SWLS. All of the variables were analyzed using the Pearson *r* correlation coefficient except for gender, which was assessed using Spearman's rank correlation coefficient. Correlations greater than the absolute value of 0.065 were significant at *p* < .05 and are presented in bold.

trait encourages creativity and adaptability, enabling individuals to envision multiple possibilities for the future, thereby increasing their hopefulness (Das et al., 2019; see also Proto & Zhang, 2021). Last but not least, individuals with high C have a strong sense of duty, organization, and perseverance. Conscientious individuals are likely to set and pursue goals diligently, maintaining a focus on future achievements, which reinforces their hopeful outlook (Barrick & Mount, 2012; Roberts et al., 2018). Taken together, these traits map a personality profile that not only supports resilience in the face of adversity but also actively promotes a hopeful and forward-looking perspective, which is crucial in navigating public health crises and other everyday life challenges.

Of particular note is that during the worst wave of the pandemic in Hong Kong, the mental wellness indicators, happiness and hopefulness, were each associated with a unique personality profile. Extraverted and agreeable individuals reported higher levels of happiness during the 30-day study period (Yik & Siu, 2024). In the present study, we found that individuals who are emotionally stable, extraverted, open to experience, and conscientious reported high levels of hopefulness. Although both happiness and hopefulness appear to be useful indicators of mental health, they each captured a different aspect of mental wellness. Feeling happy ("How happy were you today?") focuses more on the here-and-now and is related to the two interpersonal traits of extraversion and agreeableness, both of which promote social interactions and cultivate a supportive environment, thereby enhancing positive emotional experiences (Tan et al., 2018). Focusing on finding meaning in life and anticipating positive outcomes in the future, feeling hopeful ("How

Table 2

Modeling the 30 Days of Hopefulness Scores on Social Distancing and the Big Five Personality Factors.

Effects		Hopefulness, *b* (*SE*)		
		Empty model	Main effects model	Interaction model
Fixed Effects				
Intercept	γ_0	3.093 (0.021)***	2.643 (0.043)***	2.643 (0.051)***
N	γ_1		−0.006 (0.001)***	−0.006 (0.002)**
E	γ_2		0.012 (0.001)***	0.015 (0.003)***
O	γ_3		0.018 (0.001)***	0.016 (0.003)***
A	γ_4		0.001 (0.001)	0.003 (0.003)
C	γ_5		0.007 (0.001)***	0.010 (0.003)***
Social Distancing	γ_6		0.083 (0.048)	0.083 (0.048)
Holiday	γ_7		−0.108 (0.055)	−0.108 (0.055)
Weekend	γ_8		−0.011 (0.045)	−0.011 (0.045)
SWLS	γ_9		0.112 (0.007)***	0.112 (0.007)***
Age	γ_{10}		0.024 (0.004)***	0.024 (0.004)***
Sex	γ_{11}		0.052 (0.014)***	0.052 (0.014)***
Social distancing x N	γ_{12}			0.000 (0.003)
Social distancing x E	γ_{13}			−0.005 (0.003)
Social distancing x O	γ_{14}			0.004 (0.003)
Social distancing x A	γ_{15}			−0.002 (0.003)
Social distancing x C	γ_{16}			−0.004 (0.003)
Random effects				
LRT, χ^2(df)		156.9 (1)***	137.5 (1)***	137.6 (1)***
Residual Variance	σ^2	0.787	0.726	0.726
Variance	τ^2	0.012	0.010	0.010
Goodness of fit				
AIC		39,270.00	38,143.00	38,194.00
BIC		39,138.08	38,113.67	38,203.36

Note: N = neuroticism; E = extraversion; O = openness to experience; A = agreeableness; C = conscientiousness; SWLS = satisfaction with life scale; AIC = Akaike information criterion; BIC = Bayesian information criterion. Standard errors are given in parentheses. All of the models were fit using a likelihood ratio test (LRT) estimation. In the main effects and interaction models, the slopes of the predictor variables were free to vary. The Big Five personality factors were mean centered.

