Mental Health of Hong Kong University Students Under COVID-19: Protective Ecological Factors and Underlying Mechanism

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Abstract

While the COVID-19 has brought severe challenges to university students' mental health, there is inadequate research on the related protective factors from different ecological systems and the underlying mechanisms. Guided by the ecological systems theory and the positive youth development approach, this study investigated the associations between two protective factors in the ecological systems (i.e., positive family functioning in the microsystem and Chinese cultural beliefs of adversity in the macrosystem) and students' mental health in Hong Kong higher education during the period of the pandemic, with resilience (i.e., an important positive youth development quality) proposed as a mediating factor. This study was based on data collected in a large-scale survey of 978 Hong Kong Chinese undergraduate students (mean age=20.69 with 62.9% being female) in the summer of 2022. Validated measures were used to assess students' mental health problems (anxiety and depression), the ecological protective factors (positive family functioning and Chinese cultural beliefs of adversity), and resilience. Structural equation modelling was conducted to examine the associations between ecological protective factors and mental health problems, as well as the mediating effects of resilience in the associations. Structural equation modelling revealed that both positive family functioning and Chinese cultural beliefs of adversity negatively predicted anxiety and depression, with resilience partially mediating all paths. The study contributes significantly to the understanding of different ecological protective factors in higher education students' mental health and the mediating role of resilience. It also provides practical implications for intervention and prevention.

Keywords Mental health · University students · COVID-19 · Family functioning · Cultural beliefs of adversity · Resilience

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Introduction

University Students' Mental Health Problems During the COVID-19 Pandemic

As a global public health threat, the pandemic of COVID-19 has brought significant challenges to the mental well-being of people worldwide, particularly university students (Pierce et al., 2020). Compared with other subgroups in the general population, students in higher education sectors might be more at risk during the pandemic due to multiple stresses and pressures faced including campus closure, social isolation, abrupt transition from face-to-face to online classes, increased financial difficulty, uncertainty about future and so on (Alghamdi, 2021; Farris et al., 2021; Savage et al., 2020). Under these pressures and challenges, higher level of psychological problems was reported in students in higher education in some countries, including the UK (Savage et al., 2020), Egypt (Ghazawy et al., 2021), and mainland China (Wang & Zhao, 2020). With particular emphasis on Hong Kong, the pandemic may have a particularly significant impact on students in Hong Kong universities due to the vulnerability of the society after experiencing the social unrest in 2019 (Jung et al., 2021). Several studies identified high rates of mental problems, particularly depression and anxiety, among students in Hong Kong higher education amid the pandemic. For instance, a study on 1,648 university students showed that around half of the students demonstrated certain levels of anxiety and depression (from mild to highly severe levels) (Shek et al., 2022a). Another research ($N=1,121$) revealed that 39.4% and 32.6% of university students reported anxiety and depressive symptoms, respectively, under COVID-19 (Lai et al., 2022). Similarly, a study on 255 university students in Hong Kong revealed that 56.9% of the students reported depressive symptoms during the pandemic (Sun et al., 2020). As anxiety and depression are two most common mental health problems (Reivich et al., 2013) that are associated with a broad scope of negative developmental outcomes such as suicidal ideation, risk behavior and academic performance (Awadalla et al., 2020; Lehrer et al., 2006; Teismann et al., 2018), it is crucial to identify factors that could protect university students from the negative impacts of these two mental health issues during the pandemic.

Ecological Systems Theory and Positive Youth Development Approach on Protective Factors of Mental Health

According to the ecological systems approach, an individual's development is shaped by the mutual interaction between the individual and his/her environments which include different layers of systems comprising "microsystem", "mesosystem", "exosystem", "macrosystem", and "chronosystem" (Bronfenbrenner, 2005). While the five systems all play an important role in shaping an individual's development, we particularly focused on two systems: the microsystem (the system closest to an individual) and the macrosystem (the cultural and social context in which an individual lives). There are several justifications for this focus. First, we pay particular attention to the microsystem because this system is the closest one to an individual, which includes elements that have a direct and strongest influence on the individual, such as family and friends (Berk, 2000). In addition, although the macrosystem plays an

important role in shaping an individual's development (McLaren & Hawe, 2005), there is a scarcity of research conducted to understand the effects of factors in this system on mental health issues like anxiety and depression. Furthermore, among the limited studies on macrosystem factors and mental health problems, most of them focused on socioeconomic status, and there are quite limited studies on the role of cultural factors such as cultural beliefs. Moreover, the potential underlying mechanisms linking ecological factors and mental health problems remain unclear and less examined. The positive youth development (PYD) approach and Positive Psychology stress that youth and adolescents' positive development qualities could be a strong psychological buffer for the development of mental health problems (Shek et al., 2019). Catalano and his colleagues (2004) proposed a total of fifteen PYD qualities among which resilience is an important PYD construct. Theories and empirical research particularly highlight the protective role of resilience in mental health of university students and suggest that resilience might be an underlying mechanism through which positive ecological factors reduce mental health problems (Miranda & Cruz, 2020; Nam et al., 2016). Therefore, we also attempted to examine the role of resilience as a mediator in the relationships between the two positive ecological factors and depression and anxiety in our study. The overall conceptual framework of this study is shown in Fig. 1. The following part is a detailed review of existing literature which forms the conceptual framework and derivation of hypotheses of our study.

Family Functioning and Mental Health

Within the microsystem, family functioning is an essential factor influencing university students' mental health and well-being. Defined as the capability of a family to function effectively to satisfy the needs of its members, family functioning involves different interactions and relationships in a family such as cohesion, conflict, communication, flexibility, and adaptability (Caprì et al., 2021; Tam et al., 2021). Theo-
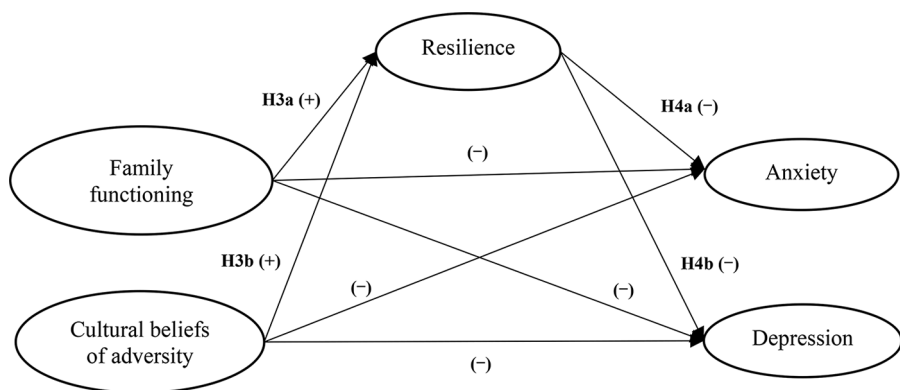

Fig. 1 Conceptual model of the study hypotheses 1a and 1b refer to the total effects of family functioning on anxiety and depression, respectively. Hypotheses 2a and 2b refer to the total effects of cultural beliefs of adversity on anxiety and depression, respectively. Therefore, these hypotheses are not marked in the figure

retically, family is the first and primary system or social context an individual lives in, which exerts an essential influence on individual development, particularly in childhood and adolescence (Peterson, 2005; Yang et al., 2022). The familial influence might be more powerful in Chinese society as family is regarded as the fundamental unit of Chinese society and the value of family has been highly upheld in Chinese culture (Lee & Mock, 2005; Shek, 2006). Particularly, in Chinese culture, the values of family cohesion and filial piety are highly emphasized and valued, and an individual may even sacrifice one's personal interests to uphold these core values (Lee & Mock, 2005). Therefore, positive family functioning would protect an individual from the development of mental health problems. The role of positive family functioning might be more important during the pandemic period as university students have to stay at home for their academic studies due to the campus being closed, and their interaction with their family members has largely increased.

In line with the theoretical argumentation, a body of empirical studies also showed that higher family cohesion, flexibility, and adaptability and lower family conflict were linked with reduced mental health issues such as depressive symptoms and psychological distress (Nam et al., 2016; Pereira-Morales & Camargo, 2019) as well as adolescent problem behaviour (Shek et al., 2022a, b). In addition, studies found that positive family functioning predicted decreased psychological distress, anxiety, and depressive symptoms amongst students in tertiary education during the period of pandemic (Kim et al., 2021; Li et al., 2021; Yang et al., 2021). Grounded on the above theoretical and empirical literature review, the following two hypotheses were proposed.

Hypothesis 1a: Positive family functioning would be negatively associated with students' anxiety during the pandemic.

Hypothesis 1b: Positive family functioning would be negatively associated with students' depression during the pandemic.

Chinese Cultural Beliefs About Adversity and Mental Health

While the importance of the macrosystem has been proposed and discussed in different literature (Bronfenbrenner, 2005; Rogers & Way, 2021), limited empirical research has been done to examine the role of factors in this system in the mental health of adolescents and university students. Particularly, scholars argued that the research on child and adolescent development focused more on the factors at the microsystem level but overlooked the factors at the macrosystem level (Rogers & Way, 2021). In addition, while culture is an important factor at the macrosystem level, existing research on the impact of cultural values on adolescent mental health and well-being is very limited. Culture, referring to "a system of beliefs, values, languages, and behaviors, and human-made aspects of the physical environment that varies from one group to another", plays a significant role in an individual's development (Chen & Farruggia, 2002, p. 5). Particularly, cultural beliefs constitute the core of a culture, which refer to beliefs and values shared by a group of people that form

the common outlooks of their interpretation of the world and the norms for behavior and social practices (Ngueutsa et al., 2023). All individuals live in a society that is bounded by certain common values, outlooks, and tradition. Through influencing an individual's processing and interpretation of personal experience and environmental stimuli, decision-making, and action, cultural beliefs influence the individual's mental health.