** $p < .01$.

*** $p < .001$.

hopeful were you today?") is not related to the Cinderella factor of agreeableness (cf. Proto & Zhang, 2021). These results allude to the important differences in seemingly similar mental health indicators and offer a potential explanation of the diverse personality correlates of mental wellness reported in pandemic studies.

Contrary to our expectation, agreeableness had no influence on levels of hopefulness during the pandemic. Agreeable people, who hold a positive view of human nature, were neither more nor less hopeful than those who were less agreeable. This finding is in stark contrast to those of previous pandemic studies, in which agreeableness was related to mental wellness (see Getzmann et al., 2021; Pauly et al., 2021; Proto & Zhang, 2021; Yik & Siu, 2024). Thus, while agreeableness typically fosters a positive outlook, the pandemic-specific stressors might have exacerbated the vulnerabilities of agreeable individuals, highlighting the complex interplay among personality factors, resilience, and mental health outcomes during challenging times. These results also align with findings from previous cross-sectional studies, indicating that while agreeable individuals are often altruistic and accommodating, agreeableness does not directly correlate with their level of hope (Mishra & Datta, 2019). Rather, its effects are more indirect, primarily functioning through its influence on motivation rather than exerting a strong direct impact on hopefulness itself (Moltafet, 2020).

In most, if not all, studies that have tested the relationship between hopefulness and personality, researchers have relied on cross-sectional designs in which participants reported how hopeful they were feeling "in general" in everyday life (e.g., Carbone et al., 2024; Jibeen, 2014).

One finding was that agreeable people tended to feel hopeful and to hold a positive view of the future overall (Sharpe et al., 2011). In contrast, our study used an experience-sampling design, tapping into 30 days of hopefulness scores in the context of the ongoing COVID-19 pandemic. This unique natural experiment approach allowed us to capture the participants' daily hopefulness levels in a real-time setting. When "feeling hopeful" was assessed in a real-life context, it was not related to being agreeable or positive.

Taken together, our findings highlight the importance of considering contextual factors and methodological approaches when examining the relationship between personality dispositions and hopefulness, as this relationship may vary depending on the specific circumstances and study design. Furthermore, agreeable individuals may have experienced unique and unparalleled challenges that limit their capability to remain hopeful during the pandemic, potentially rendering them an at-risk group during a public health emergency.

5. Conclusion

Social distancing measures were widely adopted as a crucial strategy to mitigate the spread of virus infections during the worst pandemic of the century. While struggling to balance the need to quarantine the virus with the maintenance of people's mental health, policymakers depend on research that maps the impact of social distancing measures and identifies at-risk individuals for possible intervention. The current study tested the ongoing daily impact of social distancing on hopefulness

while Hong Kong was transitioning out of the worst wave of the pandemic. Using a 30-day diary design, we observed that individuals' levels of hopefulness remained relatively stable throughout the enforcement and subsequent easing of social distancing measures. It is justifiable to conclude that our study participants were largely resilient during the pandemic. Furthermore, we successfully mapped the prototype of a survivor during the pandemic as emotionally stable, extraverted, open-minded, and conscientious. Interestingly, typically agreeable individuals, who are known for their positive outlook, did not demonstrate significantly higher levels of hopefulness during the 30-day period. These findings suggest that individuals who are generally positive may be at risk during a real health crisis, a finding that calls for intervention for this seemingly healthy group in everyday life.

The study is not without limitations. Our study sample was restricted to university students. This demographic may not fully capture the diverse experiences and emotional responses of the broader population during public health crises, although previous studies using community samples have similarly failed to find a significant relationship between agreeableness and hopefulness (Carbone et al., 2024). The sole focus on daily hopefulness was another limitation. Ultimately, the pandemic was an unprecedented crisis that might have elicited a collection of emotions. To fully capture the range of mental health outcomes during a pandemic, future studies should include other measures of mental well-being, such as depression and anxiety, allowing researchers to map a comprehensive descriptive trajectory of thriving in a public health crisis.