The cultural beliefs of adversity is defined as "those concepts about the nature of adversity such as its causes, consequences and the proper coping behaviour" existing in a cultural group or a society (Shek, 2004, p. 64). In Chinese culture, there are a set of positive beliefs regarding adversity such as "*you zhi zhe shi jing cheng* (when there is a will, there is a way)" and "*zhi yao you heng xin, tie zhu mo cheng zhen* (if you work hard enough, you can turn an iron rod into a needle)". Individuals with positive beliefs of adversity would perceive adversity and interpret their own negative experiences in a more positive and constructive manner and adopt positive and adaptive coping strategies. Therefore, they may have a lower level of mental health problems. For example, a study on Chinese left-behind adolescents showed positive Chinese cultural beliefs of adversity negatively predicted adolescent depression (Wang & Liu, 2022). Another study on 1,519 Hong Kong adolescents showed that positive beliefs of adversity was positively associated with different indicators of well-being, including self-esteem, mental health, and life satisfaction, and negatively correlated with problem behavior (Shek, 2004). In addition, a three-wave longitudinal research on primary school students in Hong Kong revealed that higher positive beliefs of adversity predicted higher healthy habits and lower problem behavior in the students (Lee et al., 2010). Despite of the existing research, few studies investigated the association between positive beliefs of adversity and university students' anxiety and depression amidst the pandemic. As COVID-19 is a significant adversity experienced by university students, examining the role of cultural beliefs about adversity in the mental wellness of students in university level amidst the pandemic is important. Drawing upon the literature, the following two hypotheses were formulated.

Hypothesis 2a: Cultural beliefs of adversity would be negatively associated with students' anxiety during the pandemic.

Hypothesis 2b: Cultural beliefs of adversity would be negatively associated with students' depression during the pandemic.

The Mediating Effect of Resilience

Besides limited research on the associations between the two ecological protective factors (positive family functioning and cultural beliefs of adversity) and university students' mental wellness in the context of the pandemic, the potential underlying mechanisms in the relationship between these two domains also remain unclear. Positive Psychology and the PYD approach highlight the protective function of positive psychological attributes in adolescent development (Catalano et al., 2004; Seligman & Csikszentmihalyi, 2000; Shek et al., 2019). Particularly, both theoretical models

and empirical evidence suggest that resilience, one important positive psychological attribute, may play an underlying mechanism linking positive ecological factors and mental health problems in adolescents and university students. First, the literature suggests a positive association between positive ecological factors and resilience. Resilience is defined as an individual's ability or capacity to successfully adapt when facing challenges, stress, adversity, and negative life events (Dowrick et al., 2008; Liu et al., 2018). Lerner's theoretical proposition on positive youth development highlights that ecological factors influence an individual's development of PYD qualities such as resilience (Lerner, 2005). Particularly, the recent development in the conceptualization of resilience involves a more ecological perspective, which highlights the important role of resources from different ecological systems (such as family and culture) in shaping an individual's capacity for resilience (Ziaian et al., 2012).

Specifically, in a family with positive functioning, an individual would gain more support from his/her family members which contributes to his/her capacity for adaptation and coping with adversity. Different empirical studies showed that resilience exhibited a positive correlation with the functioning of the family in adolescents and university students (Dou et al., 2023; Nam et al., 2016). In addition, holding positive cultural beliefs regarding adversity, an individual would interpret adversity from a more positive and optimistic approach and even derive positive meaning from adversity, which influences the individual's coping strategies and patterns (Lee et al., 2010). Therefore, an individual's resilience quality would be strengthened. Empirically, positive cultural values were found to constitute resilience in Afghanistan children in a qualitative study (Eggerman & Panter-Brick, 2010). A positive relationship was also identified between positive values in Mexican-American culture and resilience in Mexican-American university students (Morgan Consoli & Llamas, 2013). Based on both the conceptual discussion and empirical studies, two hypotheses were formulated as below.

Hypothesis 3a: Positive family functioning would be positively associated with students' resilience during the pandemic.

Hypothesis 3b: Cultural beliefs of adversity would be positively associated with students' resilience during the pandemic.

Regarding the relationship between resilience and depression and anxiety, resilience enables an individual "to avoid stress-induced mental disorders such as depression, posttraumatic stress disorder, and anxiety" (Liu et al., 2018, p.1). Therefore, one essential function of resilience is to help an individual withstand the negative influence of adversities to maintain their inner equilibrium and stable mental health (Herrman et al., 2011). In line with this conceptualization, empirical research indicates negative associations between resilience and depression and anxiety in university students. For example, a longitudinal study based on 2,948 university students in mainland China showed that resilience was inversely associated with depression and anxiety among the students amidst the COVID-19 pandemic (Li et al., 2023). Another longitudinal study based on Italian university students also found that resilience negatively predicted students' anxiety and depressive symptoms under COVID-19

(Renati et al., 2023). There are also studies suggesting the protective role of resilience against the development of the two mental issues in students at the university level before the pandemic (Mak et al., 2018; Zhang et al., 2018). Therefore, referring to the literature, the following two hypotheses were formulated.

Hypothesis 4a: Resilience would be negatively associated with students' anxiety during the pandemic.

Hypothesis 4b: Resilience would be negatively associated with students' depression during the pandemic.

As resilience is an important psychological factor protecting an individual from developing anxiety and depression and positive ecological factors (i.e., positive family functioning and cultural beliefs of adversity) are important ecological resources shaping or contributing to resilience, it is reasonable to assume that resilience may play as an underlying mechanism in the relationships between positive ecological factors and anxiety and depression. In other words, positive ecological factors such as positive family functioning and cultural beliefs of adversity may not only directly protect an individual from the development of anxiety and depression in adverse situations but also indirectly protect an individual from the development of these mental health problems through strengthening the quality of resilience in the individual. Some existing empirical studies provide support for the mediating role of resilience in linking positive functioning of family with mental health problems. For example, resilience was found to fully mediate the negative predicting effect of some dimensions of family functioning (family communication and adaptability) on mental health problems in patients in Japan (Kukihara et al., 2020). Resilience also mediated the negative predicting effect of family cohesion on depression in Korean refugees (Nam et al., 2016) and adolescents from single parent families (Yee & Sulaiman, 2017). In addition, a few studies showed that resilience mediated the association between optimism (sharing some similar elements with cultural beliefs of adversity as optimism referring to positive perceptions about the future) and subjective and psychological well-being (Miranda & Cruz, 2020; Zayas et al., 2021). Based on the literature, four specific hypotheses were formulated as below.

Hypothesis 5a: Resilience would mediate the relationship between positive family functioning and students' anxiety during the pandemic.

Hypothesis 5b: Resilience would mediate the relationship between positive family functioning and students' depression during the pandemic.

Hypothesis 5c: Resilience would mediate the relationship between cultural beliefs of adversity and students' anxiety during the pandemic.

Hypothesis 5d: Resilience would mediate the relationship between cultural beliefs of adversity and students' depression during the pandemic.

Method

Participants and Procedure

The study employed the data collected in one large-scale survey conducted at one public university in Hong Kong in the summer of 2022 which aimed at investigating students' psychological health in Hong Kong universities amid the period of the pandemic. Ethical approval has been obtained from the Institutional Review Board (or its Delegate) at the authors' institution. From July to August 2022, undergraduate students at the university were recruited based on quota sampling to respond to an online survey questionnaire. The period of data collection was during Hong Kong's fifth wave of the pandemic. In total, 978 students completed the questionnaire which consisted of demographic variables and a set of scales assessing students' mental health problems, well-being, and different psychosocial protective and risk factors in the ecological systems. Before doing the questionnaire, all participants were briefed on the survey's objectives and the data confidentiality principle. They have also given their formal consent for survey participation. The participants had a mean age of 20.69 years, with a standard deviation (SD) of 1.61. Around two-thirds (62.9%) of the participants were female students, and most of them were local students (93.8%). Among the participants, 43% were in the second year of their study and 33% and 24% were in their third year and fourth year of study, respectively. In addition, a small portion of the participants (4.6%) reported lower socioeconomic status (i.e., receiving the "Comprehensive Social Security Assistance of the Hong Kong Government").

Measures

Anxiety and Depression

The "Anxiety" and "Depression" subscales of the "Depression Anxiety and Stress Scale (DASS-21)" were employed for assessing the two psychological symptoms, respectively. As a shortened version of DASS (42 items), the DASS-21 assesses three types of psychological morbidity, including anxiety, stress, and depression, with each construct comprising seven items (Lovibond & Lovibond, 1995). The measure has been broadly utilized in studies with various populations, including university students, and in different cultural contexts, including Asian cultures, which demonstrated good psychometrical properties (Chan et al., 2012; Wang et al., 2016). With each item, the students need to indicate the extent to which they had the symptom utilizing a four-point rating gauge from "0" = "*not at all*" to "3" = "*most of the time*"). In this study, the Cronbach's alpha = 0.88 and 0.83 for both subscales.

Cultural Beliefs of Adversity

The cultural beliefs of adversity were assessed through the "Cultural Beliefs of Adversity Scale (CBA)" developed by Shek and his colleagues (2003). The original version of CBA contains nine items in total, with seven items corresponding to seven ancient Chinese proverbs on positive beliefs regarding adversity and two

items corresponding to two traditional Chinese sayings related to negative beliefs (reversely coded items), respectively. Previous studies that utilized the scale reported favorable psychometric properties (Shek et al., 2003; Shek, 2005). In this study, the two reverse-code items were taken out from the measure as the reverse-code items were criticized and shown as causing confusion and being ineffective in preventing response bias (Sonderen et al., 2013). The Cronbach's alpha of the measure in the present study was 0.86.

Positive Family Functioning

The positive family functioning was gauged using two subscales in the "Chinese Family Assessment Instrument (C-FAI)" (Shek, 2002). C-FAI is a measure containing five subscales in which two subscales are related to positive family functioning including "family communication" and "family mutuality", one subscale is related to negative family functioning that is "family conflict", and two subscales are related to parenting factors including "parental concern" and "parental control". The two subscales related to positive family functioning were employed in the present study to gauge the students' positive family functioning. The C-FAI showed favorable psychometric properties in prior research (Shek, 2002; Shek & Ma, 2010b; Shek et al., 2023c). In the present study, the two subscales possessed good reliability (Cronbach's alpha=0.78 and 0.88, respectively).