CRediT authorship contribution statement

Michelle Yik: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Nicolson Yat-Fan Siu:** Writing – review & editing, Methodology, Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix. Model specifications

A multilevel model separates the residual variance of a sample into level 1 (within-person) and level 2 (between-person) variances. Multilevel modeling allows for data dependency and implies that the measures of one participant are more similar to one another than to the measures of another participant. In addition, not all of the participants provided 30 days of hopefulness ratings, and multilevel modeling tolerates such missing observations. All of the models were adjusted for age, sex, the Satisfaction with Life Scale, weekends, and public holidays. We conducted all of the analyses in R version 4.3.1 (R Core Team, 2022) and RStudio version 2023.06.0.421 (RStudio Team, 2023) and used the lme4 package for multilevel modeling analyses (Bates et al., 2015).

To test whether the effect of social distancing on hopefulness varied across the 30 days, we estimated time as a random effect at level 1 (within-person). We tested the main effect model using the daily hopefulness scores of all of the participants as the dependent variable and social distancing as the independent variable. Other covariates were controlled at level 2 (between-person). The equations for the main effects model were as follows:

$Level\ 1\ (within - person):$

$$Hopefulness_{ij} = \beta_0 + \beta_{1j} * Time_{ij} + e_{ij}$$

$Level\ 2\ (between - person):$

$$\beta_0 = \gamma_0 + \gamma_1 * Neuroticism_j + \gamma_2 * Extraversion_j + \gamma_3 * Openness\ to\ Experience_j$$

$$+ \gamma_4 * Agreeableness_j + \gamma_5 * Conscientiousness_j + \gamma_6 * Social\ distancing_j$$

$$+ \gamma_7 * Holiday_i + \gamma_8 * Weekend_i + \gamma_9 * Satisfaction\ with\ life\ scale_i$$

$$+ \gamma_{10} * Age_i + \gamma_{11} * Sex_i$$

Note: β_0 is the intercept of the model, β_{ij} is the regression coefficient for the jth group, *Time*$_{ij}$ is the value of the independent variable "time" for the ith observation in the jth group, and e$_{ij}$ is the error term, which represents the unobserved factors that contribute to the variation in the dependent variable "hopefulness" that are not captured by the independent variable "time" or the model's coefficients.

To further examine whether the relationship between social distancing and hopefulness varied over time as a function of the Big Five personality factors, we tested a model with five interaction terms between personality traits and social distancing (one for each Big Five personality factor) and covariates. The equations for the interaction effects model were as follows:

Level **1** (*within* − *person*):

$$Hopefulness_{ij} = \beta_0 + \beta_{1j} * Time_{ij} + e_{ij}$$

Level **2** (*between* − *person*):

$$\beta_0 = \gamma_0 + \gamma_1 * Neuroticism_j + \gamma_2 * Extraversion_j + \gamma_3 * Openness\ to\ Experience_j$$

$$+ \gamma_4 * Agreeableness_j + \gamma_5 * Conscientiousness_j$$

$$+ \gamma_6 * Social\ distancing_i + \gamma_7 * Holiday_i + \gamma_8 * Weekend_i$$

$$+ \gamma_9 * Satisfaction\ with\ life\ scale_i + \gamma_{10} * Age_i + \gamma_{11} * Sex_i$$

$$+ \gamma_{12} * Neuroticism_j * Social\ distancing_i$$

$$+ \gamma_{13} * Extraversion_j * Social\ distancing_i$$

$$+ \gamma_{14} * Openness\ to\ Experience_j * Social\ distancing_i$$

$$+ \gamma_{15} * Agreeableness_j * Social\ distancing_i$$

$$+ \gamma_{16} * Conscientiousness_j * Social\ distancing_i$$

Note: β_0 is the intercept of the model, β_{ij} is the regression coefficient for the *j*th group, *Time*$_{ij}$ is the value of the independent variable "time" for the *i*th observation in the *j*th group, and e$_{ij}$ is the error term, which represents the unobserved factors that contribute to the variation in the dependent variable "hopefulness" that are not captured by the independent variable "time" or the model's coefficients.

Data availability

The data that support the findings of this study are available on request from the corresponding author with the permission of the HKUST.

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