Resilience

Resilience was assessed using the Resilience subscale of the "Chinese Positive Youth Development Scale (CPYDS)" (Shek et al., 2007). Developed according to the 15 PYD qualities put forth by Catalano and his colleagues (2004), CPYDS assesses the positive growth and development of young people and adolescents in Chinese communities. As other subscales are not conceptually related to the conceptual model of the study, we focused on the Resilience subscale in this scale. The scale demonstrated good psychometric properties in previous studies (Shek et al., 2007; Shek & Ma, 2010a). The Resilience subscale contains three items, and the students were required to express the degree of their agreement with each statement through a measure of five points ("1" = "*strongly disagree*"; "5" = "*strongly agree*"). The Cronbach's alpha for the subscale is 0.82 in this study, indicating good reliability.

Data Analyses

Descriptive statistics, including mean score, SD, and reliability statistics for the key variables, were examined. In addition, correlations among major variables were computed. For testing the five hypotheses, a structural equation model (SEM) was conducted in which the latent variables of positive family functioning and cultural beliefs of adversity were two independent variables, the latent variables of anxiety and depression were two dependent variables, and the latent variable of resilience was the mediating variable. The latent variable of cultural beliefs of adversity was indicated by the seven items of the CBA; resilience was indicated by the three items

of the Resilience subscale of CPYDS; anxiety and depression were respectively indicated by the Anxiety and Depression subscales of DASS-21; and positive family functioning was a higher order factor indicated by its two primary factors (i.e., family communication and family mutuality) which were further indicated by their respective items.

Three steps were involved in the SEM analyses. In the first step, we examined the construct validity and discriminant validity of the five latent constructs included in the SEM model. For construct validity, we mainly assessed the "Composite Reliability" (CR) and "Average Variance Extracted" (AVE) for each latent construct. Referring to the Fornell-Larcker criterion (Fornell & Larcker, 1981), the recommended threshold for CR is 0.7 or higher and for AVE is 0.5 or above for the latent variables in SEM. For discriminant validity, we used two methods to examine it. For the first method, in accordance with the Fornell–Larcker criterion (Fornell & Larcker, 1981), if the positive square root of the AVE for a specific latent construct exceeds the highest correlation of that construct with any other latent construct in the SEM model, the discriminant validity of that latent construct can be established. For the second method, based on Byrne (2013) and Rönkkö and Cho (2022), a model comparison was made between a measurement model including the latent variables to be examined (a free model) and a nested model in which the covariance between the latent variables was fixed at 0.95. The significant chi-square difference would indicate the discriminant validity of the latent constructs (Byrne, 2013; Rönkkö & Cho, 2022).

In the second step, a measurement model comprising all latent variables was assessed to determine its adequacy. On the establishment of the measurement model, in the third step, we examined two SEM models. The first model examined the direct effects of the two independent variables (positive family functioning and cultural beliefs of adversity) on the two dependent variables (anxiety and depression). The second model examined the mediating effects of resilience on the associations between independent variables and dependent variables. The construct validity, discriminant validity, measurement model, and SEM models were all examined using Mplus. Different indices were utilized to assess the model fit in both the measurement and SEM models, comprising "comparative fix index" (CFI), "Tucker-Lewis index" (TLI), "root mean squared error of approximate" (RMSEA), and "standardized root mean squared residual" (SRMR). A value equal to or higher than 0.90 for both CFI and TLI and a value equal to or lower than 0.80 for RMSEA and SRMR will be regarded as a desirable model fit (Byrne, 2013). The path coefficients among different latent variables in the SEM model were tested through the "delta method" (also called "Sobel test" sometimes) which is the default test of mediation effects in Mplus (Geiser, 2023; Landers-Potts et al., 2015; Williams et al., 2022) and the bias-corrected bootstrap estimation.

Results

Descriptive Statistics

Table 1 displays the descriptive profiles of the variables. The correlations among the variables are shown in Table 2. Anxiety and depression exhibited a positive correlation with each other, and they had negative correlations with the healthy functioning of the family, adversity-related cultural beliefs, and resilience. In addition, the healthy functioning of the family and cultural beliefs about adversity had a positive correlation with resilience.

Construct Validity, Measurement Model and Structural Equation Model

The skewness of the items in all latent variables ranged between -0.682 and 1.021 and the Kurtosis of all items ranged between -0.635 and 0.541, which were acceptable for further analyses (Muthén & Kaplan, 1985). Regarding the construct validity of the five latent variables, the CR of all latent constructs ranged between 0.827 and 0.976, which is higher than 0.7 following the Fornell-Larcker criterion (Fornell & Larcker, 1981). The AVE of three latent constructs, depression, resilience, and family functioning, were 0.522, 0.615, and 0.953, which are higher than 0.50 based on the Fornell-Larcker criterion. The AVE of two latent constructs, anxiety, and beliefs of adversity, were 0.424 and 0.484, which were slightly below 0.50. However, as advised by Fornell and Larcker (1981), the AVE lower than 0.5 could also be considered if the CR value is high. The detailed information of CR and AVE of each latent construct is presented in Table 1.

Regarding discriminant validity, our analyses showed that except for the latent variables of anxiety and depression, all other latent variables have achieved discriminant validity as per the Fornell–Larcker criterion (Fornell & Larcker, 1981) (i.e., for each latent variable, the positive square root of AVE should surpass the highest correlation that variable has with any other latent variable). The positive square root values of the AVE for anxiety and depression were lower than the correlation between the latent variables of anxiety and depression (0.891) in the SEM model. However, previous validation studies on DASS-21 suggest a generally high inter-factor correlation between the anxiety factor and depression factor in the Chinese context (Wang et al., 2016). This might be due to the reason that Chinese people might have a lower ability to discriminate between different negative emotions as they are less inclined to express negative emotions compared to Western people (Wang et al., 2016). We also used another method based on Byrne (2013) and Rönkkö and Cho (2022) to compare a measurement model including latent variables of anxiety and depression (a free model) and a nested model in which the covariance between anxiety and depression was set to be 0.95. The chi-square difference was significant at $p < 0.001$, which supports the discriminant validity of the two latent constructs. Based on the above analyses and considering the different meanings of anxiety and depression, we believe it is justified to treat anxiety and depression as two different constructs in our SEM analyses.

Table 1 Mean, standard deviation, reliability statistics, composite reliability, average variance extracted, and item information for each variable in the measurement model

Variable	Mean	SD	Cronbach's alpha	Mean inter-item correlation	No of Items	Sample Item	Composite Reliability (CR)	Average Variance Extracted (AVE)
Anxiety	0.75	0.54	0.83	0.42	7 items	• "I was aware of dryness of my mouth." • "I was worried about situations in which I might panic and make a fool of myself."	0.834	0.424
Depression	0.79	0.59	0.88	0.51	7 items	• "I found it difficult to work up the initiative to do things." • "I felt that I had nothing to look forward to."	0.883	0.522
Positive Family Functioning	3.47	0.81	0.90	0.59	6 items: 3 items in "Family Communication" and 3 items in "Family Mutuality"	• "Parents understand children's mind." (Family Communication) • "Parents often talk to their children." (Family Communication) • "Family members love each other." (Family Mutuality) • "Family members get along well." (Family Mutuality)	0.976	0.953
Cultural Beliefs of Adversity	4.15	0.84	0.86	0.48	7 items on positive beliefs about adversity	• "Hardship increases stature." • "If you work hard enough, you can turn an iron rod into a needle."	0.866	0.484
Resilience	4.12	0.86	0.82	0.61	3 items	• "I would not give up easily even in face of difficulties." • "Even though the future is not very optimistic, I would still hang on."	0.827	0.615

Based on the above analyses, a measurement model including all the five latent variables (i.e., positive family functioning, cultural beliefs of adversity, resilience, anxiety, and depression) was further examined, which demonstrated a desirable model fit: χ2/df=2.725; CFI=0.94; TLI=0.93; RMSEA=0.042; SRMR=0.038. The factor loadings for all latent variables fell within the range of 0.45 to 0.99. The item information for the different latent variables in the measurement model is presented in Table 1. The SEM model on direct effects of the two independent latent variables (i.e., positive family functioning and cultural beliefs of adversity) on the two dependent latent variables (i.e., anxiety and depression) was examined, which yielded a desirable model fit: χ2/df=2.954; CFI=0.94; TLI=0.93; RMSEA=0.045; SRMR=0.039. For the path analyses based on the "delta method" (the default method of Mplus), positive family functioning negatively predicted anxiety and depression ($\beta = -0.239$ and -0.309, $ps<0.001$, respectively) and cultural beliefs of adversity also negatively predicted anxiety and depression ($\beta = -0.258$ and -0.283, $ps<0.001$, respectively). Therefore, Hypotheses 1a, 1b, 2a, and 2b were supported. The SEM model on the mediating effects of resilience also yielded a desirable model fit: χ2/df=2.725; CFI=0.94; TLI=0.93; RMSEA=0.042; SRMR=0.038. Family functioning and cultural beliefs of adversity predicted resilience in positive direction ($\beta=0.221$ and 0.571, $ps<0.001$, respectively), supporting Hypotheses 3a and 3b. Resilience negatively predicted both anxiety and depression ($\beta = -0.192$ and -0.262, $ps\leq0.001$), supporting Hypotheses 4a and 4b. Resilience also partially mediated the connections of positive family functioning with anxiety and depression (indirect effects: $\beta = -0.042$ and -0.058, $ps<0.01$, respectively), supporting Hypotheses 5a and 5b. Finally, resilience partially mediated the linkages of cultural beliefs of adversity with anxiety and depression (indirect effects: $\beta = -0.109$ and -0.150, $ps<0.01$, respectively). Therefore, Hypotheses 5c and 5d were also supported. The detailed information is shown in Table 3 (Fig. 2).

To further examine the mediation effects, we also conducted a "bias-corrected bootstrap estimation" using 5,000 bootstrap samples on the above SEM model (Table 4). Regarding all the mediating effects, the 95% confidence intervals did not include zero, which indicated these effects were significant.

Discussion

The present study tested the association between two ecological protective factors (positive family functioning and cultural beliefs of adversity) and two mental problems (anxiety and depression) among Hong Kong higher education students amidst the pandemic and the role of resilience as a mediator in the associations. The study was significant as there is limited research on factors protecting the mental well-being of students in higher education in the context of COVID-19. Particularly, there is little research examining the safeguarding role of positive cultural beliefs in students' mental wellness and the function of resilience as an underlying mechanism linking positive ecological factors and mental problems of higher education students in the context of the pandemic. We also used validated measures (e.g., Shek et al., 2023c) in this study.

Table 2 Correlations among major variables

	1	2	3	4
1. Anxiety	-			
2. Depression	0.77***	-		
3. Positive Family Functioning	-0.29***	-0.37***	-	
4. Cultural Beliefs of Adversity	-0.29***	-0.35***	0.37***	-
5. Resilience	-0.31***	-0.40***	0.39***	0.56***

***p<0.001

Table 3 Results of SEM on predictive effects of positive family functioning and cultural beliefs of adversity on anxiety and depression with the mediating effects of resilience

	β	SE	p value
Positive family functioning → Resilience	0.221	0.038	0.000
Cultural beliefs of adversity → Resilience	0.571	0.038	0.000
Resilience → Anxiety	-0.192	0.056	0.001
Resilience → Depression	-0.262	0.055	0.000
Positive family functioning → Anxiety (with resilience as mediator)			
Direct effect	-0.197	0.039	0.000
Indirect effect	-0.042	0.014	0.003
Total effect	-0.239	0.038	0.000
Positive family functioning → Depression (with resilience as mediator)			
Direct effect	-0.251	0.038	0.000
Indirect effect	-0.058	0.016	0.000
Total effect	-0.309	0.038	0.000
Cultural beliefs of adversity → Anxiety (with resilience as mediator)			
Direct effect	-0.149	0.054	0.006
Indirect effect	-0.109	0.032	0.001
Total effect	-0.259	0.040	0.000
Cultural beliefs of adversity → Depression (with resilience as mediator)			
Direct effect	-0.134	0.052	0.010
Indirect effect	-0.150	0.033	0.000
Total effect	-0.283	0.039	0.000

First, this study revealed that positive family functioning directly and negatively predicted university students' anxiety and depression. This aligns with findings in the existing literature suggesting the protective effects of positive functioning of family on the psychological wellness of university students (Kim et al., 2021; Li et al., 2021). The findings underline the protective function of the family in the healthy development of students in higher education sectors, particularly amidst the pandemic. Particularly, in Chinese culture, the perception and importance of family have been highly emphasized and highlighted which would have a significant influence on individual development and well-being (Lee & Mock, 2005). Besides family factors, this study also revealed that cultural beliefs of adversity also significantly predicted
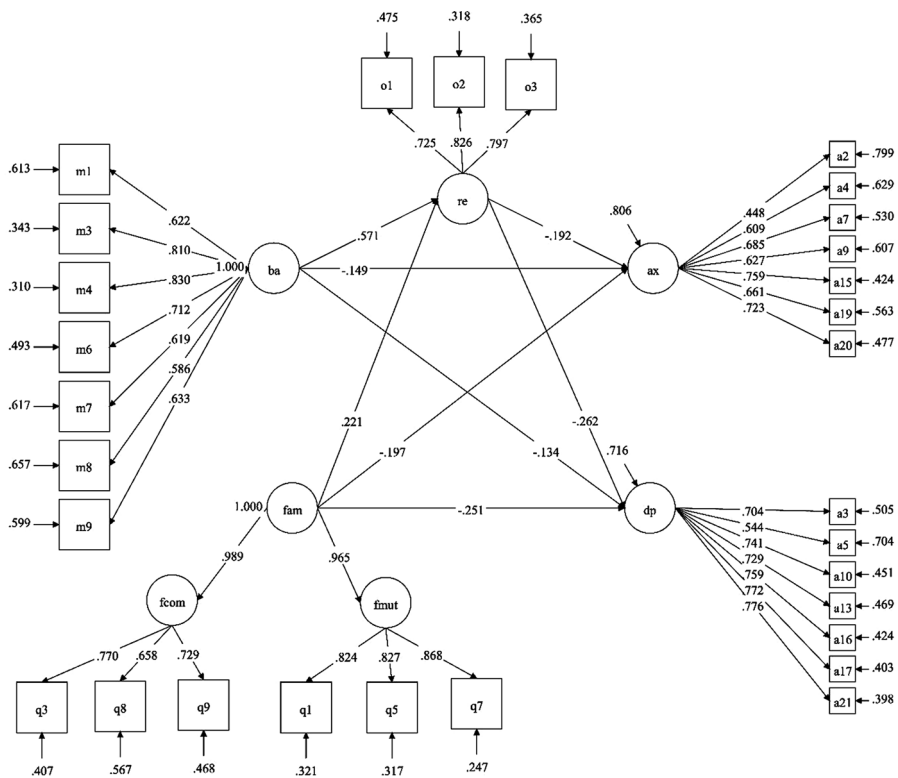
Fig. 2 SEM model results of mediating effects of resilience on relationship between two ecological factors (beliefs about adversity and positive family functioning) and mental health problems (anxiety and depression)

anxiety and depression in a negative direction. This enriches the existing limited literature and understanding of the protective role of adversity-related cultural beliefs in youth development (Shek, 2004; Wang & Liu, 2022). While factors in different ecological systems would influence youth development, most of the existing studies focused on the factors in the microsystem such as factors from family and school, and there is quite limited research focusing on factors in the macrosystem such as cultural factors. Understanding the role of factors from the macrosystem is important and needed (Martinello, 2020). Particularly, in the period of the pandemic, the beliefs and values related to adversity residing in a culture may play an essential protective role for youth and adolescents to face challenges and adversities posed by the pandemic, which then prevents the development of mental health problems. The results of this study offer additional support to the protective function of Chinese cultural beliefs of adversity in adolescent development as shown in the existing theoretical and empirical literature (Shek, 2004; Wang & Liu, 2022). As Hong Kong society is deeply influenced by both Chinese traditional cultural values and Western values, the Chinese cultural beliefs about adversity still influence the mindset and behaviors of university students in Hong Kong. Overall, the findings of this research highlight the important protective functions of positive factors from both microsystem and macrosystem in

Table 4 Results of bias-corrected bootstrap estimation for the mediation model

	Point estimates	95% CI	
		Lower 2.5%	Upper 2.5%
Positive family functioning → Resilience	0.221	0.147	0.296
Cultural beliefs of adversity → Resilience	0.571	0.490	0.640
Resilience → Anxiety	-0.192	-0.296	-0.076
Resilience → Depression	-0.262	-0.366	-0.152
Positive family functioning → Anxiety (with resilience as mediator)			
Direct effect	-0.197	-0.274	-0.116
Indirect effect	-0.042	-0.076	-0.018
Total effect	-0.239	-0.314	-0.162
Positive family functioning → Depression (with resilience as mediator)			
Direct effect	-0.251	-0.330	-0.175
Indirect effect	-0.058	-0.095	-0.030
Total effect	-0.309	-0.385	-0.232
Cultural beliefs of adversity → Anxiety (with resilience as mediator)			
Direct effect	-0.149	-0.261	-0.046
Indirect effect	-0.109	-0.174	-0.046
Total effect	-0.259	-0.336	-0.181
Cultural beliefs of adversity → Depression (with resilience as mediator)			
Direct effect	-0.134	-0.240	-0.032
Indirect effect	-0.150	-0.219	-0.087
Total effect	-0.283	-0.361	-0.205

the mental well-being of students in tertiary education amidst the pandemic. Besides, positive cultural beliefs related to adversity constitute a valuable resource that can be utilized during the pandemic.

Second, this study found that resilience predicted students' anxiety and depression in a negative direction in the context of the pandemic. This aligns with the findings in the current empirical literature underlining the significant protective effect of positive psychological factors in the mental well-being of adolescents and tertiary education students (Shek et al., 2022b, c, 2023a, b). It is also in accordance with the empirical literature on the protective function of resilience in the mental well-being of adolescents and students in universities (Renati et al., 2023; Zhang et al., 2018). In addition, this study revealed that resilience not only negatively predicted mental health problems, but also plays an underlying mechanism through which positive family and cultural factors exert protective functions on the mental well-being of students in higher education. The findings are novel as there is limited research examining resilience as an underlying mechanism linking ecological protective factors and mental wellness in students in the university level under COVID-19. The findings provide strong support to the theoretical proposition that resilience is one essential positive psychological attribute and PYD quality (Catalano et al., 2004) which helps adolescents to effectively cope with challenges and difficulties. They also provide support

for the important role of positive psychological qualities in the association between environmental factors and adolescent mental problems.

The findings have several theoretical implications. First, this study lends support to the ecological systems theory and the theory of PYD. Specifically, this study adds to the comprehension of the role played by different ecological system factors in the mental wellness of adolescents and students in higher education. In addition, the present findings underline the importance of resilience as a mediating mechanism in the connection between protective factors and mental well-being, which advances the theoretical comprehension of the role played by positive psychological attributes in the mental well-being of youth and adolescents. The study also has practical implications for the intervention and prevention of students' mental issues in universities in the context of the pandemic. First, helping students to maintain good family functioning is helpful. Unfortunately, there are few family-based intervention programs in the higher education sector. Second, it is helpful to promote positive beliefs regarding adversity in Chinese culture. This point is important because counseling in the higher education sector is based primarily on Western theories with little emphasis on the importance of cultural resources (Leung, 2019). Finally, promotion of resilience in university students would be helpful in reducing their mental health problems. Again, there is no systematic effort to cultivate resilience in university students in university students (Shek et al., 2022b, c).

The limitations of the study should be acknowledged. First, the study sample was recruited based on quota sampling which is a non-probability sampling method. However, it should be noted that similar methods were used in other studies during the pandemic where random sampling was very difficult (Kamali & Bagheri-Nesami, 2022; Montagni et al., 2020). Second, the participants came from one university in Hong Kong. While this may raise challenge to the generalizability of the findings, it was difficult to recruit students in different universities during the pandemic. Actually, there were other published studies conducted based on the data collected from one university (e.g., Chen & Lucock, 2022; Morganti et al., 2022). Third, the study was based on cross-sectional design which is not able to draw any definitive conclusions on the causal relationship among the variables. Further research should be done through employing longitudinal data to verify the relationships and the mediating role of resilience. Despite the limitations, the study provided important insights and implications on protective factors for the mental well-being of students in universities amidst the pandemic.

Declarations

Conflict of Interest The authors declare that they have no conflict of interest.

